UNDERGRADUATE RESEARCH OFFICE

MEETING OF THE MINDS

CARNEGIE MELLON UNIVERSITY

WELCOME

THANK YOU FOR JOINING US FOR THE 21ST ANNUAL MEETING OF THE MINDS.

This is a true Carnegie Mellon tradition where undergraduate research takes center stage, and where the entire campus gathers at the Cohon University Center to celebrate the creativity, inventiveness, and originality of our students, their mentors, and the collaborations between them.

The abstracts in this booklet are a good place to begin as you plan your day and decide what you want to see and hear. These projects come alive in a variety of ways: in the poster displays in the hallways as well as in Rangos Ballroom; in the oral presentations in the meeting rooms on the second floor; the art installations in the first floor Connan room; and performances/films in McConomy Auditorium. Please make sure that you visit Wiegand Gym where new additions to our Meeting of the Minds—the IDEATE program and a project-based Biomedical Engineering project—will be wowing you with their new inventions and innovations. Whatever you decide to see and hear—whether it is truly a topic of burning intellectual interest to you, or perhaps a friend's presentation, you will undoubtedly learn something new.

There are two important times to keep in mind. At 2:30 pm, Provost Farnam Jahanian will deliver a brief talk in the Kirr Commons area on the first floor. We will also hold a drawing of some items during this time—plus, there will be plenty of food.

Just as importantly, our Awards Ceremony begins at 5:00 pm in McConomy Auditorium. Winners of the Meeting of the Minds competitions will be announced and prizes will be awarded. A listing of all of the competitions is included near the end of this program booklet.

Thank you again for coming, and we hope that you enjoy our 21st annual Meeting of the Minds.

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SPECIAL THANKS

WE EXTEND OUR SPECIAL THANKS TO:

- **COLLEGE OF ENGINEERING DEAN'S OFFICE FOR THE MID-AFTERNOON WELCOME**
- **INTEGRATIVE DESIGN, ARTS & TECHNOLOGY NETWORK (IDeATe) FOR THE WIEGAND GYM PRESENTATIONS**
- **SCHOOL OF COMPUTER SCIENCE DEAN'S OFFICE FOR THE JUDGES' RECEPTION**

THIS SYMPOSIUM WAS FUNDED BY THE OFFICE OF THE PROVOST AND THE UNDERGRADUATE RESEARCH OFFICE.

Many thanks to Kourtney Bandish, Amy Burkert, Rachel Chang, Catherine Copetas, Thomas Cortina, Kelly Delaney, Joanna Dickert, Susan Finger, Marcia Gerwig, M. Stephanie Murray, Kurt Larsen, Shannon Lin, Emily Mohn-Slate, Shoba Subramanian, Joanne Ursenbach, Jen Weidenhof, Conrad Zapanta, MediaTech, Culinart Catering Staff, Cohon University Center Staff, AlphaGraphics, A.G. Trimble Company, Miss Elaineous Balloons, and all the other wonderful students and staff who make this event work.

Please note:

Research project titles, student names, advisor names and abstracts were submitted by the student researchers. Due to the great number of students and the large volume of text contained in this booklet, it is impossible for the Undergraduate Research Office to ensure the accuracy or omission of information submitted for publication.

PRESENTATIONS

DESCRIPTIONS OF TYPES OF PRESENTATIONS

STUDENTS WHO ARE PRESENTING AT THE SYMPOSIUM COULD SIGN UP TO DO ONE OF FOUR DIFFERENT TYPES OF PRESENTATIONS:

1 POSTER PRESENTATIONS

Students will be standing by their posters for two hours to answer questions. Students participating in the Sigma Xi poster competition will be by their posters from 10 a.m. until 12:30 p.m. in **Rangos 2 and 3**. Students participating in the CIT poster competition will be by their posters from 12 noon to 2:30 p.m. in **Rangos 1**. Students participating in the general poster session will be by their posters from 12 noon until 2:30 p.m. or from 3 p.m. until 5 p.m. in the common areas of the Cohon University Center, including the Wiegand Gym. Please feel free to wander through the poster presentations and ask questions of the students.

2 ORAL PRESENTATIONS

Students have been assigned a 20-minute time slot and will be located in one of six rooms along the second floor corridor **(Dowd, Pake, McKenna, Peter, Wright or Class of '87)**. Students have been instructed to prepare a 10-minute oral presentation about their research, leaving five minutes for questions from the audience and five minutes to gather up their materials and make way for the next presentation.

3 VISUAL ARTS

Students' work is displayed in the **Connan Room** and other areas of the Cohon University Center. Students will be standing by their work from 12 noon until 2:30 p.m. or from 3 p.m. until 5 p.m. to answer questions.

4 PERFORMING ARTS PRESENTATIONS

Students will perform in **McConomy Auditorium** at a time assigned to them. They have been instructed to leave time after their performance for discussion with the audience.

ABSTRACTS

COLLEGE OF ENGINEERING

CHEMICAL ENGINEERING

2-D MODELING OF GENIPIN DIFFUSION-REACTION KINETICS WITHIN INTRACRANIAL ANEURYSMS

STUDENT Charles Webb *Chemical Engineering*

ADVISOR Christopher Bettinger *Materials Science and Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 10:00 am

Currently, the Bettinger Lab is working on developing a drug eluting coating for endovascular coils to improve the treatment of intracranial aneurysms. Material selection for the coil coating will be important in this process as it will affect the elution rate of the drug used, which will impact the effectiveness of the treatment as quantified by crosslinking of the clot formed by coil embolization. To determine the best material for this task, properties such as diffusion rate must be examined and their effect on crosslinking evaluated. A two dimensional model simulating a cross-section of an aneurysm containing coils was developed with the ability to alter the properties of the coil coating to assist with this. Information obtained from this model will be used to determine the ideal properties of the material, focusing the search for a material and saving time and resources. A more developed version of this model will hopefully be able to be compared with results from in vivo and in vitro studies using the results of the model to compare both the treatment and model effectiveness and improve the model if possible.

A QCM STUDY ON ADSORPTION

STUDENT Zachary Blonder *Chemical Engineering*

ADVISOR Nisha Shukla *Chemical Engineering*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Quantum dots have uses in various branches of scientific research. Different conditions and chemical species that quantum dots are exposed to may drastically affect the performance of the quantum dots. Through use of a Quartz Crystal Microbalance (QCM), the effects of various media are analyzed by comparing the relative adsorption onto quantum dot surfaces. Quantum dots are held on the surface of a QCM sensor, and exposed to flows of various different media. Mass uptake onto the quantum dots is measured by the QCM, and relative mass uptake is compared among various analytes. The adsorbed mass onto quantum dot surfaces varies depending on the media which the quantum dots are exposed to, and this experiment aims to measure the results of species interactions with quantum dots and identify optimal substance exposure for quantum dots.

BATTERY-POWERED CAR WITH LUMINOL AND SYRINGE STOPPING MECHANISMS

STUDENTS Anna Bandecca *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Jaewoo Kim *Materials Science and Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Alexander Peterson *Chemical Engineering* • Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The purpose of this project is to design the chemical mechanisms for powering and stopping the motion of a shoebox-sized car that will compete at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. At the competition, this car must stop as close as possible to an assigned distance while carrying an assigned load, within an allotted time limit. The powering mechanism for this car will be comprised of lab-made battery cells. In constructing the batteries, a novel method of distributing the electrolyte solution will be used involving a polyvinyl alcohol (PVA) gel to increase the surface contact area to increase the power output. The feasibility of two different stopping mechanisms will be explored, the first of which will be based on a luminol chemiluminescence (light-producing) reaction, while the second will be based on an oxygen gas-producing reaction with a syringe acting as a constant-pressure piston. For the luminol reaction, the light produced by this reaction will be detected using a photoresistor relay to ultimately stop the car. For the gas-producing reaction, pneumatic action resulting from this reaction will be used to move a syringe plunger, whose motion will activate a sensor and relay to stop the car's forward motion. Successful integration of these mechanisms will allow for accurate stopping of the car.

BAYER HEALTHCARE MEASURING FLUID TEMPERATURE INSIDE A SYRINGE

STUDENTS Justin Finkenaur *Design* • Edna Fongod *Chemical Engineering* • Justin Knobloch *Materials Science and Engineering* • Alexandra Mod *Chemical Engineering* • Shreya Munjal *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Computerized tomography (CT) scans are commonplace in the medical community. These scans require the injection of syringes containing contrast media and saline solution. Currently, in practice, there are safeguards in place such as heat maintainers to prevent the contrast media from becoming too hot, but there is no way to monitor the actual temperature of the media. Having temperature measurement capabilities allow for quick setup and determining the optimal temperature for patient comfort. In addition, the temperature sensor is a reliable method to measure the fluid temperature in a syringe. As an add-on, it can be easily incorporated into the CT syringe injector model. For our second prototype, the sensor uses an insulating material known as rigid polyurethane foam, a material with a low thermal conductivity, to accurately measure the temperature inside the syringe with no effect from its surrounding environment, while incurring minimal cost. Additionally, the sensor communicates electronically with an existing display with the use of an arduino board.

BEAM: BIOSENSOR EMISSION ANALYSIS MACHINE

STUDENTS Ruchi Asthana *Biological Sciences* • William Casazza *Computational Biology* • Donna Lee *Biological Sciences* • Kenneth Li *Biological Sciences* • Wei Mon Lu *Chemical Engineering* • Dominique MacCalla *Materials Science and Engineering* • Niteesh Sundaram *Electrical & Computer Engineering* • Maxwell Telmer *Materials Science and Engineering* • Jordan Tick *Electrical & Computer Engineering* • Michelle Yu *Biological Sciences*

ADVISOR Cheryl Telmer *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Engineered sensors are all around us, biological systems contain natural biosensors that can be utilized to monitor the environment and health of ecosystems and the individuals within them. A critical part of building a sensor is the ability to detect and measure the output. To enable the design and fabrication of DIY biosensors we are creating instructions on how to build a low cost luminometer and fluorimeter. The precision, accuracy, and sensitivity of the instrument will be demonstrated using a set of luciferase and fluorescent protein reporters. The luminometer is a simple photodiode detector and signal is integrated using a Raspberry Pi and output data is processed with open source software. The fluorimeter is an extension that includs an LED light source and emission and excitation filters appropriate for the fluorescent protein to be analyzed. The entire device is encased in a 3D printed shell. To test the luminometer, the luciferases from Gaussia princeps, Renilla reniformis and Photinus pyralis were codon optimized for E. coli and expressed from a strong constitutive promoter and the Gaussia luciferase was extracellularly targeted. Fluorescent proteins including blue, green, yellow, orange and red with different promoter strengths and an estrogen sensitive system were used to calibrate the fluorimeter. To engage the public about synthetic biology and iGEM we have developed a BioLight powered by luciferase. For education purposes, a light, with parts, and a fluorimeter were provided to the "The Citizen Science Lab" in Pittsburgh and we are hopeful that this will excite the community to start building.

CAPILLARY SIEVING ELECTROPHORESIS WITH WORM-LIKE MICELLES FOR DNA SEPARATION

STUDENT Caroline Morin *Chemical Engineering*

ADVISOR James Schneider *Chemical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 10:00 am

Solutions containing nonionic CiEj surfactants, polyoxyethylene alkyl ethers, can be used as running buffers for DNA separation by capillary electrophoresis. The wormlike micelles form a dynamic entangled network that serves as a sieving medium for DNA analysis that is faster and easier to perform than the gel standard. This project aims to develop a model that describes the migration of DNA through the system and characterizes the electrophoretic mechanisms present in different conditions. Data illustrates the possibility of multiple temperature determined regimes that result in varied elution times and resolution. Identification of the present electrophoretic mechanisms will allow for their application in the separation of unalkylated DNA fragments using the sieving matrix and alkylated DNA fragments using end labeled free solution electrophoresis.

CHARACTERIZATION AND PHOTOLUMINESCENT PROPERTIES OF CADMIUM SULFIDE QUANTUM DOTS

STUDENT Yongyi Zhao *Chemical Engineering*
ADVISOR Nisha Shukla *Chemical Engineering*
ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 10:26 am

This project seeks to analyze a specific subset of nanoparticles known as quantum dots, nanoparticles composed of semiconductor elements. Quantum dots have numerous intriguing properties, which make them excellent candidates in the development of solar cells and quantum computing. Ultimately this research seeks to analyze how certain synthesis procedures lead to optical and physical characteristics. In addition to this synthesis analysis, it is also important to characterize these quantum dots, determining their size, shape, and photoluminescence through optical characterization techniques, such as UV-Vis spectroscopy, Transmission Electron Microscopy (TEM), and spectrofluorometer.

CHARGE DENSITIES OF SURFACES IN DODECANE AT VARIOUS CONCENTRATIONS OF OLOA 11000

STUDENT Xi Chen *Chemical Engineering*
ADVISOR Dennis Prieve *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

When a solid surface is immersed in a solution and develops a surface charge, an electric double layer will form. The surface charge densities of glass, silicon wafer, indium tin oxide, mica, and fused silica in dodecane at various concentrations of the commercial dispersant OLOA 11000 were measured. The ZetaSpin method was used to measure the streaming potential in response to rotating the surfaces, which would be used to determine the charge densities by finding the zeta potential first. These measurements will help determine the charging mechanisms on surfaces in nonpolar solvents with dispersants.

CHARGE UTILIZATION FOR STATIC AND SLURRY SYSTEMS FOR CAPACITIVE DEIONIZATION

STUDENT Alexandra Newby *Chemical Engineering*
ADVISOR Meagan Mauter *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

As fresh water reserves become scarce and the population of the world increases, technologies for desalinating water effectively and economically are becoming vital. Capacitive Deionization (CDI), is one technology which can be used to desalinate brackish water by the application of an electric potential between two carbon electrodes to draw ions out of a solution. This carbon electrode could be a solid, static electrode, or a slurry of carbon. Charge storage and ion removal is directly proportional to the surface area of the activated carbon used on a gravimetric basis. On a volumetric basis however, the higher surface area carbons do not perform as well as some of the lower and intermittent surface area carbons. This work relates the physical properties of the carbon to observed gravimetric, areal and volumetric ion removal capacities of different activated carbons.

CHIROPROKTOR: A SPINAL MISALIGNMENT SIMULATOR TO AID CHIROPRACTIC ADJUSTMENTS

STUDENTS Christopher Chao *Electrical & Computer Engineering* • Meave Higgins *Chemical Engineering* • Nicole Kawakami *Materials Science and Engineering* • Eric Parigoris *Mechanical Engineering* • Lauren Zemering *Design*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The main function that a chiropractor serves is to adjust spinal misalignments, which is when vertebrae move out of their normal positions. Misalignments can cause a wide range of complications, ranging from back pain, to high blood pressure, to swelling of back muscles and tissues. In order to alleviate this discomfort, years of practice and experience are required to properly identify and correct the misalignment. Currently, chiropractic and osteopathic students are limited to practicing their techniques on friends, family, and fellow chiropractic students, which can be both dangerous and inconvenient. We propose incorporating a spinal simulator into chiropractic schools that would mimic a wide range of spinal misalignments. This would provide students, interns, and beginner chiropractors with a dynamic model to practice both identifying and adjusting spinal misalignments.

CMU GLOBAL MEDICAL BRIGADES IN PANAMA

STUDENTS Neil Carleton *Chemical Engineering* • Tiffany Fu *Materials Science and Engineering* • Maya Holay *Chemical Engineering* • Nicole Huang *Mechanical Engineering* • Paola Lopez *Mechanical Engineering* • Megan Pudlo *Chemical Engineering* • Cameron Smith *Chemical Engineering* • Anna Zhang *Chemical Engineering*

ADVISOR Jason D'Antonio *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This year, CMU GMB engineering students received a CIT travel grant to visit rural Panama over spring break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and the engineering applications behind the sanitation and environmental initiatives they engaged in.

CO-SOLVENT EFFECTS ON FE-TAML CATALYZED OXIDATIONS

STUDENT Ximena Olivares *Chemical Engineering*

ADVISOR Terrence Collins *Chemistry*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The Fe-TAML catalyst developed by the Collins Group has been shown to successfully degrade endocrine disruptors. However, for analysis purposes, degradations using this catalyst are often carried out in the presence of a co-solvent to increase solubility of the pollutant. In this investigation, the co-solvent effects on Fe-TAML catalyzed oxidations were analyzed. Acetonitrile was found to be theco-solvent that least affected the oxidation of orange II by slowing the reaction down by 24%, while dimethyl sulfoxide was found to be the co-solvent that had the largest effect by slowing the oxidation down by 95% (both co-solvents being 5mol%). From analysis of NMR data, a possible explanation for why the co-solvent slows the degradation down is it favors the formation of an intermediate species. This is an important finding because extended research has been dedicated to looking at the kinetics of Fe-TAML catalyzed oxidations, and thus there needs to be a way to account for the co-solvent presence when determining the kinetics of the reactions.

COLLOIDAL FORCES IN IONIC LIQUIDS

STUDENT Jakob Przybycien *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Charged particles in ionic liquids display counter-intuitive motion - rather than like charges repelling and opposite charges attractive, the opposite is observed. This research will attempt to mathematically describe this motion, testing any models developed using data that has been previously taken from observations of the motion of charged particles in ionic liquids.

COMPARING THE STATIC AND DYNAMIC BINDING CAPACITIES OF PEGYLATED PROTEIN A CHROMATOGRAPHY RESINS

STUDENTS Gillian Crews *Chemical Engineering* • Justin Weinberg *Chemical Engineering*

ADVISOR Todd Przybycien *Chemical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 11:31 am

IgG-class monoclonal antibodies (mAbs) are the fastest growing class of protein therapeutic drugs within the pharmaceutical industry and are expected to command a $140B global market by 2017. mAbs are industrially produced in cell culture, typically secreted from recombinant Chinese hamster ovary (CHO) cells, and are accompanied by a slew of contaminants such as host cell proteins, product aggregates and fragments, host DNA, and virus particles that must be removed to form the final pharmaceutical product. Protein A chromatography is a highly selective capture and purification technique that takes advantage of specific binding interactions between immobilized Staphylococcal Protein A (SPA) and the mAbs to remove >98% of these process contaminants. We have previously demonstrated that chemical modification of ProA affinity ligands with polyethylene glycol (PEGylation) can increase the selectivity of ProA chromatography an order of magnitude or more by sterically suppressing non-specific contaminant binding interactions during processing. In this study, we evaluate the performance of the PEGylated resins by comparing the static/equilibrium and dynamic binding capacities of resins modified with varying amounts of 5 and 20 kDa linear PEG chains. We observe that PEGylation sacrifices up to 37% of the static binding capacity of human IgG in the modified resins depending on the PEG molecular weight and reaction extent. Here, we show that the decrease in static capacity is directly correlated to the immobilized volume of PEG within the modified resins. However, in the dynamic case, we demonstrate that this same correlation does not hold. A light modification with a 5 kDa PEG did not decrease dynamic capacity while heavier modifications with 5 and 20 kDa PEGs resulted in significant decreases in capacity. These results suggest a modification threshold for loss in dynamic binding capacity and give a promising indication that is possible to increase the selectivity of the resin without significant losses in performance.

COMPETITIVE BINDING OF IGG THROUGH BREAKTHROUGH COLLECTION

STUDENTS Allison Kirkby *Chemical Engineering* • Justin Weinberg *Chemical Engineering*
ADVISOR Todd Przybycien *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

IgG-class monoclonal antibodies (mAbs) are the fastest growing class of protein therapeutic drugs within the pharmaceutical industry and are expected to command a $140B global market by 2017. mAbs are industrially produced in cell culture, typically secreted from recombinant Chinese hamster ovary (CHO) cells, and are accompanied by a slew of contaminants such as host cell proteins, product aggregates and fragments, host DNA, and virus particles that must be removed to form the final pharmaceutical product. Protein A chromatography is a highly selective capture and purification technique that takes advantage of specific binding interactions between immobilized Staphylococcal Protein A (SPA) and the mAbs to remove >98% of these process contaminants. While mAbs or single-component antibody fragments/conjugates are almost the exclusive industrial separations target(s) for ProA, the adsorption equilibrium and kinetics of many ProA resins have been characterized in the literature with multi-component human polyclonal antibodies (hIgG). Linear pH elution gradients of hIgG bound to ProA reveal a distribution of IgG-ProA binding strengths that is the likely result of multiple IgG subclasses, heterogeneity of variable region binding contributions, and/or IgG conformations among the polyclonal sample. Although IgG-ProA binding is generally highly specific, the adsorption of multi-component hIgG at neutral pH reveals a surprising yet exciting result: stronger-binding IgG species are capable of displacing and eventually desorbing bound, weaker-binding IgG species from ProA. Repeated linear pH elution gradients of fractions collected from a hIgG breakthrough curve on a ProA column demonstrate a clear progression from weaker (higher pH eluting) to stronger (lower pH eluting) IgG species exiting the column as a direct result of this displacement phenomena. Additionally, the displacement and competition among IgG species results in extremely long saturation times. We repeat these experiments with ProA resins containing ligands modified with varying molecular weights and amounts of polyethylene glycol (PEG) polymers and show that the competition exists regardless of ligand modification. Finally, we compare the rates of competition among fraction groups between the unmodified and PEGylated resins.

COMPUTATION OF MAGNETIC PROPERTIES OF PROTEINS FOR USE IN PROTEIN CRYSTALLIZATION

STUDENT Isaac Jones *Chemical Engineering*
ADVISOR Meagan Mauter *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Protein crystallization is a technique that has long been used for structural biology studies, and has found applications in 'lab on a chip' sensors, drug development studies and ultra-high purity separation membranes. Certain membrane proteins have shown increased crystalline order when crystallized in the presence of an external magnetic field. However, there is not much research done as to why some proteins are affected by external magnetic fields and others are not. To understand this phenomenon, computational approaches have been taken into the determination of magnetic properties of membrane proteins. Specifically, the primary and secondary structure of membrane proteins are examined to determine how they affect the protein alignment in an external magnetic field. Most work is done computationally in MATLAB, with experimental work planned to support theoretical findings.

DESIGN OF BIOLOGICALLY ACTIVE EMBOLIZATION COILS FOR TREATING INTRACRANIAL ANEURYSMS

STUDENTS Joetsaroop Bagga *Chemical Engineering* • Onyenma Enwereji *Chemical Engineering* • Darwin Kwok *Chemical Engineering* • Derek Loh *Materials Science and Engineering* • Ann Rutt *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One current method of treating intracranial aneurysms is known as endovascular coiling. This procedure involves passing thin platinum coils through a catheter and into the aneurysm. The coils slow blood flow within the aneurysm allowing a clot to form, thereby blocking blood flow and reducing the risk of aneurysm rupture. A problem with this procedure is that after a period of time, approximately six months, the clot formed by endovascular coiling begins to degrade. This process, known as recanalization, reintroduces blood flow to the aneurysm and increases the chance of rupture. In order to provide a more permanent solution, this project is investigating thin films of poly(lactic-co-glycolic acid), or PLGA, loaded with genipin for coating the platinum coils used in endovascular coiling. Genipin is a small-molecule capable of creating crosslinks between primary amine groups that will be released from the PLGA layer. The crosslinks formed by genipin between the primary amines in the fibrin network will stabilize the clot and render it resistant to enzymatic degradation. By effectively releasing genipin to align with the clot's development, the clot will remain stable and the chances of recanalization will be reduced. A series of PLGA films loaded with genipin were cast in order to evaluate their genipin release capabilities. In addition to characterizing the properties of these PLGA thin films, a series of reaction-diffusion models are being developed for releasing genipin within an aneurysm site. These findings will ultimately better inform the design of PLGA and genipin coated platinum coils to improve endovascular coiling.

DETERMINATION OF SPHERICAL AND THH AU NANOPARTICLE SIZE FROM UV-VIS SPECTRA

STUDENT Jeannie Michaels *Chemical Engineering*

ADVISOR Nisha Shukla *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

In this project the correlation between ultraviolet-visible spectroscopy (UV-Vis) data and the characteristics of gold (Au) nanoparticles will be established. This study will deal with both spherical and tetrahexahedral (THH) Au nanoparticles, which in turn will expedite the process of determining size and shape for samples, thus benefitting the production of specific Au nanoparticles.

DEVELOPMENT OF COST-EFFECTIVE HEMODIALYSIS APPARATUS

STUDENTS Eleanor Kwik *Chemical Engineering* • Muyuan Li *Chemical Engineering* • Marissa Morales *Chemical Engineering* • Dhrisya Raman *Chemical Engineering* • Anthonia Raphael-Chieke *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The financial cost of dialysis treatment is often too much of a financial burden for patients needing dialysis treatment. Additionally, there is little to no availability of dialysis machines for patients with kidney failure in developing nations due to the lack of access to medical care and the expensive cost of dialysis machines. The goal of this project is to construct a hemodialysis system by making cost-effective improvements to a basic dialysis system. These improvements include the optimization of system conditions to lower the energy requirements of the system and the addition of a recycle loop, allowing for both the reuse of dialysate and an increase in the number of times the dialyzer can be reused.

DRUG DELIVERY APPLICATIONS: INCREASING ENDOTHELIAL LAYER PERMEABILITY BY COUPLING SONOPORATION WITH MICROBUBBLES

STUDENT Darwin Kwok *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 10:52 am

Research studies prove that sonoporation has led to the delivery of drugs to a target tissue without being present within the endothelial cells themselves, suggesting a macromolecule trans-membrane diffusion through the opening of tight junctions rather than vesicle transport through the endothelial cells themselves. This experiment proposes to verify and replicate the theory by juxtaposing diffusion rates of fluorescin through non-coated or cell-coated transwell membranes with or without sonoporation. Cellular sonication, otherwise known as sonoporation, utilizes ultrasound frequencies to modify the permeability of a cell membrane. Coupling sonoporation with the introduction of microbubbles significantly enhances transfection of large drug molecules into the cell.1

Though recent research studies have indicated successful drug delivery to sites beyond the endothelial layer, no concrete evidence has been made on the delivery mechanism itself.2 The macromolecular transport across the endothelium, due to the sonication of microbubbles, can occur via intracellular junctions between endothelial cells or vesicular transport across endothelial cells. The goal of this project is to identify which method of transportation occurs during sonoporation by applying cellular sonication onto a 3.0 um transwell membrane dual-plated with human umbilical vein endothelial cells (HUVEC) to replicate an in vivo study. By verifying whether sonoporation results in opening the intracellular junctions, we will be able to further quantify different levels of sonoporation and apply this method towards treating portions of the body that are only accessible by creating a gap in the intracellular junction.

ETHANOL FUEL CELL USING CELLULOSIC ETHANO

STUDENTS Anna Bandecca *Chemical Engineering* • Luke Bruce *Chemical Engineering* • Isaiah Edmonds *Chemical Engineering* • Yue Han *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Chukwudumebi Ogbogu *Chemical Engineering* • Richard Ruales *Chemical Engineering* • Shridhar Singh *Chemical Engineering* • Madison Stiefbold *Materials Science and Engineering* • Maximilien Vachon *Chemical Engineering* • Ryan Yeh *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Due to a global emphasis on addressing issues of climate change, both bioethanol production and ethanol fuel cells appear to be feasible methods for mitigating aspects of this problem. The proposed research to be conducted addresses this problem on a smaller scale. The proposition is to evaluate the production of cellulosic ethanol from plant cells as well as and the optimization of ethanol fuel cells through the use of carbon catalyst derivatives. Cellulosic ethanol is either produced through the enzymatic or chemical hydrolysis of plant cell walls. Both method have their advantages and disadvantages with respect to economics and scalability. Ethanol fuel cells have been traditionally run with platinum based catalysts in an acidic medium. Modifications in the catalyst can provide better economics while running in an alkali medium can allow for higher operating temperature and then improved performance. The results of this research will be presented at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. They will then be utilized as a driving mechanism for the following year's car.

EVALUATING THE USE OF A DOPA-PCB COATING ON GAS EXCHANGE FIBERS IN REDUCING BLOOD CLOTS

STUDENT Benjamin Yang *Chemical Engineering*

ADVISOR Keith Cook *Biomedical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Current lung support devices serve as less than ideal bridges to lung transplantation for patients with severe lung diseases. This is due to the formation of blood clots endangering the patient and limiting the duration of use. As a result, research in Dr. Keith Cook's lab is being conducted to determine if the use of a DOPA-pCB anti-coagulant coating on gas exchange fibers will be effective in reducing blood clots, thus prolonging the life of an artificial lung. This will be tested in an in vitro setting by pumping platelet-rich plasma through a clotting chamber with polypropylene or polymethylpentene gas fibers. After the plasma has been pumped for several hours, the amount of blood clotting will be measured and analyzed using a variety of techniques, such as electron microscopy and a lactate dehydrogenase assay. In the long term, the purpose of this research is to extend the time a patient can be on a lung support device without harm and increase chances of receiving a new lung.

FLUID-MIXING MANAGEMENT DURING RADIOLOGY FLUID INJECTION

STUDENTS Corrine Bacigal *Chemical Engineering* • Steven Geier *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Carrie Qiu *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Computed Tomography (CT) scans are a common form of imaging used to detect tumors and fractures, as well to monitor diseases. Many scans require the use of contrast, a type of dye, in order to take clearer images. Our project encompasses the usage of contrast administered intravenously through a Stellant Injection System, made by Bayer Healthcare.This is a power-assisted injector that pushes saline and contrast through two separate syringes connected by tubing and into a catheter which has been placed in the patient's arm. During this procedure, two different fluids are injected separately.

The focus of our project is to resolve the issue of the mixing of the saline solution and the contrast due to backward flow of each fluid into the other fluid's syringe. This is a concern because saline is a sterile solution, and accidental contamination by the contrast could lead to further complications from injecting an unexpected amount of contrast into the body. In addition, contrast the dilution of contrast affects the final image produced. As of now, we have come up with several designs to alter the tubing and junction so that fluid mixing can be prevented without adding significant cost to the current design.

FORM: FITNESS RESPIRATION MONITOR

STUDENTS Evaline Ju *Electrical & Computer Engineering* • Laiyee Kwan *Chemical Engineering* • Gabriel Mitchell *Design* • Brigitte Quirk *Electrical & Computer Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The goal of this project is to develop a breathing monitor device to help prevent breathing-related exercise injuries. In the current market of personal fitness monitors, there is not currently an affordable and accurate device that notifies the user of dangerous breathing rates and breathing depths as they occur. The device will consist of sensors and feedback vibration motors embedded into a chest strap to be worn during exercise. Our approach over the course of the upcoming semester is to design, build, test, and repeat through four total prototypes to develop an aesthetic, comfortable, and accurate breathing monitor with real-time feedback to the wearer.

GHB DETECTION DEVICE

STUDENTS Minrui Feng *Chemical Engineering* James Ham *Chemical Engineering* Sean Kim *Chemical Engineering* • Hao-Jan Shue *Materials Science and Engineering* • Kathryn Sullivan *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Gamma hydroxybutyric acid (GHB) is a chemical that has been used in drug-facilitated assault. A detection method is needed to serve as an early warning signal to people who may have been unknowingly exposed to such a drug. We propose a design concept that alerts the person of drink contamination by forming a hole at the bottom of the

liquid container. The hole is formed after the introduction of GHB, which causes a plug on the bottom of the cup to shrink via osmosis. This product is intended for use in alcohol-serving establishments and locations with frequent alcohol consumption, such as bars, clubs, and college campuses.

INFRA-RED STUDIES OF ORGANIC CAPPING LAYERS ON SEMICONDUCTING NANOPARTICLES

STUDENT Sally Zhao *Chemical Engineering*

ADVISOR Nisha Shukla *Chemical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 10:39 am

Chiral separation is essential in the pharmaceutical and biomedical industries because of the difference in behavior of each enantiomer. One must not be mistaken for the other, but traditional separation techniques, such as electrochemistry and high-performance liquid chromatography, are expensive and time consuming. Thus, researchers have found that gold nanoparticles have the capability of enantioselective separation. One such method involves adsorbing a chiral molecule onto the surface of the gold nanoparticles to create chirality. As a result, when the nanoparticles are used to separate molecules, the different enantiomers can be distinguished from one another.

INGESTIBLE MEDICAL DEVICE FOR CONTROLLED DRUG DELIVERY TO THE SMALL INTESTINE

STUDENTS Amy Desalazar *Chemical Engineering* • Rachel Freer *Materials Science and Engineering* • Linna Griffin *Design* • Molly Klimak *Materials Science and Engineering* • Mathea Tenwalde *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Crohn's disease, or the chronic inflammation of the gastrointestinal (GI) tract, can cause potentially severe symptoms. Current treatment options are often unsuccessful due to their lack of site specificity, causing unwanted side effects. In order to combat the issue of these negative side-effects, we designed a device capable of drug delivery directly to the inflamed area of the intestine. Our device uses a gastro-retentive system in order to prolong the delivery of drugs to the the target area over time. The device will be loaded into a polymer capsule in order to protect its payload from low pH environments and digestive enzymes when passing through the stomach and early small intestine. This new treatment method for Crohn's disease increases patient compliance by reducing the frequency in which patients must take medication compared with current treatment strategies.

INTEGRATION OF CELLULAR STRUCTURES MODULATE MOTILITY AND RESPONSE TO APPLIED FORCE

STUDENT Alexandra Cerny *Chemical Engineering*

ADVISOR Kris Dahl *Chemical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 11:05 am

Muscular dystrophies are a class of genetic disorders that affect children and adults through the weakening and destruction of muscle tissue, including skeletal and cardiac muscle. This disease is caused by malfunctions within

the nuclear force transduction network that cause structural defects within the cell. We have shown a preliminary link between the structural proteins emerin, lamin A and spectrin and the ability of the cell to deform and reform from strain. However, there has not been a rigorous quantification and correlation of protein level and mechanical response of cells. For a proper mechanical model, we need to consider the full structure of the protein networks and how this network influences mechanics. Here we investigate the individual effects of proteins within the force propagation network through multiple different mechanical assays. The stretching assay tests the cell's ability to maintain its shape under strain caused by stretching the cells on a substrate. The effects of tensile strain on the movement and shape of the cell can also be measured using a micropillar assay. It has been found that cells with knocked down KASH-domains, which are the main connection between the nucleus and the cytoskeleton, are unable to move smoothly through the micropillars and often get stuck with the nucleus lagging at the back end of the cell. The mean squared displacement of the cells with the inhibited KASH-domain was less than that of the control cells. This decrease in motility suggests the role of a mechanically integrated nucleus in the viability of the cell. In performing this research, we hope to characterize the different effects of each protein within the force propagation network on cell viability such that targeted treatment can be given to the patients who experience the effects of cell mechanical malfunctions.

INTERDISCIPLINARY TEAMS OF ENGINEERS AND DESIGNERS WITH THE FORMATION OF TEAMS AND SUCCESS

STUDENT Corrine Bacigal *Chemical Engineering*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

The purpose of the study is to determine how to optimize the likelihood of success with interdisciplinary teams of engineers and designers. At Carnegie Mellon, engineers and designers work together in the BME Design Course, 42-401 and 42-402. How we define "success" for a BME Design class will be analyzed and the results will help structure a different grading criteria for the course in the future. Comprehensive Assessment for Team-Member Efficiency (CATME) Data is collected from each of the participants of the class, and this data is used to help answer the question of what factors are found among teams that have success. These include questions about team dynamics, individual traits, is going to be created--is there a way to grade designers and engineers using the same rubric? If so, what does this rubric look like. In addition, correlations will be analyzed for specific traits from the data to see if factors such as preferred leadership styles and "openness to new ideas" play a large role in a team's success.

INVESTIGATION OF FRUIT DERIVED PERMEATION ENHANCERS FOR TRANSEPITHELIAL DRUG DELIVERY

STUDENTS Vishal Ahuja *Chemical Engineering* • Anna Zhang *Chemical Engineering*
ADVISOR Kathryn Whitehead *Chemical Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Although oral delivery is one of the most patient-friendly routes of drug administration, it cannot be currently used for large drugs because they cannot permeate the intestinal epithelium. One approach to addressing the issue

of permeability is the use of chemical permeation enhancers, which are usually toxic. This project seeks to identify safe and effective permeation enhancers by examining naturally occurring molecules derived from edible fruits. This study identifies over fifty different fruits and vegetables that are nontoxic to Caco-2, or human intestinal epithelial, cells. Further separations of the strawberry extract, given its promising initial permeation enhancements, with cyclohexane, ethyl acetate, and methanol have shown the permeation enhancement to be associated with the methanol fraction. Future work will focus on increased division of organic fractions and identification of the chemical permeation enhancer using electrospray ionization microscopy.

KOPO SAFI - LOW-RESOURCE DESILTING

STUDENTS Kelsey Rhee *Materials Science and Engineering* • Annette Ritchie *Materials Science and Engineering* • Ismael Sobek *Design* • Sun-Young Wang *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

In Rwanda alone, 24% of people do not have access to clean drinking water. Families spend thousands of hours each year collecting drinking water, but deaths from a lack of sanitation and preventable waterborne diseases persist. In response, the alumni startup Kopo, has created a Kopo Can to facilitate the use of solar disinfection in low-resource countries. Solar disinfection (SODIS) is a method approved by the World Health Organization (WHO) for eliminating pathogens present in water. However, for SODIS to be effective the water must be of a certain clarity. Therefore, Kopo Safi has developed an equally low-resource desilting method, which includes a funnel with a cloth-based filter. When the Kopo Safi Funnel is used in conjunction with the Kopo Can and SODIS method, safe drinking water will be achievable for families in developing countries.

LOW COST TRANSFEMORAL PROSTHETIC :: A BME DESIGN PROJECT

STUDENTS Lea Cody *Design* • Veronica Jaime-Lara *Mechanical Engineering* • Angela Ng *Civil and Environmental Engineering* • Priya Patel *Chemical Engineering* • Deepak Ravi *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Approximately 5.5 million transfemoral, or upper leg limb amputees exist worldwide in impoverished areas. Current prosthetics are too expensive or too crude to provide a long term solution, and our team aims to create a low cost transfemoral prosthetic that is easy to construct, manufactured in country, durable, mimics the natural gait, and is aesthetically pleasing.

The low-cost prosthetic treatment is a never-ending cycle including prosthetic fitment, patient training, prostheses inspection, assessment of patient, replacement of prosthetic components, and retraining for increased mobility. This affects the individual amputee, their families, their care providers, and sometimes even the local community. Without a leg, many amputees in developing countries lose their jobs and the ability to bring home money, increasing the burden on already impoverished families.

Our team produced a low cost above-knee prosthetic that can positively improve a user's livelihood by increasing mobility and thus re-integrating users into the local society and economy. Our above knee limb replacement is more comfortable, useful, and lifelike than the makeshift solutions currently in place. Absolute requirements

include the minimum of supporting the amputee's weight, enduring cyclic loading, and allowing the amputee to be mobile again. In addition, it is low cost and durable so the user does not have to save up for years and buy several prostheses over his or her lifetime. The prosthetic is usable in their community's environment, and unlikely to fail in uneven terrain. The prosthetic also is customizable, aesthetically pleasing, easy to produce and manufacture, and have high accessibility.

LOW-COST PURIFIED WATER INDICATOR

STUDENTS Abhinav Gautam *Electrical & Computer Engineering* • Dominique MacCalla *Materials Science and Engineering* • Courtney Pozzi *Design* • Ashwath Sankar *Biological Sciences* • Elizabeth Starck *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One in seven people have no access to clean drinking water, but current solutions are either too expensive or too culturally disruptive for many poor families. KOPO, LLC. developed the Kopo Can that purifies water while preserving the tradition of collecting water communally, a practice commonly carried out with jugs shaped like the Kopo Can. The Kopo Can disinfects water using the solar disinfection (SODIS) method that combines UV radiation and heating. Simply fill the Kopo Can with contaminated water, set it in the sun for 6 hours, and the solar exposure disinfects the water. Currently the users are told to leave the Kopo Can out for a day on a sunny day and for 2 days on a cloudy day. This reduces the efficacy of water purification where on a 12 hour sunny day, two cans of water can be purified. Plus, there is no way to tell if the Kopo Can has received enough UV radiation, which is responsible for destroying bacteria and other microorganisms. Current indicator designs on the market are either electronic based and/or are too expensive for developing countries to implement. The KOPO team approached us to create a solution that is affordable and culturally appropriate for targeted users who make less than $2 a day. Overall, we created an inexpensive, sustainable indicator, with an intuitive design that can easily indicate to users if their water has been purified using the SODIS method.

MARANGONI EFFECT: SURFACE TENSION DRIVEN MASS TRANSFER

STUDENT Michael Shimko *Chemical Engineering*

ADVISOR Robert Tilton *Chemical Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

A surface tension gradient at the interface of two immiscible fluids, namely water and oil, can be exploited to transport particles across the interface faster than diffusion alone would allow. When a surfactant solution is introduced at some point at the interface, surfactant adsorbs to the interface and decreases the surface tension at that point. Thus, a surface tension gradient is induced. The fluid tends to flow toward areas of high surface tension, spreading adsorbed surfactant across the interface, the Marangoni effect. This mechanism can be used to deliver particles of interest to specific targets (e.g. shampoo adsorbed at the interface between water and oil on a scalp can quickly be transported to hair follicles).

MESOSCALE MODELING OF MULTI-PHASE FLOWS THROUGH POROUS MEDIA

STUDENT Wooram Seok *Chemical Engineering*
ADVISOR Myung Jhon *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

The Lattice Boltzmann method (LBM), a mesoscale kinetic theory-based method, can provide a novel and efficient simulation methodology for complex transport processes. However, accurate LBM schemes have not been fully researched to incorporate molecular information, thereby hybridizing continuum and microscale levels for flow through porous media (e.g.: membranes). This project will focus on the effects of porous media microstructure, capillary forces, and thermal osmosis effects on a fluid as it traverses porous media.

NANO-PATTERNING BIOMIMETIC ECM CUES ON ENGINEERED CARDIAC TISSUE

STUDENT Sean Kim *Chemical Engineering*
ADVISOR Adam Feinberg *Materials Science and Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Cardiovascular disease is the number one cause of death in most developed countries, yet currently there are no therapies to fully restore cardiac function after a large injury without transplantation. One potential mode of treatment lies in engineering cardiac tissue that can be patched into the site of injury. The contractile part of the heart – myocardium – consists of 2-dimensional laminar sheets of cardiac muscle cells (cardiomyocytes) wrapped around the heart. 2D cardiac tissue engineering aims to recreate these sheets in vitro. One of the key factors in developing such tissue lies within creating a confluent layer of aligned cardiac muscle cells capable of synchronous contraction, for maximum contractile force. Previous studies in the field have shown that a biomimetic extracellular matrix (ECM) micro-pattern based on ECM architecture can stimulate cells to form aligned confluent cardiac sheets. However, the degree of cell alignment and the force produced by such engineered tissue can both be significantly increased. It is hypothesized that a sub micron pattern, which better represents the ECM in the native heart, may yield increased alignment of such tissue

NITRIC OXIDE PRODUCTION FROM SILICONE FIBERS WITH COPPER CATALYST

STUDENT Megan Pudlo *Chemical Engineering*
ADVISOR Keith Cook *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Despite current methods for aided ventilation in diseased lungs such as extracorporeal membrane oxygenation (ECMO), practices like this are expensive and do not offer long term solutions for patients suffering from lung disease, an extremely relevant issue in today's society. In fact, Chronic Obtrusive Pulmonary Disease (COPD) is the third leading cause of death in the United States and Cystic Fibrosis affects over thirty thousand Americans. The limited longevity of current solutions such as artificial oxygenators is often due to device failure from clotting.

Clotting leads to a shortened period of viable use for the medical devices, ultimately reducing the effectiveness of them. In an attempt to combat the body's intrinsic pathway clotting response, this experiment utilizes silicone fibers coated in copper nanoparticles and supported by a polyvinyl alcohol (PVA) core. The copper serves as catalyst for the production of nitric oxide (NO) from donors in blood. Nitric oxide has localized antithrombotic effects since it diffuses into platelets and inhibits platelet activation and aggregation. Therefore, NO can reduce clotting responses. The production of nitric oxide was determined from fibers with 10% by weight of 50 nm copper particles. Fibers of known surface area had their PVA core dissolved and were attached to spinal needles using polydimethylsiloxane (PDMS). These fibers were then submerged in solution with glutathione (GSH), phosphate buffered solution, and a prepared NO donor, S-nitrosoglutathione (GSNO), to produce nitric oxide, which was swept from a reaction vessel into a Sievers Nitric Oxide Analyzer (NOA) by nitrogen gas and detected. By using the NOA to measure the nitrate concentrations of solutions with known concentrations, a calibration curve can be established. Utilizing the calibration curve, the nitric oxide flux produced from the fibers is determined. Proving that these fibers will produce a sufficient amount of nitric oxide to limit clotting would support the fiber's practicality in an artificial lung device. In conclusion, reducing platelet aggregation could increase the viability of artificial lung devices.

OPTICAL/ELECTROMAGNETIC EFFECTS ON ORGANIC MOLECULES IN HAMR ENVIRONMENT

STUDENT Victor Michel *Chemical Engineering*
ADVISOR Myung Jhon *Chemical Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The purpose of this study is to identify the impact of the optical and electromagnetic properties on the organic molecules in the heat-assisted magnetic encoding (HAMR) environment. By developing an atomistic/molecular model for the free and surface bounded organic molecules, one can use simplified test cases to ensure the model accurately represents the behavior of organic molecules on the hard disk platter. Next, the one can investigate the effect of optical, electromagnetic, and thermal fields on methodology and extent of degradation of organic molecules by varying the strength and frequency of the external fields. Finally, an examination of the influence of the molecular architecture on the optical, electromagnetic, thermos-chemical stability of the organic molecules allows for the changes in their physiochemical properties, such as molecular weight distribution of the fragments via coarse graining. Upon identifying the effects that the optical and electromagnetic properties have on the organic molecules, thereby modifying the HAMR process to ensure it operates efficiently, thus increasing the memory capacity of future information storage devices.

PERFORMANCE COMPARISON OF COMMERCIAL PROTEIN A CHROMATOGRAPHY RESINS

STUDENTS Edward Healy *Chemical Engineering* • Justin Weinberg *Chemical Engineering*
ADVISOR Todd Przybycien *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

IgG-class monoclonal antibodies (mAbs) are the fastest growing class of protein therapeutic drugs within the pharmaceutical industry. By the year 2017, these mAbs are expected to command a $140 billion global market. mAbs are industrially produced in cell culture, typically secreted from recombinant Chinese hamster ovary (CHO) cells,

and are accompanied by many contaminants that must be removed to form the final pharmaceutical product. Such contaminants include host cell proteins, product aggregates and fragments, host DNA, and virus particles. Protein A chromatography is a highly selective capture and purification technique that takes advantage of specific binding interactions between immobilized Staphylococcal Protein A (SPA) and the mAbs. Through this technique, greater than 98% of the process contaminants are removed. Since mAbs are high in demand, requiring efficient industrial separations, numerous commercial Protein A chromatography resins have been developed to meet customer needs, including higher binding capacities and increased fouling resistance. This poster compares the physical properties, static binding capacities, and batch uptake kinetics of the MabSelect family of Protein A resins manufactured by GE Healthcare. These resins are the most commonly utilized resins within the biopharmaceutical industry. To demonstrate these comparisons, we examine the relationship between these performance characteristics on Protein A ligand density, ligand attachment chemistry, and resin particle size. Based on these findings, we suggest the best scenarios for implementation of the different MabSelect resins.

PROTOTYPING A MAGNETORHEOLOGICAL FLUID BASED, SELF-CONTAINED OIL SPILL CLEAN-UP APPARATUS

STUDENT Christopher Lee *Chemical Engineering*
ADVISOR Robert Tilton *Chemical Engineering*
ROOM/TIME Dowd / 4:00 pm

Current oil spill clean-up methods are slow, only remove the surface oil, and have difficulty removing heavier hydrocarbons that take longer to break down. Current cleanup methods are insufficient and one of the reasons why Deepwater Horizon was such a bad oil spill. I have designed a self-contained porous cylinder containing iron filings and a magnet that will trap spilled oil according to the properties of magnetorheological fluid. In my previous research, a method using this concept can collect large amounts of oil and more importantly collect oil in a 3D space around a magnet surrounded by iron filings. This is only limited to the size of the magnet used and unspecifically collects oil. It can also be used much quicker compared to other methods as water won't be collected due to hydrocarbons specific affinity with iron filings. This has been researched in recent years focusing on creating a strong magnet and a separate powder that will be dispersed over the spill. However problems lie in the difficulty of dispersal and recovery of all material and its effect on the ecosystem. Thus my research goal is to prototype a self-contained method using magnetorheological fluid and thus creating an apparatus that can be effectively used in ocean environments.

QUANTIFICATION OF DYNAMICS OF DROPS WITH SURFACTANT IN STRONG OSCILLATORY FLOW

STUDENT Vishal Vala *Chemical Engineering*
ADVISOR Aditya Khair *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

An emulsion is the dispersion of minute drops of one liquid suspended in a separate fluid phase, and they are used in inks, paints, foodstuffs, etc. For processing such materials, there is a need to understand the mechanics and flow properties of emulsions, which are critically affected by drop morphology and deformation under flow. The

dynamics of the deformation of clean drops have been studied in steady (Barthès-Biesel and Acrivos, 1973) and oscillatory flow (Li and Sarkar). Furthermore, the influence of insoluble surfactant on the deformation of drops exposed to uniform, steady flows have also been researched (Stone and Leal, 1990). However, there is a critical gap in the understanding of the behavior of drops with surfactant in large, time dependent flow. The research in this proposal seeks to fill this gap by investigating the behavior of drops with surfactant in large amplitude, oscillatory flows. Quantifying the behavior of the deformation over time will lead to a deeper understanding of emulsion phenomena under unsteady, strong flow. I assert that the boundary integral method can be used to calculate the drop deformation dynamics. Fully defining emulsion phenomena exposed to unsteady, strong flow fields will lead to optimization of the behavior of systems such as stirred tank reactors, oilfield emulsions, and micro-emulsions for vaccine delivery by modeling the shape and breakup of the drop over time.

SIRNA LOADED LIPIDOID NANOPARTICLES FOR THE TREATMENT OF DIABETIC FOOT ULCERS AND CHRONIC INFLAMMATORY STATES

STUDENT Himali Ranade *Chemical Engineering*
ADVISOR Kathryn Whitehead *Chemical Engineering*
ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 11:18 am

Diabetic foot ulcers are a serious condition that affects millions of diabetics worldwide, and may lead to lower leg amputation and an increased risk of death. These ulcers are characterized by vasculature dysfunction, infection, and most notably, chronic inflammation. Macrophages in the wound overproduce the inflammatory protein Tumor Necrosis Factor Alpha (TNF-a), which then upregulates the production of Monocyte Chemoattractant Protein-1 (MCP-1) protein by fibroblasts and contributes to increased macrophage infiltration. Knocking down the overexpression of these two cytokines with RNA interference therapy is a possible solution to improve wound healing. In this work we explore the use of topically applied short interfering RNA loaded lipidoid nanoparticles to silence TNFa within the wound bed. A topical approach is preferred over systemic or intravenous application as it offers direct and localized treatment, and reduces the incidence of side effects. We have shown that it is possible to successfully silence TNF-a in macrophages by 65% with an EC50 of 40nM. Recent testing with juxtacrine and paracrine co-cultures of both cell types shows that both TNFa and MCP-1 can be silenced together. In these co-culture experiments, a single lipidoid nanoparticle of 100nM siTNFa downregulated TNFa and MCP-1 by 64% and 32%, respectively, showing that one nanoparticle can knock down both proteins. By mimicking the environment and achieving successful silencing, it can be hypothesized that similar silencing patterns will occur in vivo. Future work will involve further recreating the wound environment by incorporating nucleases and fatty acids. The successful gene silencing and protein knockdown that has been achieved thus far is promising, and suggests that a siRNA loaded lipidoid nanoparticle is an efficient and groundbreaking treatment for chronic inflammatory states such as diabetic foot ulcers.

SURFACTANT DRIVEN MARANGONI FLOW ON A PRE-DEPOSITED LIPID MONOLAYER

STUDENT Muyuan Li *Chemical Engineering*
ADVISOR Robert Tilton *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Pulmonary mucus is a major limitation of aerosol drug delivery for multiple pulmonary diseases. To enable a more efficient delivery of medication molecules, surfactants are mixed with drug particles and deposited together. In this project, the effect of depositing external surfactant on a pre-deposited layer of lipid is examined. The surface tension difference between the external surfactant and the pre-deposited lipid layer determines if there will be a surface tension driven flow (Marangoni flow) on the surface as well as the extent of flow. The mechanism of such a flow caused by an external surfactant has been verified to be an area exclusion of the lipid, as a piston pushing the lipid to the edge. Different behaviors are shown by soluble and insoluble surfactants. Fluorescent microscopy with a fluorescently marked lipid species is used to verify the piston motion.

SYNTHESIS AND CHARACTERIZATION OF TETRAHEXAHEDRAL GOLD NANOPARTICLES

STUDENT Yongyi Zhao *Chemical Engineering*
ADVISOR Nisha Shukla *Chemical Engineering*
ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 10:52 am

Chirality is a critical property of chemical structure. The distinction between two molecules with different chirality is subtle; these molecules are mirror-images of each other, similar to a person's left and right hand. Though this distinction may seem trivial, chirality is an essential characteristic in pharmaceuticals. This small structural difference can have drastic impacts on the effects of pharmaceutical medicine. These drugs must be purely composed of the desired enantiomer; otherwise they may be ineffective or, in some cases, can be detrimental. Nanoparticles have demonstrated the potential to perform this enantiomeric separation. Nanoparticles are particularly effective because their structure can be controlled and can be made chiral. In addition they are suitable for enantiomeric separation because they have a large surface area, which makes the separation process more efficient. While there are various methods for inducing chirality in metal nanoparticles, the method that will be analyzed in this project uses high faceted gold nanoparticles. This project has been largely focused on reproducible synthesis of these tetrahexahedral (THH) gold nanoparticles, and characterization of physical properties, such as size, shape, and planes of their facets. Ultimately, their ability to perform chiral separation is analyzed through polarimetry.

THE EFFECT OF DISPERSANTS ON BIOREMEDIATION OF OIL

STUDENT Brigid McGovern *Chemical Engineering*
ADVISOR Robert Tilton *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Dispersants used in oil spill cleanup solubilize autoinducer molecules. This has a suppressing effect on quorum sensing governed bacterial behavior such as metabolization of oil.

UTILIZATION OF MIXED-INTEGER LINEAR PROGRAMMING FOR THE IDENTIFICATION OF NETWORK PROPERTY CORRELATIONS

STUDENT Do Hyung Kim *Chemical Engineering*

ADVISOR Chrysanthos Gounaris *Chemical Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Detailed modeling and simulation of complex networks are progressively being used to analyze complicated networks that exist in various forms in the society. Yet, there exists only a limited capability to design networks that adhere to specified values of properties of interest. Recent publications by Professor Gounaris demonstrated the application of mixed-integer linear programming to design networks that adhere with theoretical guarantee to a multitude of different network properties of interest. In this project, I developed a software code that automatically invokes the pre-established network design framework in an attempt to reveal (and numerically prove) currently unknown but inherent correlations among network properties. I utilized existing CMU high-performance computer infrastructure to conduct comprehensive computational experiments, which shed light into structural relationships of networks in the context of network design.

VOLTAGE EFFFECTS ON CAPACITIVE DEIONIZATION (WATER TREATMENT TECHNOLOGY)

STUDENT Ifayoyinsola Ibikunle *Chemical Engineering*

ADVISOR Meagan Mauter *Chemical Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Capacitive Deionization is a novel electrochemical water desalination technology. The application of potential across oppositely charged electrodes provides the driving force for ion removal from the salt solution. It is expected that an increase in potential difference will yield a larger gradient, allowing for more efficient salt removal from the brackish water solution. However, increasing the potential comes with limitations. A consequence of applying a high voltage to the system is the emergence of parasitic reactions (e.g. electrolysis of water). These reactions can affect charge utilization within the system, and by extension, the charge efficiency. My research serves to examine the effect of potential on charge absorption and charge efficiency.

CIVIL AND ENVIRONMENTAL ENGINEERING

EVALUATING THE DRINKABLE BOOK WATER PURIFICATION CAPABILITIES

STUDENT Angela Ng *Civil and Environmental Engineering*

ADVISOR Kelvin Gregory *Civil and Environmental Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

For 750 million people worldwide, clean water is unaffordable and not within easy access. Contaminated water contributes to diseases such as diarrhea, cholera, dysentery, typhoid, giardiasis, cryptosporidiosis, gastroenteritis, and polio. Paper based filters, more recently known as The Drinkable Book, containing silver nanoparticles represent a novel point •of•usesystem that are cheap, portable, easy to use and distribute, and requires low energy input. Due to the silver nanoparticles, which are lethal for a broad spectrum of microorganisms, these filter papers are one of the most promising options for future water purification devices. These filter papers have been shown to remove greater than 99.9999% of E. Coli in previous laboratory studies. Dissolved solids, natural organic matter, turbidity, salts, and agricultural runoff can potentially diminish the silver nanoparticle papers' antimicrobial effectiveness. General and challenge water are tested against these filter papers, evaluating not only the design of the paper, but the pH, total organic carbon, turbidity, total dissolved solids, and alkalinity. Design considerations include varying the funnel angle, the vessel itself, and evaluating the use of a pre-filter were used in improving the filtration device.

LOW COST TRANSFEMORAL PROSTHETIC :: A BME DESIGN PROJECT

STUDENTS Lea Cody *Design* • Veronica Jaime-Lara *Mechanical Engineering* • Angela Ng *Civil and Environmental Engineering* • Priya Patel *Chemical Engineering* • Deepak Ravi *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Approximately 5.5 million transfemoral, or upper leg limb amputees exist worldwide in impoverished areas. Current prosthetics are too expensive or too crude to provide a long term solution, and our team aims to create a low cost transfemoral prosthetic that is easy to construct, manufactured in country, durable, mimics the natural gait, and is aesthetically pleasing.

The low-cost prosthetic treatment is a never-ending cycle including prosthetic fitment, patient training, prostheses inspection, assessment of patient, replacement of prosthetic components, and retraining for increased mobility. This affects the individual amputee, their families, their care providers, and sometimes even the local community. Without a leg, many amputees in developing countries lose their jobs and the ability to bring home money, increasing the burden on already impoverished families.

Our team produced a low cost above-knee prosthetic that can positively improve a user's livelihood by increasing mobility and thus re-integrating users into the local society and economy. Our above knee limb replacement is more comfortable, useful, and lifelike than the makeshift solutions currently in place. Absolute requirements include the

minimum of supporting the amputee's weight, enduring cyclic loading, and allowing the amputee to be mobile again. In addition, it is low cost and durable so the user does not have to save up for years and buy several prostheses over his or her lifetime. The prosthetic is usable in their community's environment, and unlikely to fail in uneven terrain. The prosthetic also is customizable, aesthetically pleasing, easy to produce and manufacture, and have high accessibility.

NON INTRUSIVE LOAD MONITORING (NILM) BASED ON INCANDESCENT LIGHT BULB FLICKER

STUDENT Shucheng Chao *Civil and Environmental Engineering*
ADVISOR Mario Berges *Civil and Environmental Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Nonintrusive load monitoring (NILM) has always been relying on monitoring voltage and/or current running through the power line of a house. This research, on the other hand, is interested in the possibility of achieving automated appliance identification by monitoring only light flicker of an incandescent light bulb. We first conducted several experiments studying the mapping relationships between light intensity spectrum and V/I signatures of different electric appliances. We then studied how light intensity reacted to specific noises in voltage signals with the help of a power line communication kit (PLC).

PERMAFROST THAW AND ARSENIC MOBILITY IN GROUNDWATER IN FAIRBANKS, ALASKA

STUDENT Amelia Jones *Civil and Environmental Engineering*
ADVISOR David Dzombak *Civil and Environmental Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

This research investigates the hypothesis that as permafrost in the Arctic region thaws due to climate change, groundwater quality, specifically in the Fairbanks area, will be affected. Metamorphic bedrock in central Alaska contains arsenopyrite, which, when coming into contact with groundwater, produces arsenic, a water contaminant that can be toxic at high levels. Thawing permafrost has the potential to expose more of this arsenopyrite, increasing the likelihood that groundwater will contact it. The increased interaction between the groundwater and arsenopyrite may affect the levels of arsenic in the groundwater, which is a concern for Fairbanks, as the city and surrounding suburbs rely 100% on groundwater for drinking water.

THE EFFECTS OF POLY(ETHYLENE OXIDE)-GRAFTED LIGNOSULFONATE SUPERPLASTICIZERS ON METAKAOLIN-CEMENT PASTES

STUDENT Renee Rios *Civil and Environmental Engineering*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Portland cement production accounts for 7% of the world's carbon dioxide emissions. In an effort to reduce the environmental effects of cement, supplementary cementitious materials have been found and used in concrete production. The focus of this study is metakaolin, which is known to decrease the workability and flowability

of concrete, and how it affects cement pastes. The superplasticizer poly(ethylene oxide)-grafted lignosulfonate (LSPEG) is derived from lignin, which is a byproduct of cellulosic ethanol and paper production. LSPEG was used in this study to determine the effects that it would have on Portland cement pastes and Portland cement-metakaolin pastes. Up to 30 wt. % of metakaolin was added to cement mixtures and slump tests were performed to see the differences in slump between cement pastes and cement-metakaolin pastes with and without commercial superplasticizers and LSPEG. The results of slump tests found that the Portland cement pastes with the biopolymer LSPEG added to them were similar to the Portland cement paste with the leading commercial superplasticizer, polycarboxylate ether (PCE). Slump tests performed on cement-metakaolin pastes found that LSPEG reduced the viscosity of the paste by 30%, and increased the possibility of mainstream metakaolin use in the future.

WHAT DOES GLOBAL CLIMATE CHANGE MEAN FOR MY COMMUNITY? AN EVALUATION OF RECENT AND HISTORICAL PRECIPITATION AND TEMPERATURE TRENDS IN PITTSBURGH

STUDENT Madelaine Ku *Civil and Environmental Engineering*
ADVISOR David Dzombak *Civil and Environmental Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

This project involves the collection and analysis of precipitation and temperature data in Pittsburgh, including annual averages, monthly averages, monthly extremes, and daily extremes. Historical trends over a century (1872-1976) are compared to trends over the last four decades. Statisticaal nalysis is applied to evaluate these trends. This study focuses on the development of methods for assessment and presentation of local climate change information.

ELECTRICAL & COMPUTER ENGINEERING

APPLYING AUGMENTED REALITY FOR ENGAGING EDUCATION

STUDENT Steffen Holm *Electrical & Computer Engineering*
ADVISOR Austin Lee *Design*
ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 11:18 am

This project explores the intersection of Education and Augmented Reality (AR) through the development of distinct virtual educational experiences. Initially, the research will focus on producing a proof-of-concept working demo. This demo will be a piano tutoring demo that aims to teach a student a song on the piano by visually communicating the correct sequence and timing of key presses in novel ways through HoloLens AR technology. One method is to overlay pre-recorded 3D hand movements of a teacher on to a piano through augmented reality as the student follows along. Another is to have falling notes that indicate the key press timing and hand positions. A MIDI

controller will interface with these Unity simulations and provide real time audio and visual feedback. The goal is to both work on challenging problems in the areas of both human-computer interaction and education while also answering the question, "Can education be made more effective through the use of Augmented Reality technology?"

AUTOMATICALLY MINING SOCIAL MEDIA FOR VIDEOS WITH HIGH TEMPORAL AND SPATIAL LOCALITY FOR USE IN DYNAMIC 3D RECONSTRUCTION

STUDENTS Nikhil Choudhary *Electrical & Computer Engineering* • Avi Romanoff *Robotics Institute*

ADVISOR Yaser Sheikh *Robotics Institute*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Social media videos that overlap in content matter, time or space can give viewers multiple perspectives of events in the past. The search of these clusters that have high spatial and temporal proximity is usually done through manual searching on social media platforms. First, one must have knowledge of an event and then be able to conduct a thorough search for it, both which requires significant time and effort. Most commonly, researchers rely on ad hoc video capture (e.g. videos filmed by the researchers themselves), which has limited utility in simulating real world user generated videos of events.

We have created a layer of abstraction over YouTube which presents selected videos bunched together as a potential cluster to a researcher. We synthesize terms from online news and event tracking websites which form the basis for the collection of related YouTube videos based on metadata. This automated pipeline allows a small team of researchers to rapidly sift through and identify promising clusters. By automating the searches and presenting them in an efficient interface, we have reduced the time from 20 minutes on a manual search to approximately a minute on evaluating.

AUTONOMOUS VISUAL ORBIT DETERMINATION

STUDENTS Jonathan Appiagyei *Electrical & Computer Engineering* • Homer Baker *Electrical & Computer Engineering* • Ashrith Balakumar *Mechanical Engineering* • Jacob Bartel *Mechanical Engineering* • Suyash Bhatt *Electrical & Computer Engineering* • Yeongwoo Hwang *Computer Science* • Felipe Oropeza *Mechanical Engineering* • Paul Pan *Electrical & Computer Engineering* • Hannah Tomio *Electrical & Computer Engineering* • Andrew Ye *Physics*

ADVISOR William Whittaker *Robotics Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:00 am

Determining the position of a spacecraft in its orbit is a fundamental task for any planetary mission. In Earth orbit, this is fulfilled by GPS location, which is relatively cheap and simple to implement. However, for destinations beyond Earth, such as the Moon and Mars, the only tracking technique is provided by bulky onboard transponders which communicate with the Earth-based Deep Space Network (DSN). Although the DSN provides highly accurate ranging, it requires human input and is a bandwidth limited commodity allocated only for NASA's premier missions. In order to allow true mission autonomy and accurate navigation for a growing number of missions, an alternative approach must be used.

Image based navigation, known as Autonomous Visual Orbit Determination (AVOD), offers a low cost, low latency alternative to overburdened conventional radio-based spacecraft tracking techniques. AVOD uses computer

vision to determine discrete spacecraft positions. Quantified changes in image features enables the AVOD software to create an orbital model and predict its trajectory. This project proposes to use a weather balloon equipped with an AVOD system to determine flight trajectory as a terrestrial proof-of-concept. As the weather balloon flies, it will track ground features, allowing the software to parameterize the flight. Although this smaller scale test is not an orbiting system, it will serve as an analog to an actual orbiting craft. In the future, we plan to scale up this project to an orbital CubeSat platform.

BATTERY-POWERED CAR WITH LUMINOL AND SYRINGE STOPPING MECHANISMS

STUDENTS Anna Bandecca *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Jaewoo Kim *Materials Science and Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Alexander Peterson *Chemical Engineering* • Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The purpose of this project is to design the chemical mechanisms for powering and stopping the motion of a shoebox-sized car that will compete at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. At the competition, this car must stop as close as possible to an assigned distance while carrying an assigned load, within an allotted time limit. The powering mechanism for this car will be comprised of lab-made battery cells. In constructing the batteries, a novel method of distributing the electrolyte solution will be used involving a polyvinyl alcohol (PVA) gel to increase the surface contact area to increase the power output. The feasibility of two different stopping mechanisms will be explored, the first of which will be based on a luminol chemiluminescence (light-producing) reaction, while the second will be based on an oxygen gas-producing reaction with a syringe acting as a constant-pressure piston. For the luminol reaction, the light produced by this reaction will be detected using a photoresistor relay to ultimately stop the car. For the gas-producing reaction, pneumatic action resulting from this reaction will be used to move a syringe plunger, whose motion will activate a sensor and relay to stop the car's forward motion. Successful integration of these mechanisms will allow for accurate stopping of the car.

BEAM: BIOSENSOR EMISSION ANALYSIS MACHINE

STUDENTS Ruchi Asthana *Biological Sciences* • William Casazza *Computational Biology* • Donna Lee *Biological Sciences* • Kenneth Li *Biological Sciences* • Wei Mon Lu *Chemical Engineering* • Dominique MacCalla *Materials Science and Engineering* • Niteesh Sundaram *Electrical & Computer Engineering* • Maxwell Telmer *Materials Science and Engineering* • Jordan Tick *Electrical & Computer Engineering* • Michelle Yu *Biological Sciences*

ADVISOR Cheryl Telmer *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Engineered sensors are all around us, biological systems contain natural biosensors that can be utilized to monitor the environment and health of ecosystems and the individuals within them. A critical part of building a sensor is the ability to detect and measure the output. To enable the design and fabrication of DIY biosensors we are creating instructions on how to build a low cost luminometer and fluorimeter. The precision, accuracy, and sensitivity of

the instrument will be demonstrated using a set of luciferase and fluorescent protein reporters. The luminometer is a simple photodiode detector and signal is integrated using a Raspberry Pi and output data is processed with open source software. The fluorimeter is an extension that includes an LED light source and emission and excitation filters appropriate for the fluorescent protein to be analyzed. The entire device is encased in a 3D printed shell. To test the luminometer, the luciferases from Gaussia princeps, Renilla reniformis and Photinus pyralis were codon optimized for E. coli and expressed from a strong constitutive promoter and the Gaussia luciferase was extracellularly targeted. Fluorescent proteins including blue, green, yellow, orange and red with different promoter strengths and an estrogen sensitive system were used to calibrate the fluorimeter. To engage the public about synthetic biology and iGEM we have developed a BioLight powered by luciferase. For education purposes, a light, with parts, and a fluorimeter were provided to the "The Citizen Science Lab" in Pittsburgh and we are hopeful that this will excite the community to start building.

BLIND NAVIGATION USING ECHOLOCATION

STUDENT Harsha Chivukula *Electrical & Computer Engineering*

ADVISOR Pulkit Grover *Electrical & Computer Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Navigation is a critical and important aspect of everyone's lives, and this project aims to enable and help blind individuals or those with limited vision to navigate their surroundings through a hardware module, using echolocation. The project involves an Android app for blind individuals to train themselves to interpreting echoes and the relative distances to their surroundings, as well as a hardware module that collects a depth map of the surroundings to generate echoes and allow navigation in real-time. Other components of the project include local and centralized data collection in the training app.

CHIROPROKTOR: A SPINAL MISALIGNMENT SIMULATOR TO AID CHIROPRACTIC ADJUSTMENTS

STUDENTS Christopher Chao *Electrical & Computer Engineering* • Meave Higgins *Chemical Engineering* • Nicole Kawakami *Materials Science and Engineering* • Eric Parigoris *Mechanical Engineering* • Lauren Zemering *Design*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The main function that a chiropractor serves is to adjust spinal misalignments, which is when vertebrae move out of their normal positions. Misalignments can cause a wide range of complications, ranging from back pain, to high blood pressure, to swelling of back muscles and tissues. In order to alleviate this discomfort, years of practice and experience are required to properly identify and correct the misalignment. Currently, chiropractic and osteopathic students are limited to practicing their techniques on friends, family, and fellow chiropractic students, which can be both dangerous and inconvenient. We propose incorporating a spinal simulator into chiropractic schools that would mimic a wide range of spinal misalignments. This would provide students, interns, and beginner chiropractors with a dynamic model to practice both identifying and adjusting spinal misalignments.

CLIENT-CASH: PROTECTING MASTER PASSWORDS

STUDENT Anirudh Sridhar *Electrical & Computer Engineering*

ADVISOR Manuel Blum *Computer Science*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:13 am

Offline attacks on passwords are increasingly commonplace and dangerous. An offline adversary is limited only by the amount of computational resources he or she is willing to invest to crack a user's password. The danger is compounded by the existence of authentication servers who fail to adopt proper password storage practices like key-stretching. Password managers can help mitigate these risks by adopting key stretching procedures like hash iteration or memory hard functions to derive site specific passwords from the user's master password on the client-side. While key stretching can reduce the offline adversary's success rate, these procedures also increase computational costs for a legitimate user. Motivated by the observation that most of the password guesses of the offline adversary will be incorrect, we propose a client side cost asymmetric secure hashing scheme (Client-CASH). Client-CASH randomizes the runtime of client-side key stretching procedure in a way that the expected computational cost of our key derivation function is greater when run with an incorrect master password. We make several contributions. First, we show how to introduce randomness into a client-side key stretching algorithms through the use of halting predicates which are selected randomly at the time of account creation. Second, we formalize the problem of finding the optimal running time distribution subject to certain cost constraints for the client and certain security constrains on the halting predicates. Finally, we demonstrate that Client-CASH can reduce the adversary's success rate by up to 21%. These results demonstrate the promise of the Client-CASH mechanism.

DESIGN OF A BIO-INSPIRED PNEUMATIC ARTIFICIAL MUSCLE WITH SELF-CONTAINED SENSING

STUDENTS Onder Erin *Mechanical Engineering* • Nishant Pol *Electrical & Computer Engineering*

ADVISOR Yong-Lae Park *Robotics Institute*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Pneumatic artificial muscles (PAMs) are one of the most famous linear actuators in bio-inspired robotics. They can generate relatively high linear force considering their form factors and weights. Furthermore, PAMs are inexpensive compared with traditional electromagnetic actuators, such as DC motors, and also inherently light and compliant. In robotics applications, however, they typically require external sensing mechanisms due to their nonlinear behaviors, which may make the entire mechanical system bulky and complicated, limiting their use in small and simple systems. This study presents the design and fabrication of a low-cost McKibben-type PAM with a self-contained displacement and force sensing capability that does not require any external sensing elements. The proposed PAM can detect axial contraction force and displacement simultaneously. In this study, the design of a traditional McKibben muscle was modified to include an inductive coil surrounding the muscle fibers. Then, a thin, soft silicone layer was coated outside of the muscle to protect and hold the sensing coil on the actuator. This novel design measures coil inductance change to determine the contraction force and the displacement. The process can be applied to a variety of existing McKibben actuator designs without significantly changing the rigidity of the actuator while minimizing the device's footprint.

DESIGNING GAITS, AND PROTOTYPING MECHANICAL DESIGN

STUDENT Joseph Chartouni *Electrical & Computer Engineering*

ADVISOR Elif Ayvali *Robotics Institute*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

There were a multitude of projects I played a role in in the Biorobotics Lab. Among these include designing a movement gait for modular robotics, prototyping the mechanical interface for a robotically assisted surgical hydrosurgery robot, and designing the prototypical snake head for "Snaserhead", a prototype head module for the Biorobotics Lab's modular robots which can contain multiple devices to help in navigation.

ETHANOL FUEL CELL USING CELLULOSIC ETHANO

STUDENTS Anna Bandecca *Chemical Engineering* • Luke Bruce *Chemical Engineering* • Isaiah Edmonds *Chemical Engineering* • Yue Han *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Chukwudumebi Ogbogu *Chemical Engineering* • Richard Ruales *Chemical Engineering* • Shridhar Singh *Chemical Engineering* • Madison Stiefbold *Materials Science and Engineering* • Maximilien Vachon *Chemical Engineering* • Ryan Yeh *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Due to a global emphasis on addressing issues of climate change, both bioethanol production and ethanol fuel cells appear to be feasible methods for mitigating aspects of this problem. The proposed research to be conducted addresses this problem on a smaller scale. The proposition is to evaluate the production of cellulosic ethanol from plant cells as well as and the optimization of ethanol fuel cells through the use of carbon catalyst derivatives. Cellulosic ethanol is either produced through the enzymatic or chemical hydrolysis of plant cell walls. Both method have their advantages and disadvantages with respect to economics and scalability. Ethanol fuel cells have been traditionally run with platinum based catalysts in an acidic medium. Modifications in the catalyst can provide better economics while running in an alkali medium can allow for higher operating temperature and then improved performance. The results of this research will be presented at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. They will then be utilized as a driving mechanism for the following year's car.

FORM: FITNESS RESPIRATION MONITOR

STUDENTS Evaline Ju *Electrical & Computer Engineering* • Laiyee Kwan *Chemical Engineering* • Gabriel Mitchell *Design* • Brigitte Quirk *Electrical & Computer Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The goal of this project is to develop a breathing monitor device to help prevent breathing-related exercise injuries. In the current market of personal fitness monitors, there is not currently an affordable and accurate device that notifies the user of dangerous breathing rates and breathing depths as they occur. The device will consist of sensors and feedback vibration motors embedded into a chest strap to be worn during exercise. Our approach over the course of the upcoming semester is to design, build, test, and repeat through four total prototypes to develop an aesthetic, comfortable, and accurate breathing monitor with real-time feedback to the wearer.

HIGH DETAIL KINECT MOTION TRACKING FOR SIGN LANGUAGE INTERPRETATION AND INSTRUCTION

STUDENTS Sean Reidy *Statistics* • Vivek Sridhar *Electrical & Computer Engineering*
ADVISOR David Kosbie *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Our project aims to develop a high-resolution motion tracking and gesture recognition system for the Microsoft Kinect sensor, aimed at teaching American Sign Language, which, unlike most verbal languages, is very difficult to learn and to teach. We will develop this tracking and recognition system for the purpose of teaching ASL, but with the hope that it will be applied to many other areas in the future. The language is based on motion and gestures that can be hard for one to learn without hiring an instructor. Sign language interpreters serve as a good way for the hearing impaired to communicate, but they are not always available to the individual. With over 10 million Xbox One units shipped, a solution to the issue could come from the Xbox's included 3D camera: The Kinect. With an advanced 3D camera available in millions of homes, one can have a digital sign language instructor and interpreter in their home. Building upon the current Kinect API, we plan to capture more detailed positional data about hand and finger positions in order to create a sign language instructional tool. We will build an API that allows developers to access more detailed positional data from the Kinect, and an application that can be used as an instructional tool for American Sign Language. The application will be available to Xbox One uses through the Xbox Marketplace, and the API will be available as an open-source library.

HIGH IMPEDANCE MEASUREMENT SYSTEM DEVELOPMENT FOR WATER LEAKAGE DETECTION IN IMPLANTABLE NEUROPROSTHETIC DEVICES

STUDENT Aziz Yousif *Electrical & Computer Engineering*
ADVISOR Shawn Kelly *Electrical & Computer Engineering*
ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 10:13 am

Neuroprostheses are devices that are implanted into the human body to help the blind regain partial eyesight. Unfortunately, these circuits become damaged over time as a result of water leakage. Current neural implants do not possess the adequate technology to predict this damage. Impedance measurements of the implant's packaging layers may provide an early warning of device failure, thereby predicting device lifetime. Because the impedance magnitudes of such devices can be on the order of giga-ohms, a versatile system was designed to accommodate ultra-high impedances and allow future integrated circuit implementation in current neuroprosthetic technologies. Here, the circuitry, control software, and preliminary testing results of the designed system are presented.

HUMAN ECHOLOCATION

STUDENT Rudina Morina *Electrical & Computer Engineering*
ADVISORS Pulkit Grover *Electrical & Computer Engineering* • Laurie Heller *Psychology*
ROOM/TIME Rangos 1 / 12-2:30 pm

The aim of this research project is two understand how the auditory and visual channels can work together to enhance visual capabilities for individuals with limited vision. Understanding this relationship requires an

understanding of how the individual channel work so that we can understand the overlap between the two and the areas in which they can complement one another. Our ultimate goal is to reduce redundancy between the two channels and increase the data-rate of relevant information (the case of "parallel channels" in information theory). However, if the user is not trained to perceive space through echoes, the redundancy between the two channel will be introduced. Hence this research aims to first understand the relationship between auditory and visual channels and then develop a training model based on this understanding.

LOW-COST PURIFIED WATER INDICATOR

STUDENTS Abhinav Gautam *Electrical & Computer Engineering* • Dominique MacCalla *Materials Science and Engineering* • Courtney Pozzi *Design* • Ashwath Sankar *Biological Sciences* • Elizabeth Starck *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One in seven people have no access to clean drinking water, but current solutions are either too expensive or too culturally disruptive for many poor families. KOPO, LLC. developed the Kopo Can that purifies water while preserving the tradition of collecting water communally, a practice commonly carried out with jugs shaped like the Kopo Can. The Kopo Can disinfects water using the solar disinfection (SODIS) method that combines UV radiation and heating. Simply fill the Kopo Can with contaminated water, set it in the sun for 6 hours, and the solar exposure disinfects the water. Currently the users are told to leave the Kopo Can out for a day on a sunny day and for 2 days on a cloudy day. This reduces the efficacy of water purification where on a 12 hour sunny day, two cans of water can be purified. Plus, there is no way to tell if the Kopo Can has received enough UV radiation, which is responsible for destroying bacteria and other microorganisms. Current indicator designs on the market are either electronic based and/or are too expensive for developing countries to implement. The KOPO team approached us to create a solution that is affordable and culturally appropriate for targeted users who make less than $2 a day. Overall, we created an inexpensive, sustainable indicator, with an intuitive design that can easily indicate to users if their water has been purified using the SODIS method.

LOWPOWER CIRCUITS FOR INGESTIBLE ELECTRONIC DRUG DELIVERY SYSTEMS

STUDENT Thomas Eliot *Electrical & Computer Engineering*

ADVISOR Shawn Kelly *Electrical & Computer Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Here we propose an ingestible electronic mucosal drug delivery device that will deliver oral vaccines with precise dosing and spatiotemporal control to any region within the GI tract. The ingestible device will contain a lyophilized payload that is packaged within a 3D reservoir during gastric transit (Fig. 1). At the prescribed location, the ingestible device will apply a potential to the membrane for rapid electrochemical corrosion and subsequent deployment of the payload to the desired region of the GI tract.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

PARTIAL RECONFIGURATION OF STATIC COMBINATIONAL LOGIC ELEMENTS FOR HARDWARE LEAF LEVELS IN RANDOM FORESTS

STUDENT Evaline Ju *Electrical & Computer Engineering*

ADVISORS Shawn Blanton *Electrical & Computer Engineering*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

A random forest is an ensemble machine learning classifier composed of decision trees and is trained on different random subsets of a data set. Due to the need for memory resources and parallel memory accesses to accelerate random forests, FPGAs are suitable platforms. Context switching between applications allows for the amortization of the cost of different random forest implementations, and partial reconfiguration can allow for context switches within a reasonable amount of reconfiguration time, while reducing area utilization on an FPGA. Combinational logic elements are more commonly used and need fewer hardware resources than memory elements, but memory elements are more flexible for reconfiguration. An existing design uses custom comparators with known comparison

attributes and comparison values for each hardware internal level of each decision tree in the random forest, while the hardware leaf levels remain as a BRAM that contains class labels of the leaf nodes. This work extends the concept of using combinational logic elements in place of memory elements to the hardware leaf levels.

PIESPEAK - SHORT FILM

STUDENTS Evan Adkins *Electrical & Computer Engineering* • Max Harlynking *Information Systems* • Aliya Zhdanov *Business Administration*

ADVISOR James Daniels *English*

ROOM/TIME McConomy Auditorium / 1:00-2:30 pm

My project, Piespeak, is a lighthearted short film about a 12-year-old girl who attempts to break the world record for saying every kind of pie in the world in the fastest amount of time to prove that she can be the best at something. This film examines the effects of the pressure we put on ourselves to achieve and serves as an educational stepping stone to a future in filmmaking for myself and the other students involved. Using the skills and techniques myself and my crew have obtained from working on past films, we will create a work that will inspire, entertain, and showcase our skills in a meaningful way. Piespeak is important in that it seeks to portray a child learning to face a challenge we all must battle throughout our lives to become better as both human beings and workers- our own ability.

PLANE EXTRACTION BASED LOCALIZATION

STUDENT Kevin Zhang *Electrical & Computer Engineering*

ADVISOR Siddhartha Srinivasa *Robotics Institute*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

In the future, robotic butlers like HERB will be commonplace in homes, helping out with various chores around the house. However current computer vision systems for robots either require a lot of computing and processing power and time, or are optimized for real-time use, which results in less than optimal results. In addition, a robot is limited to what is visible within its field of view.

My project aims to help household robots localize themselves within a model of its typical environment, such as the home of its owner. Instead of needing to continually compute its environment, once it knows where it is within the model, the robot can then focus on identifying smaller objects that are moveable and are not located within the model. This project is designed to begin upon startup of the robot and although it may take longer to initialize, once it has initialized, the robot would be able to use motion sensors to track its movement within the model and thus only occasionally need to verify its position within the model when it has downtime. In order for the robot to localize itself within the model, I utilize objects that intrude or extrude from planes and use them to feature match with similar objects within the model, such as light switches, door knobs or cabinet handles. After localizing itself within the model, the robot will gain access to information about its distance relative to labeled objects within the model so that it may carry out commands pertaining to objects that may not at first be in its field of view. For example, if the robot was in the living room and was told a command to pour a glass of water from the fridge, the robot would already know where the refrigerator was and begin to move towards it. Then once it reaches the kitchen, it would locally search for a cup, pick it up, and then align the cup to the refrigerator's water dispenser.

PYTHON QUIZZER: CHECKING STUDENT UNDERSTANDING THROUGH MICRO-CONCEPT QUIZZING

STUDENT Erik Pintar *Electrical & Computer Engineering*

ADVISOR David Kosbie *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Checking student understanding after a lecture (content delivery) and before a student starts a homework (content application) is an educational area that is capable of rich improvement. This project developed a prototype and then conducted a user test (n = 85) for teaching recursion concepts to students in the course 15-112. We found that this kind of brief, micro-conceptual quizzing is highly engaging to students and promising in increasing student understanding of concepts before launching into in-depth applications of those concepts.

SAFE CYCLIST

STUDENT Kaan Dogrusoz *Electrical & Computer Engineering*

ADVISOR Anthony Rowe *Electrical & Computer Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

In 2013 there were more than 66,000 people seriously injured in the United States due to bicycle accidents. Bicycle transportation represents a healthy and clean mechanism to improve both transportation efficiency and parking in urban areas. Traditional bicycles are now even being augmented with electric drive systems to decrease the barrier of adoption for commuters. Unfortunately, as bicycles become more capable and hybrid and electric vehicle usage increases the ability for cyclists to perceive traffic danger is decreasing. In this project, we explore how DSRC communication, differential positioning technologies and sensor-based trajectory estimation techniques can be used to warn drivers about potential collisions with cyclists. This requires developing rider models that can help anticipate the complex motion patterns of a cyclist or pedestrian as compared to that of a vehicle. As part of my research, I will be working on data acquisition from sensor nodes that will make way for algorithms that help augment future DSRC warning systems that will be deployed in both cars as well as smartphones carried by cyclists.

SELF-DRIVING BUGGY

STUDENTS Jason Kagie *Electrical & Computer Engineering* • Elyce Milligan *Materials Science and Engineering* • Christopher Perry *Design* • Benjamin Warwick *Mechanical Engineering* • Yilin Zhang *Materials Science and Engineering*

ADVISOR David Kosbie *Computer Science*

ROOM/TIME Wright / 4:40 pm

This project aims to develop autonomous localization and navigation using low-budget sensors and hardware. This could be expanded to optimize self-driving vehicles by improving economic costs. Given a retired frame-and-shell buggy from a Sweepstakes (Buggy) organization, we will design a system that will navigate and complete the given course under varying conditions. S-D Buggy achieves this by deriving position and heading from different sensors and computer vision (CV). The system will include a personal computer, a microcontroller, multiple sensors, a steering mechanism, and a braking mechanism. The buggy would be able to complete the course in a time frame comparable to a human-driven buggy. A potential goal of the project would be to race against human drivers.

VISUALLY-MONITORED ROBOT MANIPULATION: REMOVING THE BLINDFOLD FOR PERSONAL ROBOTS IN THE HOME

STUDENT Matthew Harding *Electrical & Computer Engineering*
ADVISOR Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Wright / 3:40 pm

Our work focuses on bringing greater adaptability to autonomous robotic manipulation, which involves motion planning in dynamic human environments for the purpose of direct object interaction, like reaching and grasping, usually guided by sensor feedback. Research in this area has engineered complex manipulation systems on top of noisy, pre-action visual feedback systems, like AprilTags, and still these have demonstrated limited success in executing grasping and reaching tasks. We argue that the greatest source of the failures of these systems is in their inability to update trajectory state during execution. Therefore, we center our efforts in enhancing the feedback extracted from a machine vision system for the purposes of reliable robot manipulation. We describe multiple novel, closed-loop visual monitoring systems that can replace previously open-loop vision systems and work compatibly with preexisting manipulation motion planners. More importantly, we show that existing autonomous manipulation planners can transparently complete more successful grasps by relying instead on vision systems that include simple and learned closed-loop monitoring of manipulation actions and sub-actions.

MATERIALS SCIENCE AND ENGINEERING

AFFINITY-BASED DNA SEPARATION BY STRAND INVASION

STUDENT Kathryn Sullivan *Materials Science and Engineering*
ADVISOR James Schneider *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Because of its strong and specific binding to DNA, gamma peptide nucleic acid (PNA) can be used to separate DNA sequences from nonhomogeneous solutions. Currently, the primary technique to separate DNA using PNA sequences is gel electrophoresis which takes hours to complete. Capillary electrophoresis is a faster alternative to traditional slab gels as it allows for separations to occur within minutes under optimized experimental conditions. The results from this project will be applied to improve plasmid DNA purification from cells using the polyethylene glycol (PEG) precipitation method. Typically, the PEG interactions with plasmid DNA are facilitated by changing the ionic strength of the solution; however, this results in increased nonspecific binding to contaminant molecules present in cells. By attaching a large PEG molecule to PNA, nonspecific binding of PEG will be minimized by the PNA's high binding specificity to the plasmids.

BATTERY-POWERED CAR WITH LUMINOL AND SYRINGE STOPPING MECHANISMS

STUDENTS Anna Bandecca *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Jaewoo Kim *Materials Science and Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Alexander Peterson *Chemical Engineering* • Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The purpose of this project is to design the chemical mechanisms for powering and stopping the motion of a shoebox-sized car that will compete at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. At the competition, this car must stop as close as possible to an assigned distance while carrying an assigned load, within an allotted time limit. The powering mechanism for this car will be comprised of lab-made battery cells. In constructing the batteries, a novel method of distributing the electrolyte solution will be used involving a polyvinyl alcohol (PVA) gel to increase the surface contact area to increase the power output. The feasibility of two different stopping mechanisms will be explored, the first of which will be based on a luminol chemiluminescence (light-producing) reaction, while the second will be based on an oxygen gas-producing reaction with a syringe acting as a constant-pressure piston. For the luminol reaction, the light produced by this reaction will be detected using a photoresistor relay to ultimately stop the car. For the gas-producing reaction, pneumatic action resulting from this reaction will be used to move a syringe plunger, whose motion will activate a sensor and relay to stop the car's forward motion. Successful integration of these mechanisms will allow for accurate stopping of the car.

BAYER HEALTHCARE MEASURING FLUID TEMPERATURE INSIDE A SYRINGE

STUDENTS Justin Finkenaur *Design* • Edna Fongod *Chemical Engineering* • Justin Knobloch *Materials Science and Engineering* • Alexandra Mod *Chemical Engineering* • Shreya Munjal *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Computerized tomography (CT) scans are commonplace in the medical community. These scans require the injection of syringes containing contrast media and saline solution. Currently, in practice, there are safeguards in place such as heat maintainers to prevent the contrast media from becoming too hot, but there is no way to monitor the actual temperature of the media. Having temperature measurement capabilities allow for quick setup and determining the optimal temperature for patient comfort. In addition, the temperature sensor is a reliable method to measure the fluid temperature in a syringe. As an add-on, it can be easily incorporated into the CT syringe injector model. For our second prototype, the sensor uses an insulating material known as rigid polyurethane foam, a material with a low thermal conductivity, to accurately measure the temperature inside the syringe with no effect from its surrounding environment, while incurring minimal cost. Additionally, the sensor communicates electronically with an existing display with the use of an arduino board.

BEAM: BIOSENSOR EMISSION ANALYSIS MACHINE

STUDENTS Ruchi Asthana *Biological Sciences* • William Casazza *Computational Biology* • Donna Lee *Biological Sciences* • Kenneth Li *Biological Sciences* • Wei Mon Lu *Chemical Engineering* • Dominique MacCalla *Materials Science and Engineering* • Niteesh Sundaram *Electrical & Computer Engineering* • Maxwell Telmer *Materials Science and Engineering* • Jordan Tick *Electrical & Computer Engineering* • Michelle Yu *Biological Sciences*

ADVISOR Cheryl Telmer *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Engineered sensors are all around us, biological systems contain natural biosensors that can be utilized to monitor the environment and health of ecosystems and the individuals within them. A critical part of building a sensor is the ability to detect and measure the output. To enable the design and fabrication of DIY biosensors we are creating instructions on how to build a low cost luminometer and fluorimeter. The precision, accuracy, and sensitivity of the instrument will be demonstrated using a set of luciferase and fluorescent protein reporters. The luminometer is a simple photodiode detector and signal is integrated using a Raspberry Pi and output data is processed with open source software. The fluorimeter is an extension that includs an LED light source and emission and excitation filters appropriate for the fluorescent protein to be analyzed. The entire device is encased in a 3D printed shell. To test the luminometer, the luciferases from Gaussia princeps, Renilla reniformis and Photinus pyralis were codon optimized for E. coli and expressed from a strong constitutive promoter and the Gaussia luciferase was extracellularly targeted. Fluorescent proteins including blue, green, yellow, orange and red with different promoter strengths and an estrogen sensitive system were used to calibrate the fluorimeter. To engage the public about synthetic biology and iGEM we have developed a BioLight powered by luciferase. For education purposes, a light, with parts, and a fluorimeter were provided to the "The Citizen Science Lab" in Pittsburgh and we are hopeful that this will excite the community to start building.

BIMODAL SYSTEM OF THE POLYMER BRUSH

STUDENT Jessica Fagundo *Materials Science and Engineering*

ADVISOR Michael Bockstaller *Materials Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

In order to reveal functional properties of nanoparticles, many methods of atom transfer polymerization are being used to create polymer brushes, which is a one-component system of a spherical nanoparticle with several polymer chains tethered to its surface. Tethering polymers of different lengths and in different grafting densities to nanoparticles is a major area of research in which the fracture toughness of nanoparticles is being investigated. By tethering polymers to nanoparticles the nanoparticles adopt heightened properties, including increased fracture toughness. Experimenting with the amount and length of polymer chains tethered to the nanoparticle will allow researcher to find the most efficient amount and length of polymers to tether to a nanoparticle in order to highlight the nanoparticle's functional materials. This proposal delves into the idea of bimodal polymer brushes which have a small density of short polymer chains tethered to a nanoparticle and a small density of long chains, which assume an entangled configuration, tethered to the nanoparticle. The goal of this research is to investigate whether a bimodal polymer brushes can maintain a high fraction of inorganic material, the nanoparticle, while still having the increased fracture toughness of the polymers

CHANGES IN STABILITY AT PHYSIOLOGICAL PH AND STIFFNESS OF PEG-CAT HYDROGEL WITH VARYING FE3+ CONCENTRATIONS

STUDENT Kelsey Rhee *Materials Science and Engineering*

ADVISOR Christopher Bettinger *Materials Science and Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

The polyethylene glycol – catechol (PEG-CAT) adhesive hydrogel is an attractive material for temporary biological applications due to its ability to be degraded by ultrasound. Previously, this gel was formed in basic conditions, but it was found that by increasing the concentration of Fe3+ used to form crosslinks, the gel could be formed at a lower pH. These gels were also more stable at physiological pH. However, with more Fe3+, it became increasingly difficult to degrade the gels by ultrasound. The mechanical properties of these gels were also investigated using rheology and it was found that the gels became stiffer as Fe3+ concentration increased. By manipulating Fe3+ concentration, the stability, stiffness and US degradation ability can be optimized for use in the human body.

CHIROPROKTOR: A SPINAL MISALIGNMENT SIMULATOR TO AID CHIROPRACTIC ADJUSTMENTS

STUDENTS Christopher Chao *Electrical & Computer Engineering* • Meave Higgins *Chemical Engineering* • Nicole Kawakami *Materials Science and Engineering* • Eric Parigoris *Mechanical Engineering* • Lauren Zemering *Design*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The main function that a chiropractor serves is to adjust spinal misalignments, which is when vertebrae move out of their normal positions. Misalignments can cause a wide range of complications, ranging from back pain, to high blood pressure, to swelling of back muscles and tissues. In order to alleviate this discomfort, years of practice and experience are required to properly identify and correct the misalignment. Currently, chiropractic and osteopathic students are limited to practicing their techniques on friends, family, and fellow chiropractic students, which can be both dangerous and inconvenient. We propose incorporating a spinal simulator into chiropractic schools that would mimic a wide range of spinal misalignments. This would provide students, interns, and beginner chiropractors with a dynamic model to practice both identifying and adjusting spinal misalignments.

CMU GLOBAL MEDICAL BRIGADES IN PANAMA

STUDENTS Neil Carleton *Chemical Engineering* • Tiffany Fu *Materials Science and Engineering* • Maya Holay *Chemical Engineering* • Nicole Huang *Mechanical Engineering* • Paola Lopez *Mechanical Engineering* • Megan Pudlo *Chemical Engineering* • Cameron Smith *Chemical Engineering* • Anna Zhang *Chemical Engineering*

ADVISOR Jason D'Antonio *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This year, CMU GMB engineering students received a CIT travel grant to visit rural Panama over spring break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and the engineering applications behind the sanitation and environmental initiatives they engaged in.

CONFOCAL SCANNING LIGHT MICROSCOPY AND CONTROLLED HEATING FOR INCLUSION ANALYSIS IN IRON MELTS

STUDENT Alexander Lucci *Materials Science and Engineering*

ADVISOR Bryan Webler *Materials Science and Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Confocal Scanning Light Microscopy (CSLM) can be used to observe inclusions in an iron or steel melt. However, traditional methods melt the entire sample, which introduces interactions between the liquid sample and the oxide crucible. This project investigates methods to avoid these interactions through a controlled heating process. By heating the middle of a disk-shaped sample, the core can be melted while the remainder of the sample remains solid. This allows for CSLM and inclusion observation while avoiding the interactions associated with a liquid-to-crucible interface.

CONSTRUCTION OF ANTHROPOMORPHIC, MULTI-MODAL BREAST TISSUE IMAGING PHANTOM

STUDENT Austin Berg *Materials Science and Engineering*

ADVISOR James Antaki *Electrical & Computer Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Less than 2% of abnormal breast masses identified by doctors are cancerous, leading to huge amounts of unnecessary spending and discomfort for women worldwide. A solution to this problem is an optical sensor being developed in the Antaki lab that quantifies and tracks the size, shape and stiffness of breast masses. This device needs a fully anthropomorphic breast tissue phantom in order to validate the optical device. The phantom will be constructed out of PVA cryogels and must be developed so it matches the mechanical and ultrasonic properties of real breast tissue and benign lesions. The physical properties of the PVA can be controlled through altering the PVA concentration and the number of freeze- thaw cycles. The cryogel is tested mechanically with an Instron and optically with an ultrasound. The phantom will be compared against baseline values to produce an accurate phantom. By the end of the summer the phantom will accurately mimic both the bulk fatty tissue and the benign lumps to provide a stable and consistent platform to validate the optical device with.

DESIGN OF BIOLOGICALLY ACTIVE EMBOLIZATION COILS FOR TREATING INTRACRANIAL ANEURYSMS

STUDENTS Joetsaroop Bagga *Chemical Engineering* • Onyenma Enwereji *Chemical Engineering* • Darwin Kwok *Chemical Engineering* • Derek Loh *Materials Science and Engineering* • Ann Rutt *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One current method of treating intracranial aneurysms is known as endovascular coiling. This procedure involves passing thin platinum coils through a catheter and into the aneurysm. The coils slow blood flow within the aneurysm allowing a clot to form, thereby blocking blood flow and reducing the risk of aneurysm rupture. A problem with this procedure is that after a period of time, approximately six months, the clot formed by endovascular coiling begins to degrade. This process, known as recanalization, reintroduces blood flow to the aneurysm and increases the chance

of rupture. In order to provide a more permanent solution, this project is investigating thin films of poly(lactic-co-glycolic acid), or PLGA, loaded with genipin for coating the platinum coils used in endovascular coiling. Genipin is a small-molecule capable of creating crosslinks between primary amine groups that will be released from the PLGA layer. The crosslinks formed by genipin between the primary amines in the fibrin network will stabilize the clot and render it resistant to enzymatic degradation. By effectively releasing genipin to align with the clot's development, the clot will remain stable and the chances of recanalization will be reduced. A series of PLGA films loaded with genipin were cast in order to evaluate their genipin release capabilities. In addition to characterizing the properties of these PLGA thin films, a series of reaction-diffusion models are being developed for releasing genipin within an aneurysm site. These findings will ultimately better inform the design of PLGA and genipin coated platinum coils to improve endovascular coiling.

DEVELOPMENT OF CONDUCTIVE PLATFORM FOR CARDIAC CELL CULTURE

STUDENT Rachel McCoy *Materials Science and Engineering*
ADVISOR Itzhaq Cohen-Karni *Materials Science and Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Cardiac diseases, which damage tissues, often leaving them nonfunctional, are a leading cause of death in the developing world. There is currently work being done to culture cells in vitro to grow tissues that can replace damaged tissues in the body. It has been shown that a conductive platform is most promising for growing viable tissues. Here, we utilize the electrospinning technique to fabricate metal-polymer nanofibers that can be used as the basis of a conductive cardiac cell culture platform, attempting to simulate the cardiac microenvironment.

DEVELOPMENT OF GRAPHENE OXIDE AND SILK FIBROIN COMPOSITES FOR WOUND HEALING APLLICATIONS

STUDENT Justin Knobloch *Materials Science and Engineering*
ADVISOR Mohammad Islam *Materials Science and Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

The recent increase in antibiotic resistance among strains of bacteria has proven to be a major issue in the healthcare industry. Where they can lead to chronic wounds or even the death of patients. Because of this there has been a strong demand for materials that have inherent anti-bacterial properties. Graphene oxide has been shown as a potential material that can meet this need because of its significant cytotoxicity towards bacteria, and minimal effects on mammalian cells. The objective of this work is to create a composite between graphene oxide and silk fibroin. The addition of a silk matrix increases the versatility of treatment and allows for tunable properties and structure. Different processing routes can create either films or hydrogels for varying applications. The results confirmed that even the composites were able to prevent bacterial growth, as well as provide a scaffold which expedites the wound healing process.

DEVELOPMENT OF HORIZONTAL RIBBON GROWTH (HRG) SYSTEM FOR SILICON WAFERS

STUDENT Joshua Kubiak *Materials Science and Engineering*
ADVISOR Lisa Porter *Materials Science and Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Single crystal silicon is usually produced in large boules which must be cut into wafers for electronics applications, such as solar cells. In order to reduce the cost of silicon, it would be preferred to produce single crystal material directly as a thin sheet so that material is not lost during wafering. Horizontal Ribbon Growth (HRG) produces sheets of silicon by pulling material nucleated by a seed crystal from a pool of molten silicon under carefully controlled conditions. In this project, improvements were made to an HRG instrument to enable production of silicon samples.

DEVELOPMENT OF POLYMER HYBRID MATERIALS FOR THE BOTTOM-UP FABRICATION OF LUMINESCENT PANELS

STUDENT Ioannis Michailidis *Materials Science and Engineering*
ADVISOR Michael Bockstaller *Materials Science and Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Semiconductor quantum dot (QD)-based full color luminescent panels are expected to provide breakthrough advances in the area of energy efficient active display and lighting technologies. To facilitate this type of application established manufacturing processes apply four-color screen or inkjet printing processes to fabricate monochromatic zones of distinct-color QDs. The sequential nature of multistep zone printing presents a formidable challenge for the commercialization of QD-based active display and lighting technologies because it limits scale-up and cost efficient production. The overarching technical objective of this project is to develop a transformative new bottom-up approach for the high throughput and cost efficient production QD-based luminescent panels by harnessing the autonomous organization of mixed polymer-modified QD systems into monochromatic domain structures.

The scientific objectives of this project are twofold: First, to elucidate the mechanism and kinetics of phase separation processes in thin films of mixed polymer-grafted QD systems. Second, to understand the effect of polymer-graft modification on the microstructure and photoluminescence efficiency of QD-array structures. The results of the proposed research will provide a foundation for the development of new and transformative fabrication strategies for the cost-efficient production of full-color quantum dot-based luminescent panels by replacing the established fabrication process based on multistep zone printing with a uniform coating process and the subsequent self-assembly of quantum dots in monochromatic domain structures.

ENGINEERING BACTERIA FOR ULTRASONIC IN VIVO TRACKING OF PROBIOTICS

STUDENT Marissa Schwartz *Materials Science and Engineering*

ADVISOR Christopher Bettinger *Materials Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The microbiome is a critical aspect of human health that controls many functions such as metabolic health and inflammation. Probiotics are a viable therapeutic option to restore unbalanced microbiome profiles. However, the fate of oral probiotics within the GI tract is unknown. This experiment seeks to develop a model probiotic system that can be tracked and quantified within the body using ultrasound imaging. We will design a custom plasmid that will express a naturally occurring gas vesicle protein, which will serve as a contrast agent for contrast-enhanced ultrasound. We then hope to quantify the amount of transformed bacteria as a function of ultrasonic intensity through an active collaboration at the University of Pittsburgh.

ETHANOL FUEL CELL USING CELLULOSIC ETHANO

STUDENTS Anna Bandecca *Chemical Engineering* • Luke Bruce *Chemical Engineering* • Isaiah Edmonds *Chemical Engineering* • Yue Han *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Chukwudumebi Ogbogu *Chemical Engineering* • Richard Ruales *Chemical Engineering* • Shridhar Singh *Chemical Engineering* • Madison Stiefbold *Materials Science and Engineering* • Maximilien Vachon *Chemical Engineering* • Ryan Yeh *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Due to a global emphasis on addressing issues of climate change, both bioethanol production and ethanol fuel cells appear to be feasible methods for mitigating aspects of this problem. The proposed research to be conducted addresses this problem on a smaller scale. The proposition is to evaluate the production of cellulosic ethanol from plant cells as well as and the optimization of ethanol fuel cells through the use of carbon catalyst derivatives. Cellulosic ethanol is either produced through the enzymatic or chemical hydrolysis of plant cell walls. Both method have their advantages and disadvantages with respect to economics and scalability. Ethanol fuel cells have been traditionally run with platinum based catalysts in an acidic medium. Modifications in the catalyst can provide better economics while running in an alkali medium can allow for higher operating temperature and then improved performance. The results of this research will be presented at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. They will then be utilized as a driving mechanism for the following year's car.

EVALUATING THE EFFECT OF CRYSTALLOGRAPHIC AND CHEMICAL PROPERTIES OF LIMN2O4 ON ELECTROCHEMICAL PERFORMANCE IN AQUEOUS LITHIUM-ION BATTERY SYSTEMS

STUDENT Ann Rutt *Materials Science and Engineering*

ADVISOR Jay Whitacre *Materials Science and Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 11:44 am

LiMn2O4 is an established cathode material used in lithium-ion battery applications. These battery systems have traditionally used organic electrolytes. However, there is interest in aqueous battery systems as an alternative due to their lower cost, increased safety, and greater ionic conductivity compared to organic electrolyte systems. Thus, more recent work has evaluated the electrochemical performance of LiMn2O4 in aqueous electrolytes. While LiMn2O4 has been found to have high initial capacity in aqueous systems, capacity fading over time with repeated cycling is still a challenge. In organic electrolytes, there have been several studies to understand the relevant capacity fading mechanisms and impact of synthesis conditions, such as the synthesis temperature profile, oxygen availability, and precursor composition, on electrochemical performance. However, these results are not necessarily applicable to aqueous battery systems. The purpose of this study is to comprehensively understand the influence of different crystallographic and chemical properties of LiMn2O4, which can be controlled by the synthesis conditions used, on both the initial electrochemical capacity and long term stability with repeated cycling in aqueous electrolytes. By characterizing the properties of different sample of LiMn2O4 synthesized under different conditions, it will be possible to better understand and isolate which material characteristics of LiMn2O4 are significant for improving its long term electrochemical performance in aqueous lithium-ion battery systems.

EXPLORATION OF A SUBTALAR JOINT MECHANISM FOR USE IN LOW COST PROSTHETICS

STUDENTS Vincent Chiang *Materials Science and Engineering* • Theodore Houlis *Mechanical Engineering* • Vivian Qiu *Design* • Nathaniel Thompson *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

This project seeks to generate a low cost alternative solution for patients with lower leg amputations in developing countries such as India. Existing low-cost solutions address only a single axis of articulation. The goal of this project is to introduce additional geometry to a pre-existing solution allowing for further axes of rotation that better mimic the articulation of both the subtalar joint and true ankle joint. Introducing additional degrees of freedom will better emulate the natural movement of the ankle. Thus, this project aims to reduce the stress of the prosthetic, leading to increased longevity of the device and comfort to the patient.

FLUID-MIXING MANAGEMENT DURING RADIOLOGY FLUID INJECTION

STUDENTS Corrine Bacigal *Chemical Engineering* • Steven Geier *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Carrie Qiu *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Computed Tomography (CT) scans are a common form of imaging used to detect tumors and fractures, as well to monitor diseases. Many scans require the use of contrast, a type of dye, in order to take clearer images. Our project encompasses the usage of contrast administered intravenously through a Stellant Injection System, made by Bayer Healthcare.This is a power-assisted injector that pushes saline and contrast through two separate syringes connected by tubing and into a catheter which has been placed in the patient's arm. During this procedure, two different fluids are injected separately.

The focus of our project is to resolve the issue of the mixing of the saline solution and the contrast due to backward flow of each fluid into the other fluid's syringe. This is a concern because saline is a sterile solution, and accidental contamination by the contrast could lead to further complications from injecting an unexpected amount of contrast into the body. In addition, contrast the dilution of contrast affects the final image produced. As of now, we have come up with several designs to alter the tubing and junction so that fluid mixing can be prevented without adding significant cost to the current design.

FREEFORM 3D PRINTING OF POLYDIMETHYL SILOXANE (PDMS)

STUDENT Kira Pusch *Materials Science and Engineering*

ADVISOR Adam Feinberg *Materials Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This presentation demonstrates the additive manufacturing of three-dimensional (3D) objects comprised of Polydimethylsiloxane (PDMS). PDMS is an inexpensive, flexible, durable, and biocompatible elastomer with a diverse array of applications, most notably medical. The existing casting method by which PDMS objects are produced imposes constraints on the complexity and customizability of their geometries. To address the limitations of traditional casting methods, this research focuses on the direct extrusion of liquid PDMS, via needle, into a gel-like fluid through a method similar to freeform reversible embedding of suspended hydrogels. This gel-like fluid serves as a ubiquitous support material during the printing process and allows for the rapid and low-cost additive manufacturing of hollow PDMS objects with spiralized outer contours. Embedding the liquid PDMS into a fluid support bath obviates the need for intrusive support structures common to in-air additive manufacturing, therefore post-processing requires only that the objects be heat-cured and later released from the support bath. With further development, this process could enable the freeform fabrication of patient-specific medical devices, also helping to pave the way for the 3D-printing of other curable fluids through similar methods.

GENIPIN CROSSLINKED FIBRIN NETWORKS TO IMPROVE ENDOVASCULAR COILING FOR ANEURYSM TREATMENT

STUDENT Derek Loh *Materials Science and Engineering*

ADVISOR Christopher Bettinger *Materials Science and Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Recanalization is a common issue that arises when treating intracranial aneurysms using endovascular coiling. A method to crosslink and stabilize the clot formed by endovascular coiling would provide a more permanent solution to intracranial aneurysms. Genipin is a naturally derived small molecule capable of crosslinking primary amines. Exposure of genipin to fibrin leads to increase in storage modulus as well as resistance to enzymatic degradation. Genipin was exposed to fibrin hydrogels in both bolus form and controlled release from PLGA thin films to produce a significantly higher storage modulus than in control samples. The degree of crosslinking was also investigated by finding the degree of color change versus amount of genipin released. Finally, a study was done to elucidate the multi-step crosslinking process of genipin. Taken together, this work provides a basis for fabricating genipin release systems from endovascular coils.

GHB DETECTION DEVICE

STUDENTS Minrui Feng *Chemical Engineering* • James Ham *Chemical Engineering* • Sean Kim *Chemical Engineering* • Hao-Jan Shue *Materials Science and Engineering* • Kathryn Sullivan *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Gamma hydroxybutyric acid (GHB) is a chemical that has been used in drug-facilitated assault. A detection method is needed to serve as an early warning signal to people who may have been unknowingly exposed to such a drug. We propose a design concept that alerts the person of drink contamination by forming a hole at the bottom of the liquid container. The hole is formed after the introduction of GHB, which causes a plug on the bottom of the cup to shrink via osmosis. This product is intended for use in alcohol-serving establishments and locations with frequent alcohol consumption, such as bars, clubs, and college campuses.

INCLUSION ANALYSIS OF NITINOL

STUDENT Paul Chao *Materials Science and Engineering*

ADVISORS Anthony Rollett *Materials Science and Engineering* • Shivram Sridhar *Materials Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Inclusion content is important for the properties of high performance alloys used in fatigue rated devices. A method to analyze the total inclusion content of NiTi alloys was applied to vacuum induction melted vacuum arc remelted tubes of various sizes and thermal history. Carbides and oxides populations were analyzed. The inclusion size distributions are highly skewed. Stringers were observed.

INGAN MATERIALS FOR UNDERWATER PHOTOVOLTAIC POWER CONVERSION

STUDENT David Sparks *Materials Science and Engineering*

ADVISOR Robert Davis *Materials Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

It is difficult and hazardous to recharge the many batteries that power the host of components of an unmanned vehicle submerged in an ocean. Seawater is very transparent to blue light; a transmittance of 98% per meter is readily attained at a wavelength of 450 nm. Research is proposed to grow InGaN-based thin films of particular compositions via metallorganic vapor phase deposition and characterize these films for near-term use in photovoltaic devices for the adsorption and conversion of the blue portion of the solar spectrum to obtain power for recharging batteries in unmanned subsurface ocean vehicles. Structural, microstructural, electrical and photo-optical characterization will be conducted. Photovoltaic solar cell devices will be fabricated from our films and material device structures in collaboration with investigators at Johns Hopkins University Applied Physics Laboratory (JHU/APL).

INGESTIBLE MEDICAL DEVICE FOR CONTROLLED DRUG DELIVERY TO THE SMALL INTESTINE

STUDENTS Amy Desalazar *Chemical Engineering* • Rachel Freer *Materials Science and Engineering* • Linna Griffin *Design* • Molly Klimak *Materials Science and Engineering* • Mathea Tenwalde *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Crohn's disease, or the chronic inflammation of the gastrointestinal (GI) tract, can cause potentially severe symptoms. Current treatment options are often unsuccessful due to their lack of site specificity, causing unwanted side effects. In order to combat the issue of these negative side-effects, we designed a device capable of drug delivery directly to the inflamed area of the intestine. Our device uses a gastro-retentive system in order to prolong the delivery of drugs to the the target area over time. The device will be loaded into a polymer capsule in order to protect its payload from low pH environments and digestive enzymes when passing through the stomach and early small intestine. This new treatment method for Crohn's disease increases patient compliance by reducing the frequency in which patients must take medication compared with current treatment strategies.

INVESTIGATION OF CRYSTALLIZATION KINETICS IN IRON-NICKEL AMORPHOUS ALLOY

STUDENT Eli Zoghlin *Materials Science and Engineering*

ADVISOR Michael McHenry *Materials Science and Engineering*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The demand for soft magnetic materials capable of switching at high frequencies without overwhelmingly high core losses is being driven by a push for more efficient electrical motors and power grid technology (e.g power converters and transformers). Amorphous nanocomposites, composed of a metallic glassy matrix with

nanocrystalline precipitates, are a candidate class of materials. While research on iron and iron-cobalt based alloys is prevalent in the literature, less has been done to investigate the addition of nickel. Iron-nickel alloys have shown higher measured inductions than pure iron alloys and nickel has the potential to allow fine tuning of the Curie temperature, an important alloy design parameter as it determines allowable operating temperatures. However, the primary and secondary crystallization temperatures are known to converge with the addition of nickel. This is an undesirable result due to the deleterious effect of secondary crystal products on the magnetic properties. Here we present research into the crystallization kinetics and magnetic character of an iron-nickel amorphous alloy based on FINEMETTM. Differential scanning calorimetry (DSC) was used to measure primary and secondary crystallization temperatures as a function of iron-nickel composition. A variety of crystallization models were used to extract activation energies for crystallization from this data. These results were then compared to M(T) data from vibrating sample magnetometry (VSM) in order to compare the models.

KOPO SAFI - LOW-RESOURCE DESILTING

STUDENTS Kelsey Rhee *Materials Science and Engineering* • Annette Ritchie *Materials Science and Engineering* • Ismael Sobek *Design* • Sun-Young Wang *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

In Rwanda alone, 24% of people do not have access to clean drinking water. Families spend thousands of hours each year collecting drinking water, but deaths from a lack of sanitation and preventable waterborne diseases persist. In response, the alumni startup Kopo, has created a Kopo Can to facilitate the use of solar disinfection in low-resource countries. Solar disinfection (SODIS) is a method approved by the World Health Organization (WHO) for eliminating pathogens present in water. However, for SODIS to be effective the water must be of a certain clarity. Therefore, Kopo Safi has developed an equally low-resource desilting method, which includes a funnel with a cloth-based filter. When the Kopo Safi Funnel is used in conjunction with the Kopo Can and SODIS method, safe drinking water will be achievable for families in developing countries.

LOW-COST PURIFIED WATER INDICATOR

STUDENTS Abhinav Gautam *Electrical & Computer Engineering* • Dominique MacCalla *Materials Science and Engineering* • Courtney Pozzi *Design* • Ashwath Sankar *Biological Sciences* • Elizabeth Starck *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One in seven people have no access to clean drinking water, but current solutions are either too expensive or too culturally disruptive for many poor families. KOPO, LLC. developed the Kopo Can that purifies water while preserving the tradition of collecting water communally, a practice commonly carried out with jugs shaped like the Kopo Can. The Kopo Can disinfects water using the solar disinfection (SODIS) method that combines UV radiation and heating. Simply fill the Kopo Can with contaminated water, set it in the sun for 6 hours, and the solar exposure disinfects the water. Currently the users are told to leave the Kopo Can out for a day on a sunny day and for 2 days on a cloudy day. This reduces the efficacy of water purification where on a 12 hour sunny day, two cans of water can be purified. Plus, there is no way to tell if the Kopo Can has received enough UV radiation, which is

responsible for destroying bacteria and other microorganisms. Current indicator designs on the market are either electronic based and/or are too expensive for developing countries to implement. The KOPO team approached us to create a solution that is affordable and culturally appropriate for targeted users who make less than $2 a day. Overall, we created an inexpensive, sustainable indicator, with an intuitive design that can easily indicate to users if their water has been purified using the SODIS method.

MAGNETO CALORIC EFFECT OF HIGH ENTROPY ALLOYS FOR USE IN MAGNETIC REFRIGERATION

STUDENT Patricia Xu *Materials Science and Engineering*
ADVISOR Michael McHenry *Materials Science and Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

High entropy materials have been a large topic of research in recent years. This is largely due to a magnetocaloric effect which relates a change in magnetic field to a change in temperature within the material or vice versa. In high entropy materials, this effect is caused by an entropy change that accompanies the change in magnetism, called the magnetic entropy change, which allows heat energy to be taken in from the environment and translated into a higher entropy state within the material. This heat can be released at a later point in time. This change in entropy is largest around the Curie temperature of the material, which is the temperature at which the material loses its permanent magnetism. Materials with this effect can be used in magnetic refrigeration which has the chance of being 20% more efficient as well as quieter and more environmentally friendly than current conventional refrigerators.

MAINTAINING IN VITRO MYOTUBE CULTURES BY GENIPIN MODIFICATION OF MICROPATTERNED FIBRONECTIN LINES

STUDENT Stacy Chang *Materials Science and Engineering*
ADVISOR Adam Feinberg *Materials Science and Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Introduction: In the field of pharmacology, skeletal muscle cells play a significant role as a platform for drug testing due to their high metabolic activity. However, myotube viability has been a challenge for 2D in vitro cultures because these large, multinucleated cells often delaminate as they mature. Skeletal muscle myotubes begin to delaminate from micropatterned lines of extracellular matrix (ECM) on polydimethylsilxane (PDMS) coated glass coverslips after approximately one week of differentiation. However, crosslinking ECM to PDMS using genipin has been demonstrated to maintain adherence of smooth muscle cells to ECM proteins up to two weeks1. We hypothesized that myotubes formed on the genipin modified fibronectin (FN) would also remain attached for up to two weeks, whereas those of micropatterned FN without genipin crosslinking would begin delaminating after one week.

Materials and methods: To prepare substrates, PDMS was spincoated onto glass coverslips and cured at 65 oC overnight. Microfluidic protein delivery was used into order to obtain the desired patterns. Specifically, PDMS stamps with 40m deep features and trenches with widths of 30 m, 50 m, and 200 m were used. Stamps were sonicated and placed feature side down onto UV ozone treated PDMS coverslips. For FN only substrates, 50g/mL 30% Alexa Fluor 546 labeled FN and 70% unlabeled FN was added to the edge of each stamp. A vacuum was

applied to the opposite edge of the stamp to pull FN through the trenches, and coverslips were incubated for one hour. Phosphate Buffered Saline (PBS) was drawn through each stamp to remove excess FN. To create the genipin modified substrates, 75 L of 1mg/mL genipin solution was drawn through each stamp as previously described and incubated for one hour. PBS was drawn through each stamp to remove excess genipin before applying FN. After incubation, stamps were removed and all coverslips washed with PBS three times. C2C12 myoblasts were seeded at a density of 30,000 cells/cm2 and cultured in growth media until confluent within micropatterned lines. Once confluent, cells were switched to differentiation media, and differentiation conditions were maintained for up to 12 days. Samples were fixed and stained for nuclei and myosin heavy chain (MHC). Confocal laser microscopy was used to image samples for later analysis of percent area FN and myotubes as measured by MHC positive pixels using ImageJ software.

Results and Discussion: Images taken with confocal microscopy were analyzed for percent area of myotubes and FN, and percent area myotubes was normalized by the percent area of patterned FN. A rank sum test of the preliminary data revealed that the genipin modified substrates had a significant increase in myotube retention compared to FN only samples. The increase in normalized percent myotube coverage in genipin modified substrates indicates that genipin crosslinking of FN to PDMS slows myotube delamination.

Conclusions: The positive results of the analysis performed on the preliminary data support our hypothesis that skeletal muscle myotube delamination is reduced with the genipin crosslinking of FN to PDMS substrates. In future experiments, we may apply this method of genipin modification to other ECM proteins such as laminin, collagen I, and collagen IV to determine if genipin crosslinking maintains adherence of smooth muscle cells across different proteins.

Acknowledgements: Carnegie Mellon University's Summer Undergraduate Research Fellowship

References: E. Hald, K. Steucke, J. A. Reeves, Z. Win, P. Alford. "Long-term vascular contractility assay using genipin-modified muscular thin films" Biofabrication, 6, 2014. 045005.

MATERIALS CHARACTERIZATION OF -GA2O3 EPITAXIAL LAYER AND SINGLE-CRYSTAL SUBSTRATE

STUDENT Jaewoo Kim *Materials Science and Engineering*

ADVISORS Lisa Porter *Materials Science and Engineering* • Yao Yao Materials *Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The purpose of this project is to characterize various gallium oxide (-Ga2O3) epitaxial wafer samples to study the behavior of this material as a semiconductor. There is new interest in Ga2O3 as a semiconductor because it has only recently become available in crystalline wafer form from a commercial supplier. The junction between metal and semiconductor has a Schottky barrier height that determines the electrical behavior. The goal is to calculate the Schottky barrier height with current-voltage (I-V) and capacitance-voltage (C-V) measurements. When the Schottky barrier height is low, it has an ohmic relation where there is low resistance to charge flow. Using techniques such as X-ray diffraction (XRD), atomic force microscopy (AFM), and optical spectroradiometry, the Ga2O3 materials obtained by Prof. Porter's group will be characterized. This characterization will provide a more comprehensive understanding of the crystal structure, surface topography, and electrical and optical properties of the -Ga2O3 material.

SELF-DRIVING BUGGY

STUDENTS Jason Kagie *Electrical & Computer Engineering* • Elyce Milligan *Materials Science and Engineering* • Christopher Perry *Design* • Benjamin Warwick *Mechanical Engineering* • Yilin Zhang *Materials Science and Engineering*

ADVISOR David Kosbie *Computer Science*

ROOM/TIME Wright / 4:40 pm

This project aims to develop autonomous localization and navigation using low-budget sensors and hardware. This could be expanded to optimize self-driving vehicles by improving economic costs. Given a retired frame-and-shell buggy from a Sweepstakes (Buggy) organization, we will design a system that will navigate and complete the given course under varying conditions. S-D Buggy achieves this by deriving position and heading from different sensors and computer vision (CV). The system will include a personal computer, a microcontroller, multiple sensors, a steering mechanism, and a braking mechanism. The buggy would be able to complete the course in a time frame comparable to a human-driven buggy. A potential goal of the project would be to race against human drivers.

STRUCTURAL AND MICROSTRUCTURAL CHARACTERIZATION OF SP2-BORON NITRIDE FILMS GROWN VIA ORGANOMETALLIC VAPOR PHASE EPITAXY (OMVPE)

STUDENT Allison Perna *Materials Science and Engineering*

ADVISOR Robert Davis *Materials Science and Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Control of growth parameters during the initial stages of film thin growth is important for growth of 2D materials. The hexagonal and rhombohedral phases of boron nitride (h-BN and r-BN) occur in layered structures in the manner of graphite, a material known to have a 2D form because of its layered structure. Graphene, or 2D graphite, has shown extreme electronic and thermal properties and is desired for advanced electronic applications. To achieve these properties, the graphene must remain atomically flat on the substrate, which is difficult to achieve due to differences in substrate/graphene structural properties. Boron nitride is suggested as a substrate for graphene because of its similar in-plane structure. For this effort, nitride films, aluminum nitride (AlN) and BN, have been grown and characterized using high-resolution X-ray diffraction, atomic force microscopy, and scanning electron microscopy.

STRUCTURAL AND OPTICAL CHARACTERIZATION OF ELECTRON BEAM EVAPORATED SNS FILMS

STUDENTS Jenifer Hajzus *Materials Science and Engineering* • Rekha Schnepf *Materials Science and Engineering*

ADVISOR Lisa Porter *Materials Science and Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

SnS has been identified as a potential material for the absorber layer in thin film solar cells. In this project, we aim to investigate SnS structural, optical and electrical properties. SnS films of 50nm and 515nm in thickness were obtained by depositing SnS powder onto glass substrates using electron beam evaporation. We were able to confirm the ability to deposit stoichiometric SnS with electron beam evaporation. The films were then characterized using

XRD, and transmission and reflectance measurements. It was found that the films had preferred growth orientation of (111) and (020) planes. The films had grain sizes ranging from 17 to 34nm. In the future, we plan to study the effects of annealing on grain size and orientation in the SnS films.

SYNTHESIS OF IMPACT ABSORBING POLYMER PARTICLES FOR RUBBER TOUGHENING OF PLEXIGLAS

STUDENT Joshua Kubiak *Materials Science and Engineering*
ADVISOR Krzysztof Matyjaszewski *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Using surface initiated atom transfer radical polymerization (SI-ATRP), particles brushes with block co-polymer chains grafted from silica particles were prepared. The particle brushes have an internal block of poly(butyl acrylate) (PBA) which is soft and an external block of poly(styrene-co-acrylonitrile) (PSAN) which is miscible with poly(methyl methacrylate) (PMMA). The particle brushes, as well as analogous star polymers without a particle core, were examined as potential materials for the rubber toughening of bulk PMMA or Plexiglass.

THE ROLE OF GROWTH HORMONE RELEASING FACTOR (HGRF) IN MUSCLE TISSUE REGENERATION

STUDENT Tiffany Fu *Materials Science and Engineering*
ADVISOR Phil Campbell *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 10:13 am

Understanding the optimal combination of Growth Hormone Releasing Factor (hGRF), tumor necrosis factor (TNF-), and bone morphogenetic protein (BMP-2) is essential to developing therapy to promote muscle regeneration. hGRF is known to stimulate the release of growth hormone to accelerate the recovery of injured muscles; however, it is also possible that hGRF may contribute to unwanted inflammation and heterotopic ossification deposition in muscle. Because TNF- inhibits bone regeneration but causes inflammation, while BMP-2 induces bone formation, the purpose of this project to engineer a combination of reagents that would promote muscle repair without inflammation or bone growth in muscle tissue. Through cultured muscle stem cells, this project leads to a more comprehensive understanding of the ideal correspondence between immune system responses and tissue repair resulting from hGRF treatment in conjunction with BMP-2. The outcomes of the experiments could potentially be used to optimize recovery rates of injured muscles in a clinical setting.

THERMAL TRANSPORT IN TWO-DIMENSIONAL MONOLAYER SEMICONDUCTORS

STUDENT Julia Yang *Materials Science and Engineering*
ADVISOR Elias Towe *Electrical & Computer Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

The materials beyond graphene movement motivated widespread interest in entire classes of two-dimensional honeycomb structures. In fact, one significant realization for tunable transition metal di-chalcogenide (TMDC)

monolayer materials initiated investigations in material properties under varying chemical, geometric, and thermal conditions. Here, we analyze the challenges of thermal dissipation in vacuum-suspended monolayers. Using only first-principles, we predict thermal conductivity for a subfamily of TMDC materials, AB2 (A: Molybdenum (Mo), Tungsten (W) and B: Sulfur (S) and Selenide (Se)). We find isotropic conductivities on the order of 104 W/mK, similar to that of bulk silicon. This quantum mechanical non-empirical approach may enable powerful predictions about operation levels of other TMDC materials.

TRACKING CELL-GENERATED COMPACTION STRAINS IN 3D TISSUE USING FIBRONECTIN BASED NANOMECHANICAL BIOSENSORS

STUDENT Sabrina Liu *Materials Science and Engineering*
ADVISOR Adam Feinberg *Materials Science and Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Intra and intercellular forces play a major role in tissue growth, morphogenesis, and function. Initial geometric constraints and cytoskeletal interaction with the extracellular matrix influence changes in tissue morphology. To further investigate tissue development over time, we integrated a fluorescent fibronectin (FN) mesh with a 3D tissue construct that had an evolving morphology. Cell and gel constructs were cast in molds containing two upright posts that provided a stress field that promoted uniaxial alignment of tissue and formed a dogbone shape. Fluorescently labeled FN nanomechanical biosensors (NMBS) were fabricated to track tissue construct compaction over time, and a protocol was developed to transfer and track NMBS on the self-assembling tissue. A MATLAB code was created to analyze images of NMBS from confocal microscopy to determine segments of tension, compression, strain, and stress. Understanding the biomechanical forces that play a role in 3D tissue formation is a necessary step in improving strategies to engineer functional tissues for regenerative medicine applications.

ULTRA-COMPLIANT BIOINSPIRED HYDROGELS FOR IMPROVED RELIABILITY OF BRIAN-MACHINE INTERFACES

STUDENT Haobo Wang *Materials Science and Engineering*
ADVISOR Christopher Bettinger *Materials Science and Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Brain-Machine Interface is a powerful technology that can allow the mind to directly control the machine. Currently one of the challenges in the development of this technology is the biocompatibility problem of silicon micro electrodes with the surrounding brain tissue. Hydrogel coatings may be able to improve this tissue-device interaction. My project will be to synthesize and measure the ionic mobility in hydrogels that could be used as coating materials for electrodes in brain-machine interfaces. I will measure how well the ions moves through the hydrogels developed by Professor Bettinger's Laboratory. This will determine how the performance of hydrogels in a prospective Brain-Machine Interface technology, and help us find and develop the best hydrogel for the Brain-Machine Interface. My project will consist of four phases. The first phase of the project will involve the fabrication of a device that can measure the ionic mobility in hydrogels. The second phase of this project will the preparation of photocrosslinkable hydrogels. The third phase of my project will be measuring the electrochemical impedance of these gels as a function of hydrogel dimension. The fourth phase of this project will be data analysis.

VAN DER WAALS HETEROSTRUCTURE OF MAGNETIC SEMICONDUCTORS

STUDENT Nathan Drucker *Materials Science and Engineering*

ADVISOR Benjamin Hunt *Physics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Magnetic semiconductors have the potential to transmit information using the electron spin as the primary mode of communication. Historically, these materials have been developed by doping non-magnetic semiconductors such as GaAs with magnetic ions, endowing semiconductors with additional magnetic properties useful for spintronics. However these traditional methods are not compatible with "van der Waals" heterostructures of two-dimensional, atomically-thin materials such as graphene. Accordingly, other approaches must be implemented to study magnetic semiconductors in these heterostructure systems. We will construct field-effect transistors from an Si backgate, SiO2 substrate and the magnetic layered semiconductor CrSiTe3 to investigate the layer dependence of CrSiTe3's magnetic properties in an effort to further understand magnetism in the two dimensional limit. Additionally, by constructing van der Waals heterostructures from mono-layer graphene and CrSiTe3, we will study the magnetic proximity effect in the graphene layer.

MECHANICAL ENGINEERING

AUTONOMOUS VISUAL ORBIT DETERMINATION

STUDENTS Jonathan Appiagyei *Electrical & Computer Engineering* • Homer Baker *Electrical & Computer Engineering* • Ashrith Balakumar *Mechanical Engineering* • Jacob Bartel *Mechanical Engineering* • Suyash Bhatt *Electrical & Computer Engineering* • Yeongwoo Hwang *Computer Science* • Felipe Oropeza *Mechanical Engineering* • Paul Pan *Electrical & Computer Engineering* Hannah Tomio *Electrical & Computer Engineering* • Andrew Ye *Physics*

ADVISOR William Whittaker *Robotics Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:00 am

Determining the position of a spacecraft in its orbit is a fundamental task for any planetary mission. In Earth orbit, this is fulfilled by GPS location, which is relatively cheap and simple to implement. However, for destinations beyond Earth, such as the Moon and Mars, the only tracking technique is provided by bulky onboard transponders which communicate with the Earth-based Deep Space Network (DSN). Although the DSN provides highly accurate ranging, it requires human input and is a bandwidth limited commodity allocated only for NASA's premier missions. In order to allow true mission autonomy and accurate navigation for a growing number of missions, an alternative approach must be used.

Image based navigation, known as Autonomous Visual Orbit Determination (AVOD), offers a low cost, low latency alternative to overburdened conventional radio-based spacecraft tracking techniques. AVOD uses computer vision to determine discrete spacecraft positions. Quantified changes in image features enables the AVOD software to create an orbital model and predict its trajectory. This project proposes to use a weather balloon equipped with an AVOD system to determine flight trajectory as a terrestrial proof-of-concept. As the weather balloon flies, it will

track ground features, allowing the software to parameterize the flight. Although this smaller scale test is not an orbiting system, it will serve as an analog to an actual orbiting craft. In the future, we plan to scale up this project to an orbital CubeSat platform.

BATTERY-POWERED CAR WITH LUMINOL AND SYRINGE STOPPING MECHANISMS

STUDENTS Anna Bandecca *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Jaewoo Kim *Materials Science and Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Alexander Peterson *Chemical Engineering* • Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The purpose of this project is to design the chemical mechanisms for powering and stopping the motion of a shoebox-sized car that will compete at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. At the competition, this car must stop as close as possible to an assigned distance while carrying an assigned load, within an allotted time limit. The powering mechanism for this car will be comprised of lab-made battery cells. In constructing the batteries, a novel method of distributing the electrolyte solution will be used involving a polyvinyl alcohol (PVA) gel to increase the surface contact area to increase the power output. The feasibility of two different stopping mechanisms will be explored, the first of which will be based on a luminol chemiluminescence (light-producing) reaction, while the second will be based on an oxygen gas-producing reaction with a syringe acting as a constant-pressure piston. For the luminol reaction, the light produced by this reaction will be detected using a photoresistor relay to ultimately stop the car. For the gas-producing reaction, pneumatic action resulting from this reaction will be used to move a syringe plunger, whose motion will activate a sensor and relay to stop the car's forward motion. Successful integration of these mechanisms will allow for accurate stopping of the car.

CALLIOPE 3: AN EDUCATIONAL ROBOT THAT CAN SEE

STUDENT Vijay Sampath *Mechanical Engineering*

ADVISOR David Touretzky *Computer Science*

ROOM/TIME Rangos 1 / 12-2:30 pm

We are developing a robot with full mobility, an arm, and a vision system to bring advanced computer vision to high schools. The goal is to close the current gap in robotics education between robot kits (like Lego) in middle school and expensive graduate level robots. The robot itself is an open source platform constructed out of laser-cut Delrin with an iRobot Create 2 base as the mobile platform. The computing engine is an on-board Chromebook running Ubuntu-Linux with a software package called Tekkotsu. Tekkotsu is a robot application development framework that includes a vision system, path planning, navigation, kinematics, manipulation planning, and more. The goal is ultimately to make the system simple enough to teach computer vision to any highschool student.

CHIROPROKTOR: A SPINAL MISALIGNMENT SIMULATOR TO AID CHIROPRACTIC ADJUSTMENTS

STUDENTS Christopher Chao *Electrical & Computer Engineering* • Meave Higgins *Chemical Engineering* • Nicole Kawakami *Materials Science and Engineering* • Eric Parigoris *Mechanical Engineering* • Lauren Zemering *Design*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The main function that a chiropractor serves is to adjust spinal misalignments, which is when vertebrae move out of their normal positions. Misalignments can cause a wide range of complications, ranging from back pain, to high blood pressure, to swelling of back muscles and tissues. In order to alleviate this discomfort, years of practice and experience are required to properly identify and correct the misalignment. Currently, chiropractic and osteopathic students are limited to practicing their techniques on friends, family, and fellow chiropractic students, which can be both dangerous and inconvenient. We propose incorporating a spinal simulator into chiropractic schools that would mimic a wide range of spinal misalignments. This would provide students, interns, and beginner chiropractors with a dynamic model to practice both identifying and adjusting spinal misalignments.

CMU FACULTY WORK-LIFE STUDY

STUDENTS Yayoi Furuhata *Business Administration* • Kimberly Hsieh *Mathematics* • Pavithran Nair Jayaraman • *Statistics* • Sarah Shy *Statistics* • Tyler Wellener *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Studies have shown that employee satisfaction can be linked to motivation, performance, absenteeism, and turnover in the workplace. However, faculty involvement and satisfaction are often overlooked in universities. Our research analyzed how satisfied Carnegie Mellon University (CMU) professors are with various aspects of their work life. The mode of data collection was an online survey hosted by Qualtrics. We carried out the survey using a list of faculty Andrew emails obtained from an official directory. Since most professors check their emails daily, sending online surveys to the faculty via email was the most efficient way to recruit participants. We broke down our results by gender, department, number of years at CMU, and academic title to make observations about particular subgroups. Faculty satisfaction is integral to the success of the university as it gives rise to a stimulating learning environment while offering a more attractive option for prospective professors. With our data, we were be able to obtain an accurate measure of faculty job satisfaction at CMU and provide information to the university that will allow CMU to achieve its long-term objectives.

CMU GLOBAL MEDICAL BRIGADES IN PANAMA

STUDENTS Neil Carleton *Chemical Engineering* • Tiffany Fu *Materials Science and Engineering* • Maya Holay *Chemical Engineering* Nicole Huang • *Mechanical Engineering* • Paola Lopez *Mechanical Engineering* • Megan Pudlo *Chemical Engineering* • Cameron Smith *Chemical Engineering* • Anna Zhang *Chemical Engineering*

ADVISOR Jason D'Antonio *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This year, CMU GMB engineering students received a CIT travel grant to visit rural Panama over spring break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and the engineering applications behind the sanitation and environmental initiatives they engaged in.

CONTROL EXPERIMENTS FOR AERIAL ROBOTICS IN ENCLOSED SPACES

STUDENT Victor Yan *Mechanical Engineering*

ADVISOR Koushil Sreenath *Mechanical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

As aerial robotics technology becomes more advanced and more easily accessible, we find that there are control questions that remain unanswered. As aircraft fly close to surfaces, unexpected aerodynamic effects can cause difficulties for drone operators. Through a series of physical experiments, we aim to better understand the effects that enclosed spaces and surfaces have on aerial robot dynamics.

CONTROL SYSTEM FOR COAXIAL UAV

STUDENT Richard Lee *Mechanical Engineering*

ADVISORS Sebastian Scherer *Robotics Institute* • Koushil Sreenath *Mechanical Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Coaxial UAV systems offer distinct advantages over current quadrotor UAV systems including extended battery life and smaller relative footprint. My research aims to develop a control system for a Coaxial UAV system based on a dynamic model of that system. Through simulation tests of this system, we can predict its real world behavior given tasks such as trajectory following or a desired final state and poor initial conditions.

CURRENCY CONTROL

STUDENT Jose Veintimilla *Mechanical Engineering*

ADVISOR Karen Faulk *History*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

After spending two months in Buenos Aires I was amazed about the political issues the country was facing, particularly about money. Argentina has had a serious issue on inflation and has turned to currency control to make sure its citizens don't lose too much value on their money. This course of action has led to many consequences, most of which I'm sure I haven't even felt during my time there. One effect was the demand for US dollars even through they were restricted in the country. Many people felt better saving US dollars in their homes since it is much

more stable than their peso. Another effect was the emergence of the black market on currency exchange. Since the government locked the rate to 9 pesos to 1 dollar, many illegal vendors bought and sold dollars in the backs of stores and banks at the "blue rate' which was determined by experts based on the laws of supply and demand. These vendors were willing to buy dollars at a rate of 13 pesos to 1 dollar, a very attractive rate for visitors such as myself. One last effect that I noticed was the high interest in visiting neighboring Uruguay. Since US dollars were easily accessible there, thousands of people made day trips to the small country for the pure intention of pulling out dollars to exchange to pesos when returning to Argentina. Thus it is very clear that currency control causes a lot of change in a country. I believe it is important to investigate and see if it is worth going through such drastic measures to save one's currency and if it is even helping the country as a whole.

DESIGN AND FABRICATION OF RIGIDITY TUNING FABRIC USING ELECTROSTATIC EFFECT

STUDENT Yichu Jin *Mechanical Engineering*

ADVISOR Carmel Majidi *Mechanical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 10:00 am

Materials with electrically controlled stiffness have the potential to revolutionize robotics and assistive wearable technologies. Using electrostatic effect, we design and fabricate a double-layer fabric composition that rapidly and reversibly changes its elastic rigidity when applied with voltage difference. Each layer of fabric is elastic and electrical conductive and is embedded with aluminized Mylar cells coated with LuxPrint. At natural state, the composition stretches freely with a Young's modulus of 175 kPa; when electrically activated, its rigidity raises for 850 times with an increased Young's modulus of 148 MPa. The rigidity change is initiated with a 200 V voltage drop across the two sides of the fabric composition and is caused by the electrostatic force between the two layers of Mylar cells. In addition to demonstrating electrically controlled stiffness using electrostatic effect, we also introduce a rapid prototyping technique using laser cutter.

DESIGN OF A BIO-INSPIRED PNEUMATIC ARTIFICIAL MUSCLE WITH SELF-CONTAINED SENSING

STUDENTS Onder Erin *Mechanical Engineering* • Nishant Pol *Electrical & Computer Engineering*

ADVISOR Yong-Lae Park *Robotics Institute*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Pneumatic artificial muscles (PAMs) are one of the most famous linear actuators in bio-inspired robotics. They can generate relatively high linear force considering their form factors and weights. Furthermore, PAMs are inexpensive compared with traditional electromagnetic actuators, such as DC motors, and also inherently light and compliant. In robotics applications, however, they typically require external sensing mechanisms due to their nonlinear behaviors, which may make the entire mechanical system bulky and complicated, limiting their use in small and simple systems. This study presents the design and fabrication of a low-cost McKibben-type PAM with a self-contained displacement and force sensing capability that does not require any external sensing elements. The proposed PAM can detect axial contraction force and displacement simultaneously. In this study, the design of a traditional McKibben muscle was modified to include an inductive coil surrounding the muscle fibers. Then, a

thin, soft silicone layer was coated outside of the muscle to protect and hold the sensing coil on the actuator. This novel design measures coil inductance change to determine the contraction force and the displacement. The process can be applied to a variety of existing McKibben actuator designs without significantly changing the rigidity of the actuator while minimizing the device's footprint.

DEVELOPING AN AQUEOUS IMMERSION SURGICAL SYSTEM

STUDENT Alyssa Meyer *Mechanical Engineering*
ADVISORS James Antaki *Electrical & Computer Engineering* • Elif Ayvali *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

This project aims to develop an Aqueous Immersion Surgical System (AISS) intended to minimize intraoperative bleeding. The current lack of effective hemorrhage control results in intraoperative deaths preventable by this system. The AISS is based on the principle of immersing the surgical field in a transparent fluid, and applying a mild pressure to prevent bleeding, and is comprised of a transparent, hermetically sealed dome, an external pump, reservoir, cannulas, pressure sensor and feedback control circuit. The system can also be modified and used to contain bleeding in zero-gravity emergencies. Over the summer, a new elastic dome was developed to improve instrument access and physiological application compared to the original, rigid dome. Both domes were tested on land as well as on NASA's 49-P parabolic flight campaign for zero gravity trials, and hemostasis and blood clearance were successfully achieved on all trials.

ELECTRIC PROBE MEASURING STATION

STUDENT Jason Seepaul *Mechanical Engineering*
ADVISOR B. Reeja Jayan *Mechanical Engineering*
ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 10:13 am

Many companies and research groups are limited by their budget and are forced to take shortcuts or completely abandon their research/testing projects. In particular, electric probe measuring stations (EPRMS) are expensive pieces of equipment that are heavily used in medical research institutions such as pharmaceuticals. EPRMS are used to measure electrical charges given off by polymers and have a strong influence in pharmaceuticals where ionic charges on molecules make significant impacts on the body. These devices can easily cost a group $10,000 which may be out of the budget range for startup companies or new research groups. But what if there was a way to buy this researching tool at a cheaper price – by constructing it from scratch. This poses the question of whether one of these devices could be built with under $500. By using micro-syringes to emulate the soft touch aspect, a vertical translation stage, an 8 function digital multi-meter to measure the electrical signal, and a conductive, non-toxic liquid material such as Galinstan to transfer the electrical charge of the substrate to the multi-meter, one can create a device that can take the electrical signal of a substrate and display it on a computer screen as graphical data. This device will function as a high end EPRMS for a significantly lower price which will allow researchers and companies to put more money towards their innovative and ground breaking technologies.

ETHANOL FUEL CELL USING CELLULOSIC ETHANO

STUDENTS Anna Bandecca *Chemical Engineering* • Luke Bruce *Chemical Engineering* • Isaiah Edmonds *Chemical Engineering* • Yue Han *Chemical Engineering* • Neil Jassal *Electrical & Computer Engineering* • Joshua Kubiak *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Chukwudumebi Ogbogu *Chemical Engineering* • Richard Ruales *Chemical Engineering* • Shridhar Singh *Chemical Engineering* • Madison Stiefbold *Materials Science and Engineering* • Maximilien Vachon *Chemical Engineering* • Ryan Yeh *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Due to a global emphasis on addressing issues of climate change, both bioethanol production and ethanol fuel cells appear to be feasible methods for mitigating aspects of this problem. The proposed research to be conducted addresses this problem on a smaller scale. The proposition is to evaluate the production of cellulosic ethanol from plant cells as well as and the optimization of ethanol fuel cells through the use of carbon catalyst derivatives. Cellulosic ethanol is either produced through the enzymatic or chemical hydrolysis of plant cell walls. Both method have their advantages and disadvantages with respect to economics and scalability. Ethanol fuel cells have been traditionally run with platinum based catalysts in an acidic medium. Modifications in the catalyst can provide better economics while running in an alkali medium can allow for higher operating temperature and then improved performance. The results of this research will be presented at the 2016 American Institute of Chemical Engineers (AIChE) Chem-E-Car Regional Competition. They will then be utilized as a driving mechanism for the following year's car.

EXPLORATION OF A SUBTALAR JOINT MECHANISM FOR USE IN LOW COST PROSTHETICS

STUDENTS Vincent Chiang *Materials Science and Engineering* • Theodore Houlis *Mechanical Engineering* • Vivian Qiu *Design* • Nathaniel Thompson *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

This project seeks to generate a low cost alternative solution for patients with lower leg amputations in developing countries such as India. Existing low-cost solutions address only a single axis of articulation. The goal of this project is to introduce additional geometry to a pre-existing solution allowing for further axes of rotation that better mimic the articulation of both the subtalar joint and true ankle joint. Introducing additional degrees of freedom will better emulate the natural movement of the ankle. Thus, this project aims to reduce the stress of the prosthetic, leading to increased longevity of the device and comfort to the patient.

EXPLORING BIOLOGICALLY BASED MALNOURISHMENT THROUGH A GUT-ON-A-CHIP APPROACH

STUDENT Eric Parigoris *Mechanical Engineering*

ADVISOR Philip LeDuc *Mechanical Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 10:26 am

Malnourishment results in a cycle that degrades the gut's ability to effectively absorb nutrients due to a disruption of intestinal homeostasis. This condition typically continues even after healthy levels of sustenance are consumed. We aim to better understand impaired nutrient absorption in malnourished individuals through a microfluidic based lab-on-a-chip approach. We are developing a malnourished model of an intestine into existing gut-on-a-chip device design fabricated through soft lithography and silicon etching techniques. In order to develop a more physiologically relevant model, we have studied the effects of different components of bacteria on the mechanical properties of the gut cells. Whole bacteria, spheroplasts, and the endotoxin lipopolysaccharide (LPS) were all introduced to the gut cell layer to determine their adverse effects on the stability of the cells. We characterized this malnourished model by studying the tight junction integrity along with cytoskeletal organization of the microvilli in both healthy and malnourished models. Additionally, we have examined the permeability of the monolayer as an indicator of epithelial integrity. Our work would be useful in many areas including evaluating malnourished nutritional absorption in vitro as well as demonstrating the response of malnourished cells in a more physiologically relevant assay.

FLUID-MIXING MANAGEMENT DURING RADIOLOGY FLUID INJECTION

STUDENTS Corrine Bacigal *Chemical Engineering* • Steven Geier *Materials Science and Engineering* • Andria Lemus *Mechanical Engineering* • Carrie Qiu *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Computed Tomography (CT) scans are a common form of imaging used to detect tumors and fractures, as well to monitor diseases. Many scans require the use of contrast, a type of dye, in order to take clearer images. Our project encompasses the usage of contrast administered intravenously through a Stellant Injection System, made by Bayer Healthcare.This is a power-assisted injector that pushes saline and contrast through two separate syringes connected by tubing and into a catheter which has been placed in the patient's arm. During this procedure, two different fluids are injected separately.

The focus of our project is to resolve the issue of the mixing of the saline solution and the contrast due to backward flow of each fluid into the other fluid's syringe. This is a concern because saline is a sterile solution, and accidental contamination by the contrast could lead to further complications from injecting an unexpected amount of contrast into the body. In addition, contrast the dilution of contrast affects the final image produced. As of now, we have come up with several designs to alter the tubing and junction so that fluid mixing can be prevented without adding significant cost to the current design.

GEOMETRIC MECHANICS OF SNAKE STRIKING

STUDENT Brian Bittner *Mechanical Engineering*
ADVISOR Howie Choset *Robotics Institute*
ROOM/TIME Rangos 1 / 12-2:30 pm

Snake striking is a powerful, accurate, and extremely fast maneuver. The complexity and and versatility of serpenoidal locomotion makes this muscle coordination impressive to roboticists. In robotic control, highly articulated mechanisms have provided difficult control problems due to the complexity of the high order mechanical models. Low order, model driven control architectures look for simplifying structure in the dynamics and constraints amongst the degrees of freedom to formulate simplistic, physically intuitive control. Here we analyze low order models of snike striking using geometric mechanics, and look to how similar reductions might be formalized in classical mechanical systems.

GRANULAR IMPACT ON COR AND CRATER FORMATION

STUDENT Natalie Kuang *Mechanical Engineering*
ADVISOR Cecil Higgs *Mechanical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

An exploration into granular impact and related experiments conducted within the PFTL. Work will concern contributions to the study of COR with varying sphere to plate thickness ratios, and energy dissipation in during crater formation.

GRIPPER WITH EMBEDDED FIBER OPTIC SENSORS IN FINGERS FOR FORCE SENSING

STUDENT Kevin Low *Mechanical Engineering*
ADVISOR Yong-Lae Park *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

We present a gripper with a finger that has embedded fiber optic sensors (Fiber Bragg Grating) for force sensing. Fibers with FBG sensors were both embedded into a hollow exoskeletal structure and a fiber with 3 FBGs was used as a flexion tendon. The sensors were characterized to model loads applied to the finger. Finally, the capabilities of the sensors are demonstrated with a feedback-control loop system, using a motor to control the force output of the finger.

HEX-DOMINANT MESHING FOR COMPUTATIONAL SOLID MECHANICS

STUDENT Emily Zhen *Mechanical Engineering*
ADVISOR Kenji Shimada *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

We collaborate with Autodesk to validate the effectiveness of automated hex-dominant meshes in computational solid mechanics. Inaccurate and inefficient meshing can lead to inaccurate analysis results. Effectiveness of a mesh is dependent on element density, generation time, refinement in detailed areas, etc. Solution convergence studies are

conducted to benchmark the performance of: tetmeshes, hex meshes, and hex-dominant meshes using real-world test cases.

INDUCING OF SNAP-THROUGH BUCKLING WITH SHAPE MEMORY ALLOYS

STUDENT Yoon Hee Ha *Mechanical Engineering*
ADVISOR Kaushik Dayal *Civil and Environmental Engineering*
ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 10:39 am

Upon compression, many slender structures buckle. For a pre-compressed structure, they can experience what is called snap-through buckling. Shape memory alloys (SMAs) are a special type of metal that "remember" their trained shapes. The shape can be plastically deformed within a limit at a room temperature. However, when heat is applied, the deformed metal returns to its original "remembered" shape. This research seeks to take advantage of this unique ability of SMAs to cause snap-through buckling of thin metal. For the experiment, a thin rectangular bar is to be made of aluminum for one-third of its length on each side, and the other third (center piece) to be NiTi, common shape memory alloy (SMA). First, on the thin straight bar, critical force would be applied on each side to induce buckling. Once buckled, two sides are to be fixed. Then heat will be applied to the system to cause shape change in NiTi. The study focuses on change in potential energy and instability due to NiTi's tendency to return to its original shape.

INTERNET OF THINGS: USAGE AND OPTIMIZAITON

STUDENT Guochen Shen *Mechanical Engineering*
ADVISOR Jonathan Cagan *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Internet of Things describes the devices and networks that are Internet capable, leveraging the capability to communicate with other devices to send and receive data. These Internet of Things devices, primarily ones developed to work with Heating, Ventilation, and Air Conditioning (HVAC), have been advertised to use this capability to provide energy efficiency and cost savings compared to traditional unconnected HVAC equipment. This project simulates systems of Internet of Things devices to determine a pseudo-optimal layout, using a genetic algorithm to converge towards the solution. The simulation focuses on aspects such as cost of the energy used, cost of the devices themselves, and the comfort levels of the environment.

INVESTIGATING AND ENHANCING THE ROBUSTNESS AND EFFECTIVENESS OF THE STAND-ALONE BRAILLE TUTOR

STUDENT Tangrui Zuo *Mechanical Engineering*
ADVISOR Mary Bernardine Dias *Robotics Institute*
ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 10:52 am

Aiming to enhance literacy among the blind, TechBridgesWorld (TBW) has designed the Stand-Alone Braille Tutor (SABT) to enhance the braille learning process. This work builds on knowledge, experience, and information gathered from working with a variety of partner organizations in the developing world that work to enhance and deliver education for blind and visually impaired people.The summer research was focused on advancing and

updating the newest version of the SABT based on feedback that was gathered from a field study in the Mathru School for the Blind in India, where the SABT has been used in class for over a year the BWT has been in use since 2006. The goal of my work was to enhance the user experience of the SABT and thus, increase its potential to be used widely as a braille teaching tool.

INVESTIGATING ATTACKS ON ELECTRIC VEHICLE BATTERY SYSTEMS

STUDENT Andrew Sun *Mechanical Engineering*

ADVISORS Vyas Sekar *Electrical & Computer Engineering* • Venkatasubramanian Viswanathan *Mechanical Engineering*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The security of computerized electric vehicles must be ensured in order for electric cars to develop further and be more widely used. If an electric vehicle is hacked, its battery is at risk of being degraded. This project seeks to develop methods of detecting and protecting against attacks to drain batteries from a distance. An important component of this project is an analysis of the electric car battery. Lithium-ion and lithium-air batteries were analyzed to determine methods of detecting when a battery is being degraded.

LOW COST TRANSFEMORAL PROSTHETIC :: A BME DESIGN PROJECT

STUDENTS Lea Cody *Design* • Veronica Jaime-Lara *Mechanical Engineering* • Angela Ng *Civil and Environmental Engineering* • Priya Patel *Chemical Engineering* • Deepak Ravi *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Approximately 5.5 million transfemoral, or upper leg limb amputees exist worldwide in impoverished areas. Current prosthetics are too expensive or too crude to provide a long term solution, and our team aims to create a low cost transfemoral prosthetic that is easy to construct, manufactured in country, durable, mimics the natural gait, and is aesthetically pleasing.

The low-cost prosthetic treatment is a never-ending cycle including prosthetic fitment, patient training, prostheses inspection, assessment of patient, replacement of prosthetic components, and retraining for increased mobility. This affects the individual amputee, their families, their care providers, and sometimes even the local community. Without a leg, many amputees in developing countries lose their jobs and the ability to bring home money, increasing the burden on already impoverished families.

Our team produced a low cost above-knee prosthetic that can positively improve a user's livelihood by increasing mobility and thus re-integrating users into the local society and economy. Our above knee limb replacement is more comfortable, useful, and lifelike than the makeshift solutions currently in place. Absolute requirements include the minimum of supporting the amputee's weight, enduring cyclic loading, and allowing the amputee to be mobile again. In addition, it is low cost and durable so the user does not have to save up for years and buy several prostheses over his or her lifetime. The prosthetic is usable in their community's environment, and unlikely to fail in uneven terrain. The prosthetic also is customizable, aesthetically pleasing, easy to produce and manufacture, and have high accessibility.

MICROROBOT CONTROLS

STUDENT Luke Tsai *Mechanical Engineering*
ADVISOR Metin Sitti *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Control of Microrobot with 3 translational degrees of freedom, and indirect rotational degrees of freedom.

MICROSCALE TEMPERATURE APPROXIMATION: STATISTICAL TECHNIQUES ON INFRARED THERMAL OUTPUT

STUDENT Kemuel Noriega *Mechanical Engineering*
ADVISOR Sheng Shen *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

As a variety of robotics and electronics applications work on increasingly smaller scales, traditional techniques for various basic quantities, such as temperature, need to be updated or adapted. Temperatures of objects on the micron scale are measured using noncontact methods, and I developed one method further through statistical techniques on emissive spectral power data in the mid to far infrared range collected using Fourier Transform Infrared Spectroscopy (FTIR). By using a nonlinear multidimensional least squares fitting regression analysis, the emissive spectral power of a sample at a given temperature can be fitted to the Planck distribution, provided the emissivity of the sample can be measured as well. After regression, temperature was approximated as a fitting parameter and through Wien's law. Important considerations for the analysis included effects the wavelength domain had on temperature approximation accuracy and precision. Accuracy of the method was determined through initial benchmarking tests on a sample of black painted silica glass heated to known temperatures from 40 C to 100 C. Further tests to establish accuracy and utility of the method were conducted using 500 m square samples heated to known temperatures, in the same temperature range, using a 405 nm semiconductor based high power laser. Successful results will indicate potential use as a general methodology for noncontact temperature measurements, improving on the standard practice of assuming measured objects are grey bodies.

MOBILITY PLATFORM FOR UAV APPLICATIONS

STUDENTS Kelsey Scott *Mechanical Engineering*
ADVISOR Kenji Shimada *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

This project aims to explore the feasibility and efficiency of using a single motor and various control surfaces to create multi-DOF motion in an underwater environment. By embedding a propeller within an omni-wheel and including a flipper on the shaft, a single motor can be driven to provide a wide range of motions. This project represents a small project within the main goal of created an autonomous hull inspection and cleaning system for in port deployment. Thus, the project focuses on the application potential as it relates to this potential application.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

MODULAR ROBOT DESIGN AND NEW MODULE CREATION

STUDENT Matthew Martone *Mechanical Engineering*

ADVISOR Howie Choset *Robotics Institute*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Robots have become and integral part of modern life as explorers, manufacturers, assistants, and laborers, and their uses and abilities continue to expand with each iteration and new design. Different robotic systems are able to accomplish a variety of tasks, however there remains to be created one system that is quite as versatile as a human, with the ability to perform independently in each area, from working on an assembly line to rescuing people from disaster stricken areas. However, this is not the direction in which the field of Robotics is headed. Instead, the engineers in the Biorobotics Lab of the Carnegie Mellon University Robotics Institute look toward a different approach; creating versatile modular robots that can be reconfigured to address a particular task.

Modularity allows a robot to be made up of smaller, more specialized, self-contained modules, which can be used independently or attached together to form a coherent robot that is able to perform an array of useful tasks. Though each configuration of modules is just as specialized as a non-modular robot, it is the ability to disassemble and reassemble the modules that is the key to truly versatile robotics. Aside from reconfiguring existing modules, the versatility of modular robotics can be expanded by the creation of new types of modules with different attributes or behaviors. While the Modular Snake Robot of the Biorobotics Lab is comprised of mostly one-degree-of-freedom Rotary Modules (1-DOF Modules), it is equipped with a specialized camera head module that allows the snake to take camera input as well as input from an extensive sensor array. These specialized modules are important in expanding the abilities of the Snake Robot as well as other configurations such as the Snake Monster robot, a highly advanced modular hexapod robot that can walk around and climb with its six legs, entirely made of modules developed in the Biorobotics Lab.

This research will conceive, design, prototype, build, and test new modules for use in conjunction with the Series Elastic Actuator (SEA) software and hardware architecture currently used in the Biorobotics Lab. The research will mainly involve the creation of two modules, the wrist module, which will add a torsional degree of freedom, and a gripper module capable of force feedback and used for manipulating objects. These modules will be used to improve the use of the Snake Monster robot as well as expand the potential for other modular robots that can be created with this system of modules.

The system of modules is very well understood, and the challenge posed will be to create efficient, durable, and compact modules that can interface mechanically, electrically, and computationally with the other SEA Modules and their dedicated software such that they will be able to work in conjunction with existing modules to form a versatile robotic system.

NON-ELECTRIC DENTAL PUMP

STUDENT Nicole Huang *Mechanical Engineering*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Dentists have difficulty performing dental procedures in rural communities because electricity is scarce. The lack of electricity in rural treatment facilities prevents dentists from using equipment, such as an oral fluid suction pump, that allows dentists to perform complicated procedures effectively and efficiently. This project aims to design and develop a portable and non-electric oral suction pump device. Such a pump targets non-profit organizations that send dentists to rural areas to provide dental care to those who cannot access proper medical attention. This device has the potential to help hundreds of thousands of patients living in under-served communities obtain the proper dental treatment that everyone deserves.

PORT AUTHORITY BUS RELIABILITY ACROSS PITTSBURGH NEIGHBORHOODS

STUDENTS Meghna Baskar *Economics* • Kiersten Chuc *Statistics* • Suvrath Penmetcha *Information Systems* • Rohit Srungavarapu *Business Administration* • Skye Toor *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:31 am

The purpose of our study is to observe how often Pittsburgh PAT buses actually arrive (i.e. their frequencies), compared to their expected frequencies as stated in official PAT schedules. Buses are notorious for deviating from the official PAT bus frequencies. Pittsburgh residents frequently voice their displeasure with the untimeliness of PAT buses and this study will provide statistically sound evidence to suggest whether or not PAT buses abide by their stated frequencies.

Our study focuses on six neighborhoods closest to CMU. We stratified our sample across neighborhoods and time of day. Our sample was taken from a list of all Pittsburgh bus stops and we selected stops within our neighborhoods of interest. We then randomly assigned the sampled bus stops a time of day, and record bus frequencies in-person at each stop. Our analysis includes a hypothesis test, where our null is there is stated as "no difference between the actual and stated frequencies".

Our results provide empirical evidence for the differences between the actual frequencies and the theoretical frequencies. This information is invaluable for PAT, specifically how they can better optimize their bus usage across neighborhoods, and can start the conversation about possibilities to improve bus arrival times.

SELF-DRIVING BUGGY

STUDENTS Jason Kagie *Electrical & Computer Engineering* • Elyce Milligan *Materials Science and Engineering* • Christopher Perry *Design* • Benjamin Warwick *Mechanical Engineering* • Yilin Zhang *Materials Science and Engineering*

ADVISOR David Kosbie *Computer Science*

ROOM/TIME Wright / 4:40 pm

This project aims to develop autonomous localization and navigation using low-budget sensors and hardware. This could be expanded to optimize self-driving vehicles by improving economic costs. Given a retired frame-and-shell buggy from a Sweepstakes (Buggy) organization, we will design a system that will navigate and complete the given course under varying conditions. S-D Buggy achieves this by deriving position and heading from different sensors and computer vision (CV). The system will include a personal computer, a microcontroller, multiple sensors, a steering mechanism, and a braking mechanism. The buggy would be able to complete the course in a time frame comparable to a human-driven buggy. A potential goal of the project would be to race against human drivers.

SIMPLIFYING CLUBFOOT SURGERY: USING ROBOTIC JOINT POSITIONING

STUDENT Deepak Ravi *Mechanical Engineering*
ADVISOR Kenji Shimada *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

Clubfoot is a birth defect which affects 150,000 children annually where the foot is twisted inward preventing them from walking. Surgery to correct clubfoot can take several hours and requires surgeons to use long-term expertise to place dynamic joints to gradually correct the foot's position. By using a robotic guide, the process can be made much more precise, quicker, and easier for younger surgeons allowing the surgery to be more accessible to people around the world. The project was divided into two main phases: utilizing computer vision to plan joint locations and using a robotic arm to bring joints into position during surgery. By using precise robotic placement, it was proven to be able to reduce the number of joints in the clubfoot brace from 6 to 2 joints which further reduces the surgery complexity and the time required to install and update the brace. Ultimately, this robotic assisted surgery will increase the precision of treatment and allow more clubfoot patients to be treated in a shorter time at lower cost.

SIMULATION OF A DIESEL/NATURAL-GAS DUAL-FUEL ENGINE USING COMPUTATIONAL FLUID DYNAMICS

STUDENT Leah Tinberg *Mechanical Engineering*
ADVISOR Satbir Singh *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30 pm

This research project utilizes computational fluid dynamics (CFD) to simulate combustion in dual-fuel internal combustion engines operating on diesel and natural gas. In a dual-fuel engine, a premixed natural gas and air mixture is ignited by injection of a small amount of diesel fuel. Simulations are performed to understand the ignition process of diesel fuel and the propagation of turbulent flame into the natural gas mixture using two different combustion models: one that involves only chemistry calculations, and one that involves combustion chemistry and explicit tracking of the turbulent flame front. Predictions of the simulations are compared with available experimental measurements.

THE BABBAGE DIFFERENCE ENGINE: A TABLETOP MODEL

STUDENT Adam Zeloof *Mechanical Engineering*
ADVISOR David Touretzky *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This is a tabletop replica of Charles Babbage's Difference Engine. It was developed with the intent of being an educational, open-source kit and providing the builder and operator with an understanding of the workings of the Difference Engine. Although this project is by no means identical to the original plans drawn up by Babbage in the 1800s, it was designed to be as true to those plans as is possible for a much smaller, plastic-made model. Rather than being a fully-functioning replica, this serves as a snapshot of the Engine's necessary components. The reasoning behind this is that the Engine will not function without substantial user engagement, requiring the operator to gain an intimate understanding of its inner workings. Constructing and operating this version of the Engine will introduce the end user to the early days of computing, long before the field of Computer Science existed.

The Difference Engine was designed to automate the repetitive and error-prone task of evaluating functions for mathematical tables, such as tables of trigonometric functions. Because these tables were often a sea of numbers, it was very easy for the humans computing them to make simple mistakes that rendered values useless. Charles Babbge, after finding a plethora of mistakes in a set of astronomical tables he was referencing, eventually said "I wish to God these calculations had been executed by steam!"

With this concept in mind, Babbage designed the Difference Engine, a 25,000-part, four-ton monstrosity. Construction of the Engine, a project funded by the British government, took place from 1823-1833, at which point it abruptly stopped due to disagreements between Bababge and Joseph Clement, a master craftsman that Babbage had hired to build the engine. The Difference Engine was never completed. All Babbage had to show from this venture was a small demonstration model.

Bababge's designs were overambitious. At the time, the manufacturing techniques needed to build the Engine had barely been realized, and the entire thing would have been made out of lead. The precision needed to carry out the Engine's construction simply could not be achieved at the time. Babbage tried again in 1847, designing a new, better version of the Engine. This process took him two years, and the final designs called for 8,000 parts and would weigh approximately five tons. Although it was also not built during his lifetime, just under 150 years later, a working model was built by the London Science Museum. The process, started in 1985, took seventeen years and was completed in 2002. It is this design that the model Engine is based on.

THE EFFECT OF A TWO DEGREES OF FREEDOM ANKLE/FOOT PROSTHESIS ON BALANCE

STUDENT Hannah Lyness *Mechanical Engineering*

ADVISOR Steve Collins *Mechanical Engineering*

ROOM/TIME Rangos 1 / 12-2:30 pm

Internationally, below knee amputation is the most common type of major amputation (Lerner 2011). For individuals with below knee amputation, there is a higher risk of falling and a reduction in balance confidence (Waters 1999). Actuated prosthetic devices have been shown to decrease walking energy expended during walking (Caputo 2014). Perhaps a device actuated with two degrees of freedom can provide beneficial balancing action and thus reduce balance-related effort. This study examined the relationship between three different control schemes and walking effort measured by five major indicators. Through experimentation with amputee and non-amputee subjects, the features of helpful control schemes were differentiated from those that increased walking balance.

THE EFFECT OF VARIOUS ANNEALING TEMPERATURES ON NITI SHAPE MEMORY SPRINGS

STUDENT Kyung Min Lee *Mechanical Engineering*

ADVISORS Noe Vargas Hernandez *Mechanical Engineering* • Bryan Webler *Materials Science and Engineering*

ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 10:52 am

Shape Memory Alloys are materials that can deform freely at low temperatures and return to their permanent shape when heated. Because of this fascinating property, Shape Memory Alloys are often used in a variety of fields, such as in everyday home goods or in robotics movements. The aim of this research is to look specifically at NiTi

Shape Memory springs and how they behave after different annealing temperatures ranging from 400 to 700. The research will focus on how the annealing temperature affects the spring coefficient and the time taken to return to its permanent shape. The tests will be performed by hanging the springs onto a frame, then hanging a mass at the other end, thereby stretching the spring with constant force. Then, a current will flow through the spring, thus inducing enough heat for the spring to return to its permanent shape.

THE INFLUENCE OF THE FOSSIL FUEL INDUSTRY ON PUBLIC OPINION ON CLIMATE CHANGE, AND WHAT TO DO ABOUT IT

STUDENT Liam Walsh *Mechanical Engineering*
ADVISOR Garrett Stack *English*
ROOM/TIME Wright / 1:00 pm

This project explores how personal opinions are affected by rhetorical tactics of fossil fuel companies, what those tactics are comprised of, and how this indirectly influences the general public opinion on the matter of man-made climate change. An overwhelming majority of scientists agree that man-made climate change is real and a threat to society, but studies show that only around half of Americans worry more than a "fair amount" about it. Using the examples of major companies including ExxonMobil and British Petroleum, I explore how people asses the risks of climate change, and how companies are able to manipulate this to affect public opinion on the matter. A main hurdle to overcome is that in order to see what the public opinion really is on climate change, we must allow the scientific data to speak over the views of the fossil fuel industry which have been ingrained in our media and government. My project concludes by exploring methods such as divestment, better risk communication from the scientific community, fairer representation in the media, and prompting people to think about their long-term impact. These actions could be taken on the scale of our university, our nation, and our planet.

COLLEGE OF FINE ARTS

ARCHITECTURE

INTER·PUNCT VOL. 2, INTER·VIEW

STUDENTS Christopher Ball *Architecture* • Mark Terra-Salomao *Architecture*
ADVISOR Mary-Lou Arscott *Architecture*
ROOM/TIME McKenna / 4:20 pm

Vol. 2, inter·view is the second edition of inter·punct, Carnegie Mellon School of Architecture's student-run journal and organization for architectural theory and discourse. The issue aims to distill the contemporary situation of architecture by presenting a compilation of interviews with leading architectural practitioners. Through the translation, publication and dissemination of these dialogues, we intend to continue to promote a culture of vital discussion within the School of Architecture.

ART

HERMIT

STUDENT Swetha Kannan *Art*
ADVISOR Clayton Merrell *Art*
ROOM/TIME Connan / 12-2:30 pm

The process of creating this project was a long one. I combined elements and different technologies in the efforts of working with a particular animal; the hermit crab. My project takes a whimsical look at this hermit and presents it as a character we all know and that we all have been at some point in our lives. I do this by placing the hermit crab as a character illustrating a variety of interviews I took with the campus community that demonstrates our generation's overall experience combating race and gender stereotypes.

MARIANNES NOIRES: MOSAÏQUE AFROPÉENNES

STUDENTS Heather Cowie *Art* • Joseph Hill *Drama* • Kaytie Nielsen *BHA*
ADVISOR Mame-Fatou Niang *Modern Languages*
ROOM/TIME McConomy Auditorium / 10:30 am - 12:00 pm

"Mariannes Noires: Mosaïque Afropéennes" is a feature-length film (approx. 80 minutes) that explores Afro-Parisian female identity and experience. In this film, seven Black women born and raised in the Paris area share their personal stories and discuss their perspectives on issues of race and womanhood in the heart of the French Republic, and interrogate the foundations of the French national identity. This project is a collaboration between Dr. Mame-Fatou Niang, Assistant Professor of French and Francophone Studies, and Kaytie Nielsen, senior BHA Creative Writing and Directing student. Filmed in July 2015, with Joe Hill (Director of Photography) and Heather

Cowie (First Assistant Camera), this film is Kaytie Nielsen's Dietrich College Senior Honors Thesis, facilitated by the Dietrich Senior Honors Fellowship.

MEMORY SLUGS

STUDENTS Junghyun Kim *Art* • Maryyann Landlord *Art*

ADVISORS Ali Momeni *Art*

ROOM/TIME Pake / 1:40 pm

This interactive animation utilizes multiple Oculus Rifts to deliver a novel storytelling structure, in which the virtual space reacts to the direction of the viewer's gaze. Whereas virtual reality typically entails isolation from immediate reality, this project facilitates social interaction by encouraging multiple participants viewing unique, emergent stories to verbally share their experiences, as well as provide a spectacle for viewers outside of the Rift.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering* **ADVISORS** David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

MYMOIR-HOW TO HELP SENIORS CITIZENS TO RECALL AND SHARE THEIR MEMORIES.

STUDENT Chengcheng Zhao *Art*

ADVISOR Geoff Kaufman *Human Computer Interaction*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Mymoir is an undergraduate independent research study project aims to design a new interactive solution across generation to reconnect cultural heritage and facilitate interpersonal relationship through interactive narratives.

SLEEK, SLENDER, SEXUAL: RE-IMAGINING THE FEMALE BODY THROUGH SCULPTURE

STUDENT Amanda Jolley *Art*

ADVISOR Bob Bingham *Art*

ROOM/TIME Connan / 12-2:30 pm

In this summer research fellowship, my aim was to create sculptures that utilized fashion techniques such as crochet, knitting, and sewing in order to challenge stereotypical notions of beauty, sexuality, and gender enforced against women by society. Using these fashion techniques and the photographic image, I worked to create fantastical characters that are fabricated to be photographed and are also enriched by the environments I have placed them in. This interplay between the photograph and the sculptural object itself has become a major concern in my body of work, and I have continued to create more of these strange characters throughout the year following this fellowship.

SUMVIS: AN INTERACTIVE SUMMARY AND VISUALIZATION TOOL FOR LARGE-SCALE GRAPHS

STUDENT Ticha Sethapakdi *Art*

ADVISOR Christos Faloutsos *Computer Science*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:26 am • Class of '87 / 1:20 pm

Given a very large undirected graph (on the order of thousands or millions of edges), how can we break it up into a small number of important aspects to display to a user? And how can we determine what to show or hide in our visualization? Our proposed solution is SumVis, an interactive graph visualization tool that summarizes a large graph by visualizing it in a clear and succinct manner. The tool allows users to interact with a condensed form of an input graph and uses glyphs to represent the graph's constituent subgraphs. A spy plot of the input graph is additionally integrated with the visualization to provide context and information for each glyph.

Finally, to set SumVis apart from existing graph visualization tools, which become illegible on graphs containing more than a few hundred edges, our implementation displays no more than 5 glyphs onscreen at a time.

SWINGING DOLLS: A PROJECT BY NIVETHA KANNAN

STUDENT Nivetha Kannan *Art*
ADVISOR Elaine King *Art*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The "Swinging Dolls" project is intended to engage viewers with the creative processes of looking and making. This concept comes from the experiences I have gotten at Carnegie Mellon that encourages cross-disciplinary and multi-media work. It aims to be interdisciplinary as well as a crossing of different art mediums such as game programming, video, and traditional fabrication. Imagine participants in a gallery strolling through a flock of dolls levitated above the ground by the swings they are all perched on. Each doll is different, fragile, precious. They have codes- symbols stitched to the back of their tiny flannel shirts. Scanning the code with an smartphone apps propels viewers into a virtual world where they are content to push their small puppet partner for as long as they can. In "Swinging Dolls" viewers are invited to interact these dolls that correspond to an online application which allows viewers to push the puppets in a virtual space. The exhaustive act of scanning these individual puppets suggests the inherent loneliness, isolation, solitude, and hopefulness in each puppet adding to the overall mood of helping the dolls swing in an empty, isolated, virtual environment.

THE HIDDEN BACHELOR

STUDENT Audrey Banks *Art*
ADVISOR Elaine King *Art*
ROOM/TIME McConomy Auditorium / 3:00-4:30 pm

The presentation of the director's cut of the film 'The Hidden Bachelor', a subconscious tale of love, manipulation, hierarchy and misplaced power.

THERE IS THAT IN ME

STUDENT Margaret Navin *Art*
ADVISOR Clayton Merrell *Art*
ROOM/TIME Connan / 3-5 pm

I have an overflowing interest in private lives -- the humble ways in which we cope, the sacred environments we build over the years, and the life narratives we construct to make sense of it all. My intention in this project is to make a series of oil paintings inspired by found photographs of my childhood birthday parties that have been long forgotten. This project is a humble investigation into the shared human experience of attending to the various ways in which our past punctuates the present.

UTOPIA IN REVOLUTIONARY CUBA

STUDENT Madeline Finn *Art*
ADVISOR Susanne Slavik *Art*
ROOM/TIME Connan / 12-2:30 pm

A cultural transformation took place during the early period of the Revolution in Cuba. The undercurrents that guided the old political order under Fulgencio Batista were deemed immoral and repressive. Early on in the Revolution, as the government transitioned towards a socialist state, education was promoted and implemented as a means to shape social and political life. In theory, access to free education and healthcare would elevate each citizen within the society, enabling and charging them to become effective and loyal participants in preserving and perfecting the Revolution. In Man and Socialism in Cuba, Ernesto "Che" Guevara defined this expectation of each citizen to uphold the values of the "New Man." He stated "work must acquire a new status. Man-as-a-commodity ceases to exist, and a system is installed that establishes a quota for the fulfillment of his social duty." The model called for engagement in Revolution, education through participation, and the support for the transition into a new socialist state. The new regime was structured to maintain moral incentives, free from monetary and materialistic motivations. A social contract was established and a new political order developed, unencumbered by political corruption. To improve the personal and collective human condition, Cuba would strive toward and -ideally- reach a state of utopia. I plan to respond to these historical developments by creating narrative diorama-sculptures that reflect the illusion and the romance of the Cuban revolution, which may, in turn, reflect the nature of other revolutions across time and place.

YOUR HOME OR MY HOME?

STUDENT Jamie Earnest *Art*
ADVISOR Bob Bingham *Art*
ROOM/TIME Connan / 3-5 pm

Memory will always be a shade of the truth and humans will always hold a relationship to one or more domestic spaces. These are both facts that I wish to investigate through research and apply my findings into a painting. I want to interview subjects about their home spaces and things about these spaces that resonate with them. This project aims to apply research from the interviewee's present an past domestic home spaces into a painting combining several of the narratives, objects, colors, etc. I am interested in the temperament of memory and how interpretation becomes a shade of the truth. I plan to create three paintings from this process. I find myself making paintings about my own experiences, but I wish to add a research element to add another outside channel of information in order to investigate how this affects my paintings and my artistic practice as a whole.

DESIGN

BAYER HEALTHCARE MEASURING FLUID TEMPERATURE INSIDE A SYRINGE

STUDENTS Justin Finkenaur *Design* • Edna Fongod *Chemical Engineering* • Justin Knobloch *Materials Science and Engineering* • Alexandra Mod *Chemical Engineering* • Shreya Munjal *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Computerized tomography (CT) scans are commonplace in the medical community. These scans require the injection of syringes containing contrast media and saline solution. Currently, in practice, there are safeguards in place such as heat maintainers to prevent the contrast media from becoming too hot, but there is no way to monitor the actual temperature of the media. Having temperature measurement capabilities allow for quick setup and determining the optimal temperature for patient comfort. In addition, the temperature sensor is a reliable method to measure the fluid temperature in a syringe. As an add-on, it can be easily incorporated into the CT syringe injector model. For our second prototype, the sensor uses an insulating material known as rigid polyurethane foam, a material with a low thermal conductivity, to accurately measure the temperature inside the syringe with no effect from its surrounding environment, while incurring minimal cost. Additionally, the sensor communicates electronically with an existing display with the use of an arduino board.

CHIROPROKTOR: A SPINAL MISALIGNMENT SIMULATOR TO AID CHIROPRACTIC ADJUSTMENTS

STUDENTS Christopher Chao *Electrical & Computer Engineering* • Meave Higgins *Chemical Engineering* • Nicole Kawakami *Materials Science and Engineering* • Eric Parigoris *Mechanical Engineering* • Lauren Zemering *Design*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The main function that a chiropractor serves is to adjust spinal misalignments, which is when vertebrae move out of their normal positions. Misalignments can cause a wide range of complications, ranging from back pain, to high blood pressure, to swelling of back muscles and tissues. In order to alleviate this discomfort, years of practice and experience are required to properly identify and correct the misalignment. Currently, chiropractic and osteopathic students are limited to practicing their techniques on friends, family, and fellow chiropractic students, which can be both dangerous and inconvenient. We propose incorporating a spinal simulator into chiropractic schools that would mimic a wide range of spinal misalignments. This would provide students, interns, and beginner chiropractors with a dynamic model to practice both identifying and adjusting spinal misalignments.

EXPLORATION OF A SUBTALAR JOINT MECHANISM FOR USE IN LOW COST PROSTHETICS

STUDENTS Vincent Chiang *Materials Science and Engineering* • Theodore Houlis *Mechanical Engineering* • Vivian Qiu *Design* • Nathaniel Thompson *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

This project seeks to generate a low cost alternative solution for patients with lower leg amputations in developing countries such as India. Existing low-cost solutions address only a single axis of articulation. The goal of this project is to introduce additional geometry to a pre-existing solution allowing for further axes of rotation that better mimic the articulation of both the subtalar joint and true ankle joint. Introducing additional degrees of freedom will better emulate the natural movement of the ankle. Thus, this project aims to reduce the stress of the prosthetic, leading to increased longevity of the device and comfort to the patient.

FORM: FITNESS RESPIRATION MONITOR

STUDENTS Evaline Ju *Electrical & Computer Engineering* • Laiyee Kwan *Chemical Engineering* • Gabriel Mitchell *Design* • Brigitte Quirk *Electrical & Computer Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

The goal of this project is to develop a breathing monitor device to help prevent breathing-related exercise injuries. In the current market of personal fitness monitors, there is not currently an affordable and accurate device that notifies the user of dangerous breathing rates and breathing depths as they occur. The device will consist of sensors and feedback vibration motors embedded into a chest strap to be worn during exercise. Our approach over the course of the upcoming semester is to design, build, test, and repeat through four total prototypes to develop an aesthetic, comfortable, and accurate breathing monitor with real-time feedback to the wearer.

INGESTIBLE MEDICAL DEVICE FOR CONTROLLED DRUG DELIVERY TO THE SMALL INTESTINE

STUDENTS Amy Desalazar *Chemical Engineering* • Rachel Freer *Materials Science and Engineering* • Linna Griffin *Design* • Molly Klimak *Materials Science and Engineering* • Mathea Tenwalde *Materials Science and Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Crohn's disease, or the chronic inflammation of the gastrointestinal (GI) tract, can cause potentially severe symptoms. Current treatment options are often unsuccessful due to their lack of site specificity, causing unwanted side effects. In order to combat the issue of these negative side-effects, we designed a device capable of drug delivery directly to the inflamed area of the intestine. Our device uses a gastro-retentive system in order to prolong the delivery of drugs to the the target area over time. The device will be loaded into a polymer capsule in order to protect its payload from low pH environments and digestive enzymes when passing through the stomach and early small intestine. This new treatment method for Crohn's disease increases patient compliance by reducing the frequency in which patients must take medication compared with current treatment strategies.

KOPO SAFI - LOW-RESOURCE DESILTING

STUDENTS Kelsey Rhee *Materials Science and Engineering* • Annette Ritchie *Materials Science and Engineering* • Ismael Sobek *Design*

Sun-Young Wang *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

In Rwanda alone, 24% of people do not have access to clean drinking water. Families spend thousands of hours each year collecting drinking water, but deaths from a lack of sanitation and preventable waterborne diseases persist. In response, the alumni startup Kopo, has created a Kopo Can to facilitate the use of solar disinfection in low-resource countries. Solar disinfection (SODIS) is a method approved by the World Health Organization (WHO) for eliminating pathogens present in water. However, for SODIS to be effective the water must be of a certain clarity. Therefore, Kopo Safi has developed an equally low-resource desilting method, which includes a funnel with a cloth-based filter. When the Kopo Safi Funnel is used in conjunction with the Kopo Can and SODIS method, safe drinking water will be achievable for families in developing countries.

LOW COST TRANSFEMORAL PROSTHETIC :: A BME DESIGN PROJECT

STUDENTS Lea Cody *Design* • Veronica Jaime-Lara *Mechanical Engineering* • Angela Ng *Civil and Environmental Engineering* • Priya Patel *Chemical Engineering* • Deepak Ravi *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

Approximately 5.5 million transfemoral, or upper leg limb amputees exist worldwide in impoverished areas. Current prosthetics are too expensive or too crude to provide a long term solution, and our team aims to create a low cost transfemoral prosthetic that is easy to construct, manufactured in country, durable, mimics the natural gait, and is aesthetically pleasing.

The low-cost prosthetic treatment is a never-ending cycle including prosthetic fitment, patient training, prostheses inspection, assessment of patient, replacement of prosthetic components, and retraining for increased mobility. This affects the individual amputee, their families, their care providers, and sometimes even the local community. Without a leg, many amputees in developing countries lose their jobs and the ability to bring home money, increasing the burden on already impoverished families.

Our team produced a low cost above-knee prosthetic that can positively improve a user's livelihood by increasing mobility and thus re-integrating users into the local society and economy. Our above knee limb replacement is more comfortable, useful, and lifelike than the makeshift solutions currently in place. Absolute requirements include the minimum of supporting the amputee's weight, enduring cyclic loading, and allowing the amputee to be mobile again. In addition, it is low cost and durable so the user does not have to save up for years and buy several prostheses over his or her lifetime. The prosthetic is usable in their community's environment, and unlikely to fail in uneven terrain. The prosthetic also is customizable, aesthetically pleasing, easy to produce and manufacture, and have high accessibility.

LOW-COST PURIFIED WATER INDICATOR

STUDENTS Abhinav Gautam *Electrical & Computer Engineering* • Dominique MacCalla *Materials Science and Engineering* • Courtney Pozzi *Design* • Ashwath Sankar *Biological Sciences* • Elizabeth Starck *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One in seven people have no access to clean drinking water, but current solutions are either too expensive or too culturally disruptive for many poor families. KOPO, LLC. developed the Kopo Can that purifies water while preserving the tradition of collecting water communally, a practice commonly carried out with jugs shaped like the Kopo Can. The Kopo Can disinfects water using the solar disinfection (SODIS) method that combines UV radiation and heating. Simply fill the Kopo Can with contaminated water, set it in the sun for 6 hours, and the solar exposure disinfects the water. Currently the users are told to leave the Kopo Can out for a day on a sunny day and for 2 days on a cloudy day. This reduces the efficacy of water purification where on a 12 hour sunny day, two cans of water can be purified. Plus, there is no way to tell if the Kopo Can has received enough UV radiation, which is responsible for destroying bacteria and other microorganisms. Current indicator designs on the market are either electronic based and/or are too expensive for developing countries to implement. The KOPO team approached us to create a solution that is affordable and culturally appropriate for targeted users who make less than $2 a day. Overall, we created an inexpensive, sustainable indicator, with an intuitive design that can easily indicate to users if their water has been purified using the SODIS method.

NAYAN: MONITORING SAFETY ADD-ON FOR WALKERS

STUDENT Rufeng Ji *Design*

ADVISOR Wayne Chung *Design*

ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 11:05 am

Older adults falls is a huge medical concern. A recent study conducted by the US dept. of Health concluded that about 87 percent of serious elderly falls are attributable to walker use. The medical costs associated with the walker falls amount to $1.5 Billion.

To solve this problem, my team came up with NAYAN. NAYAN, is an affordable safety add-on that helps in user gait training and provides prescriptive feedback through a smartphone app. NAYAN app is designed to help remind seniors how to use the walker through step by step visual instructions and auditory cues. Moreover, NAYAN will help Physical therapists and caregivers remotely monitor the patient from their clinic and obtain information like number of steps walked per day, unusual gait patterns etc.

We would like to use the symposium as a chance to display our works in progress to the students on campus and spread awareness on this medical issue.

PASSPORTS AS POWER

STUDENT Chloe Chia *Design*

ADVISOR M. Stephanie Murray *BHA*

ROOM/TIME Pake / 2:00 pm

Citizenship has evolved to be more than simple inclusion and exclusion around geographic borders. The forces of the free market, globalization, and technology have led of new forms of transnationalism and statelessness. Out of this emerges figures of the cosmopolite, global citizens who manage to be 'of' the world without necessarily belonging anywhere within it. Depending on the citizenship(s) held, this has profound implications both for the power dynamics between individuals and the state, with artifacts like passports being the key tool to asserting that power, yet lacking the design to embrace such cosmopolitanism. Combining insights from both a global systems and design perspective, this presentation will cover that spectrum of power and social hierarchy that the citizenship market produces, its ethical implications for the idea of the nation-state and universal human rights, and potential solutions for the inequalities it produces.

SELF-DRIVING BUGGY

STUDENTS Jason Kagie *Electrical & Computer Engineering* • Elyce Milligan *Materials Science and Engineering* • Christopher Perry *Design* • Benjamin Warwick *Mechanical Engineering* • Yilin Zhang Materials *Science and Engineering*

ADVISOR David Kosbie *Computer Science*

ROOM/TIME Wright / 4:40 pm

This project aims to develop autonomous localization and navigation using low-budget sensors and hardware. This could be expanded to optimize self-driving vehicles by improving economic costs. Given a retired frame-and-shell buggy from a Sweepstakes (Buggy) organization, we will design a system that will navigate and complete the given course under varying conditions. S-D Buggy achieves this by deriving position and heading from different sensors and computer vision (CV). The system will include a personal computer, a microcontroller, multiple sensors, a steering mechanism, and a braking mechanism. The buggy would be able to complete the course in a time frame comparable to a human-driven buggy. A potential goal of the project would be to race against human drivers.

DRAMA

ENFANTINE: PRAGUE QUADRENNIAL (SURG)

STUDENT Olivia Hern *Drama*

ADVISOR Susan Tsu *Drama*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

I created puppetry and costumes for piece, entitled Enfantine, presented at Prague Quadrennial of Performance Design and Space in June 2015. Attending and participating in this event allowed me to expand my own experience and exposure to theatrical design while providing me a venue to participate as a designer on a student-created work. This opportunity allowed for me as a student and costume designer to witness, participate in and be able to exchange ideas at the leading edge of international theatrical design. The work done with the team of Enfantine let me explore new ideas combining sculpture and costume, and allowed me to witness the way performance is able to use imagery and movement to transcend boundaries of both culture and language.

MARIANNES NOIRES: MOSAÏQUE AFROPÉENNES

STUDENTS Heather Cowie *Art* • Joseph Hill *Drama* • Kaytie Nielsen *BHA*

ADVISOR Mame-Fatou Niang *Modern Languages*

ROOM/TIME McConomy Auditorium / 10:30 am - 12:00 pm

"Mariannes Noires: Mosaïque Afropéennes" is a feature-length film (approx. 80 minutes) that explores Afro-Parisian female identity and experience. In this film, seven Black women born and raised in the Paris area share their personal stories and discuss their perspectives on issues of race and womanhood in the heart of the French Republic, and interrogate the foundations of the French national identity. This project is a collaboration between Dr. Mame-Fatou Niang, Assistant Professor of French and Francophone Studies, and Kaytie Nielsen, senior BHA Creative Writing and Directing student. Filmed in July 2015, with Joe Hill (Director of Photography) and Heather Cowie (First Assistant Camera), this film is Kaytie Nielsen's Dietrich College Senior Honors Thesis, facilitated by the Dietrich Senior Honors Fellowship.

PLANTS AND OLD PEOPLE: AN EFFORT TO MAKE THE VIDEOGAME TALK BACK

STUDENT Samuel McInerney *Drama*

ADVISOR Alan Black *Language Technologies Institute*

ROOM/TIME Dowd / 12:00 pm

Details the ongoing effort to develop a videogame in which a first-person narrative is generated naturally in a constant stream of messages which are responsive to the actions of the player. These messages must be capable of describing the situations or events of the game with accuracy while accounting for the infinite variety of ways in which a player might approach the game. To achieve this a modified version of the English Resource Grammar is used to generate Minimal Recursion Semantics for each possible generated in-game message which are then

semantically generalized, enabling one message to apply to a multitude of different contexts within the game. The details and potential shortcomings of this method will be the primary focus of the presentation.

TOUCHPOINTS: A TECHNIQUE FOR EMBEDDING TECHNOLOGY IN THEATRICAL COMPOSITION

STUDENT Michael James *Drama*
ADVISOR Lawrence Shea *Drama*
ROOM/TIME Wright / 12:40 pm

Touchpoints offers directors and designers a framework and vocabulary for thinking about and acting upon technology in performance. Based on observations from international work exhibited at the Prague Quadrennial, work created by leaders in the field, and educational experiences at CMU, the model identifies different variables present in mediated performance. With the vocabulary to articulate how these gradients apply to their work, theatre artists new to the integration of technology in theatre can improve the sophistication of their choices. Similarly to Viewpoints, a technique for composing movement and gesture in theatre, Touchpoints can be used to generate work by providing collaborators a shared language to focus on specific qualities within their compositions.

WHERE THE HARDYHEAD LIVE: REVISITED

STUDENT Iris Beaumier *Drama*
ADVISOR Wendy Arons *Drama*
ROOM/TIME McConomy Auditorium / 12:00-12:30 pm

Home to thousands of fish species across the world, coral reefs are disappearing from the planet. Where the Hardyhead Live is an eco-drama film/theatrical piece, which depicts the effects of ill-conceived marine zoning laws on coral reefs and the populations that depend on them in the Wakatobi Triangle of Indonesia. Content for research was collected during the summer of 2015 in Indonesia where I was generously funded to film and conduct research as a Jennings Scholar. During the Playground Festival in the School of Drama at Carnegie Mellon, classmates and I experimented with applying movement to film and bringing ecological issues to a new audience. The piece features original underwater cinematography and choreography devised by four actors in the School of Drama. The performance and oral presentation will highlight the importance of co-management between the locals and centralized Indonesian government to solve the issue of failing coral reefs in the Wakatobi and around the world.

CROSS COLLEGE

COMPUTER SCIENCE & ARTS

ALGORITHMIC ANIMATION: A TOOL FOR CREATING TWO-DIMENSIONAL PAINTERLY ANIMATION IN THE CONTEXT OF WEBCOMIC STORYTELLING

STUDENT Sylvia Kosowski *BCSA*

ADVISOR James Duesing *Art*

ROOM/TIME Connan / 12-2:30 pm

Algorithmic Animation is a project in three parts: an animation tool I programmed in C#, example animations created using my tool, and pages of my upcoming webcomic which were digitally painted in Photoshop. My animation tool allows users to computationally create 2D animations in complex visual styles which would be very time-consuming to paint by hand. To accomplish this, I began with an algorithm used in computational photography for synthesizing textures based on image analogies and adapted it to work with animation. My motivation for creating this tool is that in the future I want to make animations in the painting style of my webcomic. Using my program will allow me to significantly cut down on the time it takes to produce each frame of animation. Therefore, the tool will be used to streamline my animation process as well as maintain a consistent visual style across the comic and its animations.

In my research, I was interested in exploring the interaction between automated computation and the manual labor of the artist's hand. My tool cannot perfectly replicate a digital painting which is as detailed and precise as I could paint manually. Therefore, when producing my final animations I still need to manually touch up the frames that are rendered by the tool. However, a tool by definition is a means to an end, not the end itself. Therefore, over the course of creating this project, I investigated the extent to which software tools can realize artistic vision.

CAN YOUR SMARTPHONE TOUCH YOU BACK? RENDERING HAPTIC TEXTURES FROM FRICTION ON ANDROID OS

STUDENTS Sara Adkins *BCSA* • Prachi Bodas *Computer Science*

ADVISOR Roberta Klatzky *Psychology*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Despite leaping advances in smartphone and tablet technology in the past decade, the use of haptic feedback in these devices has not yet been implemented on the market. Though it is still in the early stages of development, haptics has the potential to improve the experience of using a smartphone by providing tactile feedback to the user. We worked with one such device that utilizes haptic technology, the Senseng "Feelscreen" developer's kit tablet, in order to investigate human response and sensitivity to various virtual textures. We conducted a series of trials where participants swipe across a small area of the tablet and feel a gradient texture, and are then asked to determine if the texture was increasing or decreasing in intensity as they swiped. Using signal detection, the results of our experiments showed that participants are able to determine the direction of a gradient across a small area with high accuracy. Participants responded best to texture gradients that spanned the lower range of the intensity spectrum, consistent with a Weber fraction for virtual texture perception. These findings support the feasibility of using haptics as a way for users to feel where their fingers are on the screen without looking down, and would be useful in the design of applications such as a swipe typing keyboard.

LUNAR GALA: EXAMINING THE SHOW EXPERIENCE

STUDENT Jessica Shen *BCSA*

ADVISORS Carrie Hagan *BHA* • M. Stephanie Murray *BHA*

ROOM/TIME Wright / 3:20 pm

As multidisciplinary show experiences become more and more popular, it is important to understand how elements come together to form different experiences. For example, a show that focuses on video complementing a performance versus a performance complementing a video. These elements may be exactly the same, but the way each element is executed can create a completely different experience. I will be researching the creation of these multidisciplinary experiences and applying this knowledge to the Carnegie Mellon Fashion show, Lunar Gala. Lunar Gala is a student-run organization at CMU that is invested in cultivating interdisciplinary talent at CMU. In February, student designers, models, dancers, videographers, motion designers, technicians and a creative team bring their skills together to produce a fashion show. As one of the producers, I will be focusing on the creative and technical aspects of the show and the branding, while the other two producers will primarily focus on the fashion lines and training the models and dancers in the show. I will be developing the creative voice and designing the show experience. This involves establishing the branding, print deliverables, and technical set design. Aside from the progress videos and blogs that the organization produces, I will be writing a manual of my experiences and research. This manual will not necessarily be specific to Lunar Gala, but rather uses it as a case study. This project will require research and exploration in the world of fashion as well as set design and other technical opportunities. It will also require a lot of exploration in combining different disciplines to extend the abilities of individual disciplines. The deliverables will be the show itself, the motion graphics, print, copy, magazines and videography that come from the show, as well as a compilation of my experience and past producers' experiences. Unlike a typical fashion show, Lunar Gala focuses on the combination of several different aesthetic fashions, set design, dance, and technical setups to tell a story. It's not just about the articles shown it emphasizes the culmination of these elements. For myself, this is an opportunity to play with the balance of these disciplines on a huge scale to shape what people can experience in a show.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

HUMANITIES & ARTS

[SUPERFLUOUS]: AN EXPLORATION IN INDEPENDENT TELEVISION

STUDENT Emily Clark *BHA*

ADVISORS Sharon Dilworth *English* • Carrie Hagan *BHA*

ROOM/TIME McKenna / 12:40 am

Until recently, television did not have an independent outlet. All television content was dictated by networks and tied entirely to ratings and viewership. This prevented the creators of the medium from taking risks, because they faced real threat of losing their jobs. The web series, a form of small- scale serial or episodic filmmaking employing many of the same narrative methods as television, acts as the long-missing independent piece of the genre. This correlates with a change in television content, which is currently at its artistic height. Has the web series played a role in reinventing the television genre, and can it be looked to as an indicator of what is to come? What role does independent television play in the evolution of the product?

In my project, I will attempt to answer these questions by strategically creating characters and plotlines that are not seen commonly in television. I will attempt to incorporate aspects of one or more topics including race, gender, lgbt, disability, mental illness, and diversity of body types in order to create my world. The final project will take the form of a series of short scripts made for the internet, the preliminary work that goes into filming (storyboards, visual design, location scouting, etc.), and a portion of an episode filmed.

AMERICAN SYMPHONY FINALE?

STUDENT Micah Wallen *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 12:00 pm

My project is a comprehensive research paper and oral presentation on the decline of the American symphony. My research covers the history of symphonies in America, as well as current trends during the last few decades. My research has been centered on two main questions: Why are the symphonies declining? What can we do to stop it? My research includes researching literature, journals, and the opinions of symphony musicians themselves. The point of the project is to find a solution to the problem of the disappearing symphony. It has always been a major part of western culture, and is not something that we should stand back and watch fall apart. America as a whole can benefit from finding a way to maintain this valuable asset to our culture. I hope that my research project provides an answer.

AN EXPLORATION OF SPATIAL PERCEPTION THROUGH OPTICAL ART

STUDENT Liza Otto *BHA*
ADVISORS William Cooper *Architecture* • M. Stephanie Murray *BHA*
ROOM/TIME McKenna / 1:20 pm

How can a two-dimensional image create the perception of a three-dimensional space? Combining theories of Architecture and Psychology, this project is a painted mural that addresses the human body's significance in spatial perception. This cognitive experiment is designed based on various theories of visual perception, centered on the idea of embodied cognition. Embodied cognition is the idea that the mind and body are not as separate as Descartes' mind-body dualism theory suggests. Not only does the mind influence the body, but also the body influences the way the mind operates. The installation is a work of optical art designed through principals of perspective and motion parallax to form an illusion that sustains while the viewer is moving past the piece. In this way, the body is engaged not only visually, but haptically too, supporting the theory of embodied cognition and challenging the idea that illusions of this sort can only succeed from a single view. The mural is painted in the long corridor below the stands of CMU's Gesling Stadium. It is to be experienced permanently by the CMU community and seeks to make an uninspiring space on campus a bit more inspiring.

ANDY WARHOL: ENVIRONMENTALIST

STUDENT Dennis Kosovac *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

Was Andy Warhol an environmentalist? The project examines this under-explored question, covering a span of the artist's life and career. Research is presented in two formats: a screen-printed short essay and a proposal for a hypothetical exhibition on the subject at the Andy Warhol Museum.

BEAUTY SLAP

STUDENT Jacob Berntsen *BHA*
ADVISOR Riccardo Schulz *Music*
ROOM/TIME Peter / 12:20 pm

Beauty Slap is an electro-brass-funk machine hailing from Pittsburgh, Pennsylvania. The thunderously funky screams of a brass quartet (two trumpets, two trombones) are twisted and tweaked by Ableton wizard Jakeisrain into sweltering and beat-driven dance music, the likes of which you have never heard before. Since forming at CMU roughly two years ago, Beauty Slap has enjoyed national attention surrounding their debut EP and northeastern tours. Armed with a powerfully groovy live show and a litany of releases in the near future, the group is poised for complete world domination. It all begins with their first full length album, dropping at the crest of the summer.

BENIS WARS: THE TAIL OF WEENERDOG'S SON

STUDENT Christian Murphy *BHA*
ADVISORS Carrie Hagan *BHA* • M. Stephanie Murray *BHA*
ROOM/TIME Connan / 12-2:30 pm

The story of Weenerdog's Son's dramatic hallucination in his early childhood.

After spending sleeping several nights around toxic chemicals, Weenerdog's Son steps outdoors to get fresh air. In doing so he hallucinates a massive castle- filled with his father's enemies! Imagining that he is wielding his father's sword, a javelin, and a bomb.... Weenerdog's Son sets out to eradicate the soldiers of the castle and finally win his father's approval.

A violent and challenging first person platforming experience in the Unity 3D Engine.

CESARINA AND CHARLES: THE ITALIAN OPERA SINGER AND THE RICH ENGLISHMAN

STUDENT Francesca Begos *BHA*
ADVISOR Kevin Gonzalez *English*
ROOM/TIME McKenna / 1:40 pm

In Cesarina and Charles: The Italian Opera Singer and the Rich Englishman, Cesarina travels to England to perform in the premier of Rinaldo, Handel's first Italian opera written for the British stage. This work of historical fiction follows Cesarina as she navigates dingy England and mingles with the upper classes who were the biggest patrons of Italian opera.

Full-scale Italian opera existed in England from the late 17th century to the mid 18th century, but was supported almost exclusively by England's richest social circles. These circles were associated with stereotypically feminine qualities like vanity and indulgence. Critiques of Italian opera employed these same terms. The historical aspect of this project argues that the gendered critiques of Italian opera masked an underlying resentment of England's most elite circles. The fictional aspect of this project contextualizes that argument in the life of Cesarina, an Italian woman who would have been caught in the midst of this issue. The story uses fiction to contextualize the social circumstances of Handel's operas for modern performers of his work, allowing performers to access this information in a way that aligns with the creativity of their own artistic processes.

DREAM GIRL IN SOCIAL MEDIA

STUDENT Nicole Yoon *BHA*
ADVISOR Martin Prekop *Art*
ROOM/TIME Connan / 3-5 pm

The Manic Pixie Dream Girl is a well known trope in popular culture that brings to light issues and discussions in the disciplines of gender studies and cultural dynamics in contemporary culture. First coined in 2007 by Nathan Rabin in a film critique of the movie Elizabethtown, the term Manic Pixie Dream Girl (MPDG) has since been widely used to describe various contemporary female characters who, as Rabin puts it, "exists solely in the fevered imaginations of sensitive writer-directors to teach broodingly soulful young men to embrace life and its infinite mysteries and adventures." Since the term's creation, there has been much debate over the MPDG and how this fictional character affects the perceptions and lived realities of women who exist off the screen. The MDPG is a very pervasive trope that many women, including myself, both loathe and unconsciously try to strive for. Since Nathan Rabin's first commentary on the MPDG, he has expressed regret in creating the term, wishing to erase or kill her off from "public discourse". Simply stopping all discussion on the MPDG will not quell any sexist beliefs that pervade pop culture, time, and age behavior, and I believe the dialogue should continue in an effort to understand how women place themselves in the world in contemporary society.

Through painting, I wanted to celebrate, indulge, question, and criticize the space women occupy in society and the nuances that make being a woman as wonderful as it is heartbreaking.

My objective was to paint women in surreal spaces where the realities and hyper-realities of the concept of the MPDG conflict and celebrate real women.

Through multiple lenses built upon ideals and expectations based largely on youth, beauty, and certain sets of gender performances that are dependent upon a gender binary I hoped to reveal a more complex understanding of the historical, folkloric, and contemporary female characters that occupy our history and present. I wanted to discuss how our own personal histories feed into, subvert, influence, or counteract our own conscious choices of who we choose and wish to become through the exposure of social media and pop culture in relation to the MPDG.

I often wonder whether these archetypes encourage women to turn themselves into a commodity under the false propaganda that they will then become a more desirable object of happiness and love, misrepresented as gateways to greater happinesses they are excluded from. I wanted to stress that though the MPDG is often a whimsical trope helping young men move forward with their own accomplishments, MPDGs usually do not come to any sort of greater realization of their own.

GENDER AND HANDWRITING: THE DEPTH TO WHICH SOCIAL EXPECTATIONS OF GENDER INFLUENCE PERSONAL EXPRESSION

STUDENT Raquel Caticha *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME McKenna / 4:00 pm

This project looks at 115 people, 115 gender inventories, 230 handwriting samples, and correlations perceptions of gender and gender identity. Researchers collected information about student's actual gender and gender identity in addition to handwriting samples. A different group of participants assessed a group of samples on a scale

of masculinity to femininity. The research resulted in little correlation between gender identity and perceived masculinity/femininity, which was illustrated in an art installation that further explored the disintegrating gender binary.

IN THREE: NORMALIZING THE ASIAN AMERICAN EXPERIENCE THROUGH POETRY

STUDENT Jennifer Huang *BHA*
ADVISORS Jane Bernstein *English* • M. Stephanie Murray *BHA* • Lauren Shapiro *English*
ROOM/TIME McKenna / 12:00 pm

"In Three" is a short collection of poems and collages, which aims to add to the repertoire of works that deal with Asian American identities. Growing up as Taiwanese American, I have always felt as if I never really belonged, floating in a strange place of being neither Taiwanese nor American. In many cases, navigating the world between Eastern and Western cultural differences causes a fragmented identity amongst Asian Americans. Often times, they must choose between fitting in with American culture or keeping true to their parent's heritage and cultural practices. "In Three" is a documentation of my experience of being Taiwanese American. It strives to normalize the fragmented experience felt by many Asian Americans, which is often not represented in film, television, fiction, and other media.

JACK & JILL: A STUDY IN VIDEO GAMES AND GENDER REPRESENTATION

STUDENT Sam Riordan *BHA*
ADVISOR Gerard Klug *Entertainment Technology Center*
ROOM/TIME Pake / 12:20 pm

Video games have long catered to a male audience, leading to very little representation for female and nonbinary characters in gaming. Jack & Jill is my answer to this shortage: a speculative video game proposal featuring an unfeminine girl and a nonbinary character set against a supernatural backdrop.

JOSZA CORNER: A DOCUMENTARY PORTRAIT

STUDENT Jordan Sucher *BHA*
ADVISOR Christopher Sepesy *Point Park University*
ROOM/TIME Connan / 12-2:30 pm

Alexander Bodnar is a refugee of the Hungarian Revolution of 1956 who has made Pittsburgh his home for over fifty years. Alex has run Josza Corner, Pittsburgh's sole Hungarian restaurant, for thirty of those years. This film takes you inside the restaurant for an evening. Food will be served, conversations will flow, and stories will be told. You will leave with a newfound appreciation for Hungarian culture, a curiosity about seemingly abandoned storefronts, and a desire to eat some goulash.

MAKING POSSIBILITIES: MAKER EDUCATION CURRICULAR INTEGRATION

STUDENT Lauren Zito *BHA*

ADVISOR Sharon Carver *Psychology*

ROOM/TIME Connan / 3-5 pm

Making Possibilities : Maker Education Curricular Integration, a Carnegie Mellon University BHA Senior Capstone Project involves the initiation, process, and evaluation of initiating a makerspace. A makerspace is an environment that encourages material and process exploration while fostering collaboration and knowledge learning and sharing. The hope is that through an emphasis on process work rather than the final outcome of a project, a learner will become internally motivated and more naturally curious about the world. Through the integration of my Psychology, Architecture, and Learning Media backgrounds, I was prepared to research precedents and principles, design spatial layout and features, and collaborate with the teachers of the Children's School on Carnegie Mellon University's campus, the site of the project. Throughout the process of this project, I conducted site visits at existing makerspaces, researched Maker Education principles and practices, used 3D design software to preview designing ideas, and worked with a teacher committee to ensure user satisfaction and project longevity. By partaking in this project, I not only challenged myself an artist and researcher, but also added value to the Children's School, an institution that places importance on the education environment.

MARIANNES NOIRES: MOSAÏQUE AFROPÉENNES

STUDENTS Heather Cowie *Art* • Joseph Hill *Drama* • Kaytie Nielsen *BHA*

ADVISOR Mame-Fatou Niang *Modern Languages*

ROOM/TIME McConomy Auditorium / 10:30 am - 12:00 pm

"Mariannes Noires: Mosaïque Afropéennes" is a feature-length film (approx. 80 minutes) that explores Afro-Parisian female identity and experience. In this film, seven Black women born and raised in the Paris area share their personal stories and discuss their perspectives on issues of race and womanhood in the heart of the French Republic, and interrogate the foundations of the French national identity.

This project is a collaboration between Dr. Mame-Fatou Niang, Assistant Professor of French and Francophone Studies, and Kaytie Nielsen, senior BHA Creative Writing and Directing student. Filmed in July 2015, with Joe Hill (Director of Photography) and Heather Cowie (First Assistant Camera), this film is Kaytie Nielsen's Dietrich College Senior Honors Thesis, facilitated by the Dietrich Senior Honors Fellowship.

MINSTRELS: IF DEBUSSY HAD A MARIMBA

STUDENTS Justin Kelly *BHA*

ADVISOR Paul Evans *Music*

ROOM/TIME McConomy Auditorium / 12:30-1:00 pm

Modern percussionists enrolled at music schools face a difficult situation if they want to receive a holistic musical education across many classical genres. Other instruments such as the violin or piano have been around for centuries, and the best composers from many different eras have written for these instruments. Percussion, on the other hand, has only been taken seriously as a musical discipline in the past half-century. This means that many of the household-name composers, such as Mozart, Beethoven, or Debussy, never wrote for solo or chamber-group

percussion. As a result, many percussionists go through their education without ever really performing Classical-era or Romantic-era music, so they never develop the more expressive side of their artistry. I arranged Claude Debussy's piano etude titled "Minstrels" for the marimba, a keyboard percussion instrument. I plan to share this transcription with the broader percussion community, providing percussion students with music that will allow them to develop another dimension of their artistic capabilities.

OPTIMIZATION OF SPACES IN HUNT LIBRARY

STUDENTS Timothy Fitzgerald *BHA* • Dee Dee Paik *Economics* • Daniel Park *Economics and Statistics* • Siqi Yang *Statistics* • Derek Young *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Hunt Library serves as the primary location for Carnegie Mellon students to gather and work on assignments, study for tests, and in some cases, eat, and sleep. As CMU students, we have noticed that Hunt Library suffers from severe overcrowding. The library is often restructured in order to better accommodate student needs, such as the removal of open computers on the first floor in favor of whiteboard rooms. However, there does not appear to be any data supporting the efficacy of these changes.

This study answers the question: "How can we optimize the space in Hunt Library to benefit the needs of students?" Our group sampled individual floors of the library at different times of different days for two weeks and observed how different spaces in the library are utilized. We also observed the activity of library printers. After data collection, we looked for correlations between the variables we observed and noted any spaces significantly different from others in terms of usage. Our findings were summarized into recommendations for a new, more effective layout for each floor of Hunt Library, which takes into account the most common behavior patterns students engage in that were observed during our study. These will serve to better optimize Hunt Library for the needs of students.

PHANTANOIR: AN EXPLORATION OF BLACK FANTASY

STUDENT Jacqueline Barnes *BHA*

ADVISORS M. Stephanie Murray *BHA* • Richard Purcell *English*

ROOM/TIME Connan / 3-5 pm

My graphic novel and animation are based in a world where black characters, black religions, magical practices, and folklore take precedence. However, forcing my work into the categories of either fantasy or black literature didn't feel right; I needed to create a new more encompassing term that I felt my work needed. Thus PhantaNoir was born. PhantaNoir is a word I created to exemplify the ideas of blackness in fantasy, and to give a place for black creators to express ideas like black knights in medieval times, black voodoo, and black magic through a non-stereotypical lens. Creative fields, both written and visual, have a very narrow vision of what makes something a medieval fantasy; there can be dragons, magic, elves(as long as they're a certain hue), witches, and warlocks, but as soon as a black person is involved it becomes an impossibility— an inaccuracy. PhantaNoir takes this hypocrisy to task by creating fantastical worlds that are filled with the aforementioned things, but with a focus on black protagonists and antagonists.

PhantaNoir delves into the population of black fantasy fans, and calls not only for their representation, but for their dominance and voices in a genre that has long ignored, debased, or derided its black fan base. Actually seeing black representation in games, animations, and novels gives blackness the credence of creativity, perseverance, and

magic that it's due. PhantaNoir opens up these fields to the conversation, and gives black children and adults alike their own Hogwarts, their own Middle Earths, and their own Narnias without having to edit the source material to see themselves.

PITT PASS: AN ONLINE RESOURCE FOR PITTSBURGH DIY MUSIC

STUDENT Arun Marsten *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Dowd / 3:40 pm

For my project I am creating an online hub for Pittsburgh's music community. By the end of this project I hope to have a functioning web application with distinct user experiences for bands, venues, and listeners.

After receiving feedback from local musicians, venue managers, and music listeners about interest in using the application, I am in the process of developing a website that allows those three groups to communicate and keep themselves updated on activity within the community.

I hope to improve the quality of the local music community by easing communication between involved parties and making information more readily available. I expect that lower barriers to entry will allow more people to participate in the community, thereby increasing diversity and activity. With more concerts covering a greater variety of genres, the community will hopefully provide a greater source of entertainment for Pittsburgh citizens as well as better opportunities for local musicians.

RECOLLECTION: A RECOVERY OF MEMORY THROUGH ART

STUDENT Asya Borahan *BHA*
ADVISORS Clayton Merrell *Art* • M. Stephanie Murray *BHA*
ROOM/TIME Wright / 11:40 am

Recollection is an ongoing attempt to recover and record memories through oil painting in the hopes that it will serve as a rediscovery of self. By combining what has been kept preserved in memory throughout the years with the more solid nature of a canvas, this project aims to encourage personal growth through the exploration of the past, and record of daily moments of introspection.

SANCTUM

STUDENT Madalyn Gryger *BHA*
ADVISORS Brittany Denigris *Art* • M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

Sanctum is a collection of 10 wearables that aims to embody some of the aspects of living with mental illness. This line explores the internal and external challenges that people who live with mental illness face as they navigate the difficulties of both the exterior world, and the one inside their head. Research in abnormal psychology, fashion design, and the history of mental illness and art contribute to the conceptual and physical formation of the designs. An emphasis is placed on depression and anxiety in the work because they are the most prevalent and accessible disorders, but inspiration is drawn from many aspects of mental illness and inform both formal and conceptual aspects of the collection. Sanctum is a place to feel safe.

STUDY OF DIETRICH COLLEGE GENERAL EDUCATION SATISFACTION

STUDENTS Kemal Dincer *Economics* • Philip Dominici *Statistics* • Aisha Han *BHA* • Leshaun Jones *Statistics* • Sean Yang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Dietrich college students often have mixed feelings about the interdisciplinary mantra inherent to majoring in the humanities and social sciences, and Dietrich College faculty and staff have recently shown interest in reforming the General Education program based more on their students' needs and educational ambitions. It is possible that students desire more from their classes than major-specific topics, or that they want a variety of classes in different topics that yield skills they might apply in their field of work and everyday lives (through hobbies and other commitments).

In order to observe students' opinions on various general education requirements, we surveyed: overall satisfaction towards each GenEd category, what classes students are actually taking, what classes they want to take, and how these opinions change with class year/major departments. Our survey utilized both rating-based and open-ended questions that help characterize student satisfaction and explain their feelings behind the responses. We implemented an aggregate scoring system to ultimately quantify students' opinions. Overall, Carnegie Mellon students like to know that their schoolwork is meaningful. Our results aim to improve a general education program meant to both cater to Dietrich students' specific needs and take them out of their comfort zones.

TECHNOLOGY USE IN STUDENT AFFAIRS

STUDENT Aamer Rakla *BHA*

ADVISORS Carrie Hagan *BHA* • Larry Heimann *Information Systems* • Bryan Koval *Student Affairs* • M. Stephanie Murray *BHA*

ROOM/TIME Dowd / 1:40 pm

The Student Affairs staff and particularly the Residential Life staff play a key role in a student's time at university, whether they realize it or not. There are many processes and systems in place to help the staff do their jobs. However, in many places, especially Student Life, they are lacking and inefficient. Why has the Student Affairs field, specifically Residential Life staff, not started using an electronic system to improve the life for students, reduce paperwork and increase efficiency for the staff? This project aims to provide an answer for this question in the form of a report and a potential system to address this gap. The system will be comprised of two parts, an optimized Residential Life workflow and an electronic information system, effectively digitizing and tweaking the proposed workflow. After I look into what's currently available, look into research already completed, and talk to professionals on campus and at other institutions, I will use the information to compile the report and create an optimized workflow for Residential Life staff.

Then I will use an existing web application framework to create the electronic system. The significance of this project is two-fold, it brings together two seemingly unrelated fields to enhance residential life. The fields brought together are Theatre Production Management and Information Systems. The theatre side of the project is really understanding how to communicate with different people and balancing a lot of different parts of the project happening at the same time. The information systems side of the field is understanding what somebody needs without them explicitly saying it and then developing an electronic information system with the information. The

Residential Life aspect of this project is very significant because it is an important field that plays a key role in a student's personal growth when done correctly, but is currently a field bogged down by a lot of paperwork and bureaucracy that could be optimized with the proper system in place.

THE PROVISO: UNDERSTANDING DYSTOPIAN DUALITIES AND HOW THEY CAN BE USED TO CHALLENGE OUR CURRENT DECISIONS AND PERSPECTIVES

STUDENT Danielle Lehmann *BHA*
ADVISORS M. Stephanie Murray *BHA* • Anjali Sachdeva *English*
ROOM/TIME Dowd / 12:20 pm

A dystopia is an extreme sense of place. Distilled to the basics, a dystopia is an imagined place where everything is bad. How do we define 'bad?' How do we determine who gets to call a society 'bad?' And how much non-reality has to go into the setting for it to be considered 'imagined?' Depending on how we answer these questions the term 'dystopia' can be used for a wide range of places and experiences. We often read dystopian novels from the vantage point of a citizen who is abused by a non-democratic government, but I think there is more to a society, especially a 'dystopian' society, than one perspective and opinion on the world. We can explore dystopias beyond highlighting innovative technology and fighting against oppressive regimes.

I have researched dystopian novels and short stories in order to understand the definition of a dystopia and where the term may be flexible in order to expand on the basic groundwork of the definition. From this research I have focused on place and character in order to produce a novella. The setting, the dystopia, is a world with today's issues and challenges exaggerated to explore the consequences of our actions. Each chapter takes you into a new character's eyes to better understand the place, their perspective, and their voice. To do this, each character is faced with an important moral decision that is influenced by the setting and the character's values. The moral challenge is important because not everything can be defined as 'good' or 'bad' as featured in many dystopian stories. By expanding the general definition of a dystopia to explore issues, perspective, and morality I hope to expand on the typical convention of a dystopia and bring our current societal and worldly challenges into the spotlight.

THE SHORT-TERM EFFECTS OF MUSIC ON ADDICTED SMOKERS' SENSATIONS OF CRAVING

STUDENT Gabriel Shoglow-Rubenstein *BHA*
ADVISOR Kasey Creswell *Psychology*
ROOM/TIME Wright / 4:00 pm

Music's ability to influence both psychological and physiological states has been well documented; the effect of music on one's internal emotions, mood, physical-well being, and stress levels is significant. Music has been found to reduce stress levels, lower blood pressure, improve concentration, and encourage a more optimistic state of mind. It can also induce specific emotional states or moods. In smoking addiction, craving reduction is considered a key factor in preventing relapse and combating the external anxiety-related triggers that lead to maladaptive behavioral tendencies. Though music, in some form, is already used in approximately 15% of addiction-related

interventions, the exact relationship between music and maladaptive behaviors associated with addiction is unclear. Within the literature there exists a gap regarding empirical evidence that music has a direct effect on the behavioral characteristics of addiction. This project examines a potential role for music in reducing craving sensations, and avoiding, detrimental behaviors.

THE ZAHRA CENTER: A PLAY. SHARING MUSLIM NARRATIVES THROUGH PERFORMANCE IN ORDER TO PROMOTE ACTION AROUND SENSITIVE TOPICS AND TO COUNTER SYMBOLIC ANNIHILATION OF ISLAM AND MUSLIMS

STUDENT Iman Mazloum *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Pake / 4:00 pm

The Zahra Center, a play based on the novel Surviving Zahra by Fatima Aly Jaffer, is a necessary piece of work and performance to work towards fostering discussions on sensitive issues of domestic abuse and sexual violence, to involve Muslims in the creative mediums of theater, and finally to combat symbolic annihilation, which is the phenomenon of misrepresentation in media, through sharing new Muslim narratives. Over time, The Zahra Center hopes to be a gateway play that Muslim communities could take on in order to dispel the culture of silence within our communities about domestic abuse and sexual assault. This is also a story that was created to be shared with others who are not familiar with Islam and Muslims, as the play shows struggles that are faced by humans regardless of age, gender, sex, religion, or race, making the content a relatable piece to any audience. In conclusion, The Zahra Center is a product of attempting to meet needs of cross cultural communications and a Muslim narrative in the performing arts.

TRANSPARENCY IS ENOUGH

STUDENT Jenna Houston *BHA*
ADVISOR Martin Prekop *Art*
ROOM/TIME Connan / 12-2:30 pm

Transparency is Enough was a photographical installation shown in the Ellis Gallery at Carnegie Mellon University in February 2016. The photographs look at the environment of eye care and general healthcare in Chennai, India juxtaposed with the people's daily lives. The show subtly addresses issues of misrepresentation in media while providing a look into more accurate depictions of the city.

WAS HANDEL TOO SEXY OR TOO RICH? AN ANALYSIS OF ENGLISH ATTITUDES TOWARDS ITALIAN OPERA.

STUDENT Francesca Begos *BHA*
ADVISOR Kristina Straub *English*
ROOM/TIME Pake / 3:40 pm

George Frideric Handel was successful in England. He worked there from 1710 until his death in 1759 composing oratorios and Italian opera. He was a favorite in the courts of all the monarchs who reigned during his time in England - this was impressive considering the monarchs all hated one another.

And yet his career was plagued by rampant criticism. Primary texts reveal that everyone who was not a member of the elite upper classes - and even some who were - resented Italian opera. Their criticisms tended to be gendered: focused on the frivolous sexuality they perceived in Italian opera, especially in figures like castrati. It was also popular to criticize the upper classes by associating them with stereotypically feminine qualities like vanity and indulgence. Criticisms of Italian opera mirrored criticisms of high society, and members of high society were the primary supporters of Italian opera. By following the trajectory of Handel's career, through its pitfalls and triumphs, this paper argues that gendered criticisms of Italian opera masked resentment for the extravagances of the upper classes.

YOUTH AND MUSIC

STUDENT Timothy Fitzgerald *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Pake / 11:40 am

Findings regarding the effectiveness of after school programs as well as my work introducing a local after school series utilizing skills learned in the undergraduate Music Technology program.

BIOLOGY AND PSYCHOLOGY

I WANNA HOLD YOUR HAND: CAN TOUCH BUFFER GOTTMAN'S FOUR HORSEMEN OF THE APOCALYPSE IN RELATIONSHIP CONFLICT?

STUDENT Lucy Shen *Biology and Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Wright / 2:00 pm

Our study primarily investigated the role of touch to buffer portrayals of the Four Horsemen of the Apocalypse (criticism, contempt, defensiveness and stonewalling) during relationship conflict in romantic couples. We also investigated whether touch amplifies positive behaviors during conflict discussions. It was predicted that couples who held hands would both (1) engage in less of the Four Horsemen behavior patterns and (2) demonstrate more positive behaviors than couples who did not hold hands.

Method: Dyads were randomly assigned to either a partner-touch or an object-touch condition while discussing a mutually rated relationship conflict. Those assigned to the partner-touch condition were requested to hold hands during the discussion, while couples in the object-touch condition were instructed to hold onto weights.

Results: Results indicate that our prediction of touch to buffer the Four Horsemen was in the expected direction, although the effects did not reach statistical significance. Our second hypothesis was supported, where couples assigned to hold hands significantly displayed more positive affect behaviors than couples who did not hold hands.

Discussion: Our finding that hand-holding amplifies positive behaviors during conflict yields strong reason to further investigate the potential benefits of touch on relationship quality. Since our sample primarily consisted of highly satisfied dating couples, future research should investigate the role of touch to buffer the Four Horsemen in married couples who would likely face more severe relationship conflicts than dating undergraduate couples.

TAKE MY HAND, WE'LL MAKE IT I SWEAR: EFFECTS OF AFFECTIONATE TOUCH ON RELATIONAL PERCEPTIONS AFTER CONFLICT

STUDENTS Amelia Clark *Psychology* • Lucy Shen *Biology and Psychology* • Delancey Wu *Science and Humanities Scholars*

ADVISOR Brooke Feeney *Psychology*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Our study examines how interpersonal touch between couple members will affect relational perceptions during and after a conflict. The relational perceptions we will consider are positive perceptions of one's partner, positive perceptions of the relationship as a whole, and optimism that the disagreement will be resolved afterwards. Romantic couples will be recruited through the psychology department participant pool, the paid participant pool, and the local Pittsburgh community. Participants be randomly assigned to hold hands or to hold a neutral object (no touch) before and during a conflict discussion. We hypothesize that couples in the touch condition will have more positive relational perceptions than couples who are in the no touch condition. The implication of this study is that touch can be a strategy to buffer against stress and increase relationship satisfaction that everyone will be able to do.

SCIENCE & ARTS

A SMALL LEAP: PLACING THEATER AT THE CENTER OF SCIENCE OUTREACH

STUDENT Lina Pulgarin-Duque *BSA*

ADVISORS Carrie Hagan *BHA* • M. Stephanie Murray *BHA*

ROOM/TIME McKenna / 1:00 pm

"A Small Leap" is a science outreach program for local students that uses theater as its medium. "A Small Leap" is exploring the intersection between physics and dramaturgy. Through the program I hope to demonstrate the place that theater can carve out for itself in the STEAM (Science, Technology, Engineering, Arts, Math) movement. I will also show how STEAM has the potential to diversify science by providing a friendly and creative place for scientific

exploration. In collaboration with Attack Theatre and their existing education program, I acted as a curator of found scientific sources as well as a coordinator for the workshops. In addition to the workshops I wrote a series of guidelines for university educators on how they can perform outreach to the communities they are a part of.

BIOLOGICAL SERIALISM: A COMPOSITIONAL TECHNIQUE MAKING MUSIC FROM STEM CELLS AND ELUCIDATING THE BIAS IN CLINICAL RESEARCH

STUDENT Diego Schaps *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 1:00 pm

The project seeks to make a commentary on the bias inherent to clinical research. This is accomplished by applying three different compositional techniques to the same set of data in order to produce three different songs. The compositional techniques are meant to symbolize the bias that a scientist may bring to their data and the set of data is meant to symbolize the data that the scientists are analyzing. The final songs are meant aurally display the different conclusions a scientist might come to depending on his bias.

SUBSIST "LIVE": A STUDY IN TRANSLATING ELECTRONIC COMPOSITION TO ENSEMBLE PERFORMANCE

STUDENT Erik Fredriksen *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Wright / 4:20 pm

This capstone project, entitled "Subsist "Live": A Study in Translating Electronic Composition into Ensemble Performance", will attempt to produce two works through composing electronic music, where electronic music is music primarily composed for synthesizers and digitally created or manipulated sounds.

A performance consisting of newly composed electronic music with a small ensemble of musicians.A score of the songs, or a written reference that describes in detail the notes performed on each instrument, such that other musicians could perform the works accurately without hearing a reference recording or additional direction from the composer.

Composition will focus on a distinct set of electronic instruments and software. As many modern electronic instruments do not standard systems of notation, new systems of notation will be created when necessary and detailed in a document attached to the score. Composition will also focus on creating a performable work, benefitting from the participation of the ensemble. As a BSA student with concentrations with Mathematics and Music Technology, knowledge of mathematical systems will be used to design an efficient system of notation, and knowledge of Music Technology will be used to interact with the software and equipment necessary to compose and perform electronic music.

DIETRICH COLLEGE OF HUMANITIES & SOCIAL SCIENCES

ECONOMICS

A SURVEY OF PRICES AT ENTROPY VS. LOCAL STORES

STUDENTS Charles Gauthey *Statistics* • Jun Yong Go *Statistics* • Michael Hsun *Economics* • Dominic Liu *Business Administration*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

College campus convenience stores are perceived as being overpriced, due to their proximity and the fact that most of them accept the university's internal currency, resulting in a small monopoly. The objective of this study is to determine whether or not this is true by comparing the prices of a representative sample of goods at Carnegie Mellon University's campus convenience store, Entropy, to the prices at local chain convenience stores. While it is difficult to generalize this to other university campuses, this is still a feasible study for the students and other affiliates of CMU.

Data will be collected by systematic sampling of items at Entropy and stratified sampling of local convenience and grocery stores by brand within a two-mile radius, then sampling the same items from Entropy at these stores. After obtaining the prices of the goods at each store, data analysis will be done to determine overall pricing, price structure of specific categories of goods, and price differences among the stores. Quantifying the differences will give us empirical evidence to determine whether or not prices at Entropy are higher relative to other convenience stores and will potentially influence purchasing habits by consumers or the prices set by Entropy.

BUS RELIABILITY FOR CMU

STUDENTS Riddhi Adhikari *Economics* • Srishti Jain *Statistics* • Leon Ji *Business Administration* • Eric Li *Statistics* • Joshua Ragen *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In our project, we researched the relative reliability of various mobile applications in comparison to the static schedule of a few select Port Authority buses. We chose this research topic because we want to help Carnegie Mellon students make better informed decisions about their travel choices. Although there has been research on the timeliness of Pittsburgh buses before, there is a new GPS tracking system enacted in 2014 that has allowed apps like the Port Authority Transit app and the Google Maps app to track buses in real time that has not been thoroughly researched yet. We focused on bus stops and bus lines especially relevant to CMU students. We picked four bus stops that we waited for hour long blocks each to watch the timeliness of 71 and 61 line buses. We want to use our findings to make a recommendation to CMU administration to either more strongly recommend the apps or schedule to students or to focus more on alternative modes of transportation as they become available.

EVALUATING CONNECTEDNESS OF COLLEGE OF FINE ARTS STUDENTS

STUDENTS Yunwen Cai *Mathematics* • Matthew De Jesus *Economics* • Kathleen Fuh *Computer Science* • Shaan Phagura *Statistics* • Vinay Viswanathan *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

CMU is divided into individual colleges, and students often, but not always, take the bulk of their coursework within the college they belong to. We want to study CFA's connectedness to other colleges because it has specialized constituent schools (not just departments), each with their own academic requirements. Our study is part of a broader discussion of whether students from different schools are too separated. To our knowledge there are no current research studies regarding this topic.

To solve the problem we conducted an email survey on CFA students, by sending out survey links to all CFA students. We did subgroup analysis on the schools within CFA and class year. We modeled the subgroups using generalized linear models, and we compared parameters across groups.

Our results could reveal CFA students attitudes of connectedness to the campus life, and which factors have the most influence on how CFA students interact with non-CFA students. This could shape future programming and initiatives made by student government, or CMU and CFA administration to promote greater cohesion among schools.

FOR SALE @ CMU CUSTOMER SATISFACTION SURVEY

STUDENTS Richard Chiang *Mathematics* • Ken MacMann *Statistics* • Michael McCaffrey *Economics and Statistics* • Shieri Suzuka *Economics*

Margaret Tung *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We surveyed members of the Facebook group "For Sale @ CMU" about their experience using the group. With over 6,000 members and growing, many CMU students utilize this group to buy and sell various items with one another. However, because this is an unregulated online platform, there is little information about this emerging market.

To conduct this survey, we acquired a list of individual members from the "For Sale @ CMU" Facebook group. Using this list, we randomly selected 2,700 members to participate in the surveys we sent out via Facebook messages. We conducted this survey to understand the overall satisfaction of using the group, to get feedback on the communications between buyers and sellers, and to see if there is any way to improve the experience of buying and selling within CMU students using this group.

GOOGLE'S ANTITRUST LAWSUITS IN THE EU: USING MICROSOFT'S PAST TO PREDICT GOOGLE'S FUTURE

STUDENT David Moss *Economics*
ADVISOR Joachim Groeger *Economics*
ROOM/TIME Peter / 3:00 pm

Google currently faces two antitrust lawsuits brought forth by the European Commission, targeting practices for their search product and phone operating system, Android. By looking at historical precedents set by a similar antitrust lawsuit against Microsoft twenty years ago, and building a framework from the justification behind Microsoft's conviction, this paper will attempt to predict the outcome of Google's two lawsuits.

IDENTIFYING CLUSTERS IN THE DRACO DWARF

STUDENT David Hua *Economics*
ADVISOR Peter Freeman *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The Draco Dwarf is a small dwarf galaxy outside the Milky Way. Dwarf galaxies are composed mostly of dark matter-- which make them an enticing target for astronomers. In this project, we attempt to cluster stars in the Draco Dwarf using clustering techniques.

MCDONALD'S VS. CHIPOTLE: THE RISE OF FAST CASUAL RESTAURANTS (A COMPARISON OF THE NET RATES OF ENTRY FOR MCDONALD'S & CHIPOTLE)

STUDENTS Charlton Cheng *Economics* • Michael Hsun *Economics* • Michelle Ong *Economics*
ADVISOR Karam Kang *Economics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Fast food restaurants like McDonald's are no stranger to Americans and are often seen as a quick meal option despite the lack of quality. However, in recent times, there has been a shift in consumers' dining patterns to a new genre of quick-meal restaurants, that is, fast casual restaurants. Restaurants like Chipotle, Subway, Panera offer healthier food options which are gaining much appeal and market share. In our study, we compare the factors that affect the market entries for fast food and fast casual restaurants like McDonald's and Chipotle respectively. Our results show that the net entry of McDonald's positively correlates with obesity rates while the net entry of Chipotle negative correlates with obesity rates. Additionally, both types of restaurants also have significant correlations with other demographic as well as health indicator variables like median age, median income, percentage of uninsured people and percentage of children in poverty.

OPTIMIZATION OF SPACES IN HUNT LIBRARY

STUDENTS Timothy Fitzgerald *BHA* • Dee Dee Paik *Economics* • Daniel Park *Economics and Statistics* • Siqi Yang *Statistics* • Derek Young *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Hunt Library serves as the primary location for Carnegie Mellon students to gather and work on assignments, study for tests, and in some cases, eat, and sleep. As CMU students, we have noticed that Hunt Library suffers from severe overcrowding. The library is often restructured in order to better accommodate student needs, such as the removal of open computers on the first floor in favor of whiteboard rooms. However, there does not appear to be any data supporting the efficacy of these changes.

This study answers the question: "How can we optimize the space in Hunt Library to benefit the needs of students?" Our group sampled individual floors of the library at different times of different days for two weeks and observed how different spaces in the library are utilized. We also observed the activity of library printers. After data collection, we looked for correlations between the variables we observed and noted any spaces significantly different from others in terms of usage. Our findings were summarized into recommendations for a new, more effective layout for each floor of Hunt Library, which takes into account the most common behavior patterns students engage in that were observed during our study. These will serve to better optimize Hunt Library for the needs of students.

PORT AUTHORITY BUS RELIABILITY ACROSS PITTSBURGH NEIGHBORHOODS

STUDENTS Meghna Baskar *Economics* • Kiersten Chuc *Statistics* • Suvrath Penmetcha *Information Systems* • Rohit Srungavarapu *Business Administration* • Skye Toor *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:31 am

The purpose of our study is to observe how often Pittsburgh PAT buses actually arrive (i.e. their frequencies), compared to their expected frequencies as stated in official PAT schedules. Buses are notorious for deviating from the official PAT bus frequencies. Pittsburgh residents frequently voice their displeasure with the untimeliness of PAT buses and this study will provide statistically sound evidence to suggest whether or not PAT buses abide by their stated frequencies.

Our study focuses on six neighborhoods closest to CMU. We stratified our sample across neighborhoods and time of day. Our sample was taken from a list of all Pittsburgh bus stops and we selected stops within our neighborhoods of interest. We then randomly assigned the sampled bus stops a time of day, and record bus frequencies in-person at each stop. Our analysis includes a hypothesis test, where our null is there is stated as "no difference between the actual and stated frequencies".

Our results provide empirical evidence for the differences between the actual frequencies and the theoretical frequencies. This information is invaluable for PAT, specifically how they can better optimize their bus usage across neighborhoods, and can start the conversation about possibilities to improve bus arrival times.

PROFESSOR EXPERIENCE AT CMU

STUDENTS Tyler Barnett *Business Administration* • Blaine Cole *Economics and Statistics* • Alexandra Falk *Biological Sciences* • Benjamin Winebrake *Economics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Our project investigates the unique experiences of professors at Carnegie Mellon and analyzes the data to potentially identify gaps as well as provide useful career advice to aspiring professors. Our motivation for this project was to characterize the colleges within Carnegie Mellon based on the varying backgrounds of their respective professors. To conduct this survey, we took a census of the resumes of professors that are currently on campus in Pittsburgh. To implement the survey, we examined curricula vitae from a list of professors sampled using a stratified random sampling scheme. We stratified our sample by department, so each professor within a department had an equal chance of being selected, and each department was accurately represented. This survey will allow Carnegie Mellon to have a better profile of its professors, provide an opportunity for administration to improve its hiring process. By comparing our survey with FCE's and other sources, we could make possible connections in our analysis to better assess instructor performance. All in all, we are confident that the results of our project would be of interest to students and faculty across America.

STUDY OF DIETRICH COLLEGE GENERAL EDUCATION SATISFACTION

STUDENTS Kemal Dincer *Economics* • Philip Dominici *Statistics* • Aisha Han *BHA* • Leshaun Jones *Statistics* • Sean Yang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Dietrich college students often have mixed feelings about the interdisciplinary mantra inherent to majoring in the humanities and social sciences, and Dietrich College faculty and staff have recently shown interest in reforming the General Education program based more on their students' needs and educational ambitions. It is possible that students desire more from their classes than major-specific topics, or that they want a variety of classes in different topics that yield skills they might apply in their field of work and everyday lives (through hobbies and other commitments).

In order to observe students' opinions on various general education requirements, we surveyed: overall satisfaction towards each GenEd category, what classes students are actually taking, what classes they want to take, and how these opinions change with class year/major departments. Our survey utilized both rating-based and open-ended questions that help characterize student satisfaction and explain their feelings behind the responses. We implemented an aggregate scoring system to ultimately quantify students' opinions. Overall, Carnegie Mellon students like to know that their schoolwork is meaningful. Our results aim to improve a general education program meant to both cater to Dietrich students' specific needs and take them out of their comfort zones.

THE EFFECT OF SOCIAL PREFERENCES ON SURVEY PARTICIPATION AND PEER RECRUITMENT

STUDENT Xiyu Wang *Economics*

ADVISOR Alexander Davis *Engineering and Public Policy*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

We plan to investigate the effectiveness of incentives for peer recruitment based on theories of social preferences. We will do this by implementing different incentive structures in a survey of the participants of the Summer Center for Climate, Energy, and Environmental Decision-Making (SUCCEED) and the Summer Engineering Experience for Girls (SEE), summer programs for young women, high school students, and teachers hosted by the Engineering and Public Policy department at Carnegie Mellon. Participants will be given a mail or online survey and will be asked to recruit a friend that they consider most similar to themselves to also take the survey. We will change the incentive structure that this participant and their friend are offered to determine which incentive structure leads to the greatest participation rates, while also testing theories of social preferences.

ECONOMICS AND STATISTICS

ANALYSIS OF CLASSROOM MAINTENANCE

STUDENTS Christopher Kim *Economics and Statistics* • Dorsa Massihpour *Statistics* • Harsimran Minhas *Business Administration* • Victor Vega-Gonzalez *Statistics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

College students spend much of their time in the classroom and studies have shown that classroom environments can change how students learn. Students' experiences in classrooms also shape the way they view their university. Classroom maintenance and it's effect on students' overall experience is important, which is why we were interested in surveying the current conditions of undergraduate classrooms at CMU. We have done so by observing classrooms based on different variables such as temperature, cleanliness, technology, etc. By observing discrepancies within classrooms of different sizes and different colleges, we hoped to understand variations between students' college experiences.

We initially observed classrooms and revisited these classrooms two weeks later to see if any improvements had been made. By surveying all 86 of the undergraduate classrooms twice (morning and afternoon), we limited sampling error. We then analyzed the data and saw if there were any trends between buildings, departments who use the classrooms, class size, etc. Using our results, the CMU administration can see discrepancies in the maintenance of classrooms, the standard of their average classroom, and if they need to make improvements.

ANALYZING THE CORRELATION STRUCTURE OF THE V1 CORTEX LFP

STUDENTS Yitian Feng *Economics and Statistics* • Yifan Leng *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

We studied electrical measurements taken from a 10 by 10 array of electrodes implanted in the V1 cortex of a monkey. We focused our analysis on the Local Field Potential (LFP), a low-frequency signal summing the activity of the neurons near each electrode. We examined the correlation structure of the LFP signals across the array of electrodes, and studied its variation with different visual stimuli.

DO WOMEN HAVE A SAY? : EXPLAINING VARIATION IN FEMALE PARTICIPATION IN HOUSEHOLD DECISION-MAKING

STUDENT Richa Mohan *Economics and Statistics*

ADVISORS Laurence Ales *Economics* • Mark Patterson *Social & Decision Sciences*

ROOM/TIME Peter / 3:20 pm

We analyze a select set of demographic features which influence women's power in household decision-making in rural India. Estimates of causal factors are generated using a large-scale, 7-year panel dataset, composed of over 1500 households from eight Indian states. We create a novel composite measure of gender-wise division of household decision making power, reflecting the extent to which women contribute to choices regarding children, contraceptives, healthcare, and investment. We examine variation in decision making power across a wide range of social and economic variables, including education, age, caste, and family wealth.

FOR SALE @ CMU CUSTOMER SATISFACTION SURVEY

STUDENTS Richard Chiang *Mathematics* • Ken MacMann *Statistics* • Michael McCaffrey *Economics and Statistics* • Shieri Suzuka *Economics* • Margaret Tung *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We surveyed members of the Facebook group "For Sale @ CMU" about their experience using the group. With over 6,000 members and growing, many CMU students utilize this group to buy and sell various items with one another. However, because this is an unregulated online platform, there is little information about this emerging market.

To conduct this survey, we acquired a list of individual members from the "For Sale @ CMU" Facebook group. Using this list, we randomly selected 2,700 members to participate in the surveys we sent out via Facebook messages. We conducted this survey to understand the overall satisfaction of using the group, to get feedback on the communications between buyers and sellers, and to see if there is any way to improve the experience of buying and selling within CMU students using this group.

INDEPENDENT STUDY ON STARS AND GALAXY

STUDENT Yan Zhao *Economics and Statistics*

ADVISOR Peter Freeman *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

In the project, I use several statistical classifiers to distinguish stars from galaxies, and also redshift failure from success.

INVESTIGATING THE GENDER DIVIDE IN INFORMAL SECTORS

STUDENT Anwesha Patnaik *Economics and Statistics*

ADVISOR Laurence Ales *Economics*

ROOM/TIME Peter / 4:40 pm

It is no secret that while many emerging economies around the world have growing gross domestic products and productivity levels among other factors, the informal economies in emerging markets have also strengthened in size and power. My project studies economic and socioeconomic patterns for informal sectors to understand possible gender differences and the motivation behind women in the informal workforce. Additionally, it also focuses on factors associated with unregulated firms to investigate whether women and other enterprise attributes such as job sector, year, revenue and number of employees have an effect on informal businesses.

MARRIAGE EXPECTATIONS SURVEY

STUDENTS Lilia Bidzyan *Economics and Statistics* • Chun Yen Chang *Computer Science* • Lue Fang *Statistics* • Mark Moskwa *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

We conducted a survey of marriage expectations for CMU undergraduate students, as we anticipated our research would help the CMU community as a whole attain a valuable understanding of CMU undergraduate students' attitudes toward marriage. Specifically, this will be with respect to demographic information, the decision of whether or not to pursue marriage, and insight into whether future academic career and academic plans influence these attitudes. While the CMU undergraduate population is inarguably unique in nature and divergent from the young adult population nationally, we anticipate our findings will help us compose a more informed opinion. We designed a survey containing demographic questions, questions regarding attitude towards marriage and expected age of marriage, and questions related to the rationales behind these reported expectations. We collected data from randomly selected CMU undergraduate students and compared the responses we obtained across different majors, sexes, class years, etc. in order to determine the whether there is a relationship between the preceding factors and expected age of marriage.

OPTIMIZATION OF SPACES IN HUNT LIBRARY

STUDENTS Timothy Fitzgerald *BHA* • Dee Dee Paik *Economics* • Daniel Park *Economics and Statistics* • Siqi Yang *Statistics* • Derek Young *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Hunt Library serves as the primary location for Carnegie Mellon students to gather and work on assignments, study for tests, and in some cases, eat, and sleep. As CMU students, we have noticed that Hunt Library suffers from severe overcrowding. The library is often restructured in order to better accommodate student needs, such as the removal of open computers on the first floor in favor of whiteboard rooms. However, there does not appear to be any data supporting the efficacy of these changes.

This study answers the question: "How can we optimize the space in Hunt Library to benefit the needs of students?" Our group sampled individual floors of the library at different times of different days for two weeks and observed how different spaces in the library are utilized. We also observed the activity of library printers. After data collection, we looked for correlations between the variables we observed and noted any spaces significantly different from others in terms of usage. Our findings were summarized into recommendations for a new, more effective layout for each floor of Hunt Library, which takes into account the most common behavior patterns students engage in that were observed during our study. These will serve to better optimize Hunt Library for the needs of students.

PROFESSOR EXPERIENCE AT CMU

STUDENTS Tyler Barnett *Business Administration* • Blaine Cole *Economics and Statistics* • Alexandra Falk *Biological Sciences* • Benjamin Winebrake *Economics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Our project investigates the unique experiences of professors at Carnegie Mellon and analyzes the data to potentially identify gaps as well as provide useful career advice to aspiring professors. Our motivation for this project was to characterize the colleges within Carnegie Mellon based on the varying backgrounds of their respective professors. To conduct this survey, we took a census of the resumes of professors that are currently on campus in Pittsburgh. To implement the survey, we examined curricula vitae from a list of professors sampled using a stratified random sampling scheme. We stratified our sample by department, so each professor within a department had an equal chance of being selected, and each department was accurately represented. This survey will allow Carnegie Mellon to have a better profile of its professors, provide an opportunity for administration to improve its hiring process. By comparing our survey with FCE's and other sources, we could make possible connections in our analysis to better assess instructor performance. All in all, we are confident that the results of our project would be of interest to students and faculty across America.

THE CMU BUBBLE

STUDENTS Zachary Cree *Statistics* • Noshin Nova *Statistics* • Mariana Robelo *Economics and Statistics* • James Yang *Computer Science* • Xiaofan Zhu *Mathematics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Carnegie Mellon is known for its rigorous coursework, but knowledge of current national and world events is also an important part of education and preparing students to become a part of society. Carnegie Mellon students are often deeply absorbed in their work so we found out how well informed they are and investigated how students can become more informed about current events.

We focused on comparing performance on a current events quiz between freshmen in different demographic groups and different majors at CMU. We conducted a stratified random sample across freshman dormitories and knocked on doors to ask selected students to take our current events quiz. We recorded their major and demographic information about the students, news sources that students used and the amount of time they spent reading the news. We then analyzed whether demographic factors, specific majors, or news sources correlated with performance on the quiz. We predicted that this investigation would reveal commonalities between groups that perform well and could lead to insight into ways to keep students well informed. Perhaps this could motivate future research to help provide easier access to news.

THE CURRENCY OF COMMUNICATION

STUDENT Yitian Feng *Economics and Statistics*

ADVISOR George Loewenstein *Social & Decision Sciences*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Why do people get so upset in the absence of a thank-you or the absence of an apology? Why do bragging and blaming draw so much resentment? The presence or lack of these messages can be a source of great conflict, and has implications for many domains, including enhancing motivation in the workplace (Grant and Gino, 2010), preventing poor customer satisfaction ratings (Abeler et al., 2009), and lowering settlement amounts in malpractice lawsuits (Ho and Liu, 2011). In this experiment, we examine whether the presence or absence of thanking between team members can affect the willingness of team members to work on projects together in the future. We recruited 164 individuals from Amazon's Mechanical Turk online work force to complete a two-part online study. The first stage involved working on a task as part of a two-person team, and the second stage involved sending a message to one's partner. Results suggest that — even when both people are anonymous and it has no impact on the monetary outcome — not thanking another person in the team for their contribution can cause negative feelings toward the non-thanker and reduce the willingness to work with the non-thanker in the future.

THE STATISTICS BEHIND CMU STEREOTYPES

STUDENTS Kruti Koppolu *Statistics* • Andrew Manka *Statistics* • Pooja Penninti *Self-defined* • Elan Rosenfeld *Computer Science* • Yoona Seon *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Stereotypes about specific colleges at Carnegie Mellon are widespread and can be damaging to students' abilities to cooperate, both in and out of the classroom. In particular, stereotypes about the Tepper School of Business, the College of Fine Arts, and the School of Computer Science are reiterated each year, ensuring that these opinions influence CMU undergraduates' attitudes towards each other. Using stratified random sampling on colleges, our group collected data through a Qualtrics survey about just how commonly (and how strongly) believed these oft-cited stereotypes are, and by whom they are held. We did a general exploratory analysis of our results and fit a linear regression model to the data in an attempt to measure what factors have a significant effect on a student's view of his or her peers. For example, does actually getting to know students of a particular college help to dispel or reinforce these stereotypes? With this information we hope to help inform school administrators on how to best promote understanding and collaboration between colleges.

ENGLISH

GLASS WOUND

STUDENT Eleanor Haglund *English*

ADVISOR Kevin Gonzalez *English*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

My culminating senior honors thesis is a novel, Angina.

Sarcastic, self-reliant and scared. Andi is away from her abusive family for the first time in her life. When she joins her college campus' Emergency Medical Service, the only thing her father doesn't seem to have control over, she attempts to lose herself in her new life and forget about her past. A love triangle fraught with tension, a roommate that curses like a sailor in her sleep and the brother she left behind are just a few things Andi is forced to confront.

Glass Wound is a complete, 70,000 word young adult novel set in modern day Pittsburgh. A story of what happens when you build with life's unstable blocks, it will appeal to fans of Tobias Wolff's moral dilemmas, Curtis Sittenfeld's themes of family and identity and all fans of medical or police procedurals.

HISTORY THESIS PRESENTATION: THE REPRESENTATION OF WOMEN IN PUSHTI MARG ARTWORK.

STUDENT Samantha Wilson *English*
ADVISOR Steven Schlossman *History*
ROOM/TIME Peter / 3:40 pm

In this presentation, I will explain my history thesis paper, in which I looked at the artwork of the Pushti Marg sect of Hinduism in order to understand how the representation of women in religious artwork translated to the place women held in society.

IT'S HARD TO SAY: A NOVEL ABOUT THE PHYSICAL AND THE ABSTRACT SELF

STUDENT Blake Chasen *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME McKenna / 12:20 pm

My project is a novel about a young man who has dreams that result in a belief that he has been another person in another time period. This project has permitted me, as an artist and humanist, to further hone my craft of creative writing while also allowing me the opportunity to further study Buddhism, Hinduism, hypnotic psychology, and other religions, philosophies, and metatheories that question the self. The impact of this project is a work of fiction that adds to and improves the discussion of the separation between body and spirit. I hope to have accomplished, using studies in Eastern religion and philosophy and the aid of my thesis advisor Professor Sharon Dilworth, a work of literature that makes one question the "self" before birth, after death, and beyond our corporeal world. The project is important to me because I believe that all fiction stems from questions about what humanity means, and I've relished the opportunity to add to this discussion with questions and responses that pertain to the topic. The project is important to my field and the larger world because the "self" is the most universally identifiable aspect of our world and additional commentary on this topic promotes and enhances relevant discussion.

NOT YET: STORIES OF YOUNG WOMEN AT HIGH RISK FOR BREAST AND OVARIAN CANCER

STUDENT Christina Galvin *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME Wright / 1:20 pm

This project will consist of a collection of stories to explore the realities of being genetically high risk for breast and ovarian cancers in a society that popularizes and sexualizes these diseases. The project will incorporate the stories of various women who are genetically predisposed to these cancers and their relationships with disease, health, sexuality, support, humor, and what the future holds for them.

ON DELIVERING THE GOODS

STUDENT Laura Scherb *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME Pake / 12:40 pm

I was first introduced to the personal essay form in Hilary Master's class called, simply, The Personal Essay. It was the first time that I was given an assignment and told to make a profound statement about real things that had happened to me, and I loved it. Hilary pushed me to explore the craft, and it was his mentorship and encouragement that made me seek out more than just Montagne on which to model my work.

Due to Hilary's mentorship, I realized how greatly the form impacted me as a writer and how much potential a collection of essays had to make me a better, more attentive writer and human. These essays are the things, small and large, that have prompted me to consider all other parts of life this year.

Hilary once told me that essays could be happy or sad, but at the end of the day, they had to "deliver the goods." In dedicating this collection and its title to him, I hope it accomplishes that goal.

ONE NAME, FOUR REGIONS: CONSTRUCTING CASCADIA THROUGH RHETORIC

STUDENT Thatcher Montgomery *English*
ADVISOR Andreea Deciu Ritivoi *English*
ROOM/TIME Pake / 1:00 pm

Through traditional rhetorical analysis, this thesis examines arguments made for a "Cascadia" regional identity (roughly located around Washington, Oregon, and British Columbia) made by four strands of Cascadian thought: Cascadia as a bioregion, as a nation, as a culture, and as an economic region. From each concept, two texts are analyzed to find the audience being targeted and the arguments being made. Examining how each Cascadia attempts to define itself and draw members—often by contrasting or coordinating with the other versions—shows some similarities, like pride in the natural environment, as well as clear distinctions, like differing opinions as to the boundaries of the region itself. The separate notions of Cascadia come with their own sets of values, and by looking at an overview of the arguments being made, this thesis provides insights into Cascadia specifically as well as regional identities in general.

POWERPOINT VISUALS IN THE HUMANITIES

STUDENT Laura Caton *English*
ADVISOR Joanna Wolfe *English*
ROOM/TIME Pake / 1:20 pm

In recent years, PowerPoint presentations have become the medium of choice for high school and college educators. Research on images in these presentations has determined that relevant diagrams and graphics improve learning in science and engineering fields; however, there has been little research on images in the humanities, where diagrams are less common. This study first surveyed college students about what images they consider informative. Using these results, I presented a new group of participants with humanities content accompanied by each of the different image types. Participants then took a quiz on the content. Quiz results seem to indicate that the images deemed

"informative" and text-only slides aided retention the most, while SmartArt and images that contradicted the slide's main ideas hurt retention. Results can help guide humanities professors and students in how to best use images in their PowerPoint slides so that their audience understands the information.

SWIM TALK: STORIES

STUDENT Laura Berry *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME Dowd / 2:00 pm

"Swim Talk" is a collection of short stories written for the senior honors thesis project. The stories are set in museums and on mountains, stretching from northeastern Japan to northeastern Jersey, sometimes glancing into years past or peering decades forward. "Swim Talk" refers to the feeling of being caught in the current of one's own thoughts.

THE COCKLEBURR

STUDENT Sayre Olson *English*
ADVISOR Gerald Costanzo *English*
ROOM/TIME Dowd / 1:20 pm

This is a writing project that focuses on the interesting and unusual life led by my grandfather. Before he died eight years ago, my grandfather decided to start writing a novel that he never finished. He deemed it a fictional story, but it was actually very closely aligned with many of the major events in his life, and thus came to be very meaningful to me and my other family members. Through this process, I have reconstructed the story of this novel, using the pieces that he left behind, and my understanding of his life and character. Interwoven into his story are my own representations of my grandfather's "real life," told in the form of short vignettes. The crux of the project lies in the distance between these two components, and what this reveals about my grandfather's self-image and morality.

THE VIOLET QUILL CLUB: CONSTRUCTING A POST-STONEWALL GAY IDENTITY THROUGH FICTION

STUDENT Brian Trimboli *English*
ADVISOR Kristina Straub *English*
ROOM/TIME Dowd / 3:00 pm

It's difficult to define "literature," let alone "gay literature." Nonetheless, a group of seven gay male authors, dubbed the Violet Quill Club, met at informal roundtables in New York City to critique each other's work in the late 1970s into the early '80s, creating a set of works that redefined the way Americans read "gay" novels. These authors published their seminal works during this time, a unique era of sexual freedom in the United States that fell between the Stonewall riots, which mark the beginning of the modern gay rights movement, and the AIDS crisis, which took the lives of four members of the group. The fiction published by the Violet Quill Club established a new gay identity born of New York's gay culture, which emphasized sexual liberation and freedom from traditional heterosexual institutions such as marriage. Although this constructed identity was narrowly construed, it influenced a generation of gay men and still resonates within today's LGBT rights movement.

THESIS PRESENTATION

STUDENT Samantha Wilson *English*

ADVISOR Jane Bernstein *English*

ROOM/TIME Peter / 4:00 pm

In this presentation, I will discuss the process of creating my senior thesis--a collection of vignettes and images about growing up.

ETHICS, HISTORY & PUBLIC POLICY

INTERNATIONAL LAW AND THE U.S. SUPREME COURT

STUDENT Lisa Tu *Ethics, History & Public Policy*

ADVISOR Jay Aronson *History*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

This paper traces the evolution of the role that international law has played in U.S. Supreme Court jurisprudence. Spanning from shortly after the American Revolution to the 21st century, I present a view of domestic international law jurisprudence as being tightly intertwined with U.S. foreign policy, undermining the common myth of an entirely independent and utterly detached judiciary branch. Especially during and immediately following times of war, the Court's historical interpretations of international law have undergone dramatic shifts in accordance with the pressing policy concerns and objectives of the time. This study divides the Court's history into three periods, each with its own distinct approach to international law: from the Founding to the Civil War; from 1865 to World War II; and from 1945 to the modern day.

HISTORY

COLD WARGAMES: ROLEPLAYING, COMPUTER SIMULATIONS, AND GAME THEORY IN EARLY COLD WAR RESEARCH, 1955-1975

STUDENT Thomas Vielott *History*

ADVISORS Donna Harsch *History* • Steven Schlossman *History*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The Cold War created uncertainty for the US military. It was difficult to discover the best way to use their new nuclear weapons, air and ground combat technologies, and counter-insurgent tactics, as these could not be readily explored outside of controlled tests. Researchers at think tanks like RAND sought to find out what would happen and predict the future - whether it be nuclear war, diplomatic crisis, or insurgent action - by simulating it with a game. How this was to be carried out - and the implications for government decision making, was in contention; the arguments had over these techniques mirrored the fractures and problems of the government research apparatus as a whole.

EDUCATING ENGLISH LANGUAGE LEARNERS IN THE PITTSBURGH PUBLIC SCHOOLS

STUDENT Lucy Pei *History*

ADVISOR Susan Polansky *Modern Languages*

ROOM/TIME McKenna / 3:20 pm

The number of English language learners (ELLs) in public schools is increasing rapidly, and soon ELLs will comprise nearly one out of every four public school students in the United States. The education of ELLs is typically supplemented with English as a Second Language (ESL) classes and programs, which involve a variety of stakeholders. In my thesis, I review the history and current policy surrounding public education of ELLs, and then delve in to a case study of the Pittsburgh Public Schools. Using ethnographic methods of participant observation and conversation, I gathered the perspectives of students, teachers, and administrators on their goals and expectations of ESL. I analyzed these perspectives to determine the amount of correspondence between the different stakeholders and contextualized the case study relative to the national landscape on public education for ELLs.

FROM HIPPIES TO HIPSTERS: AMERICAN POPULAR MUSIC FESTIVALS AS YOUTHFUL RITES OF PASSAGE

STUDENT Geneva Jackson *History*

ADVISOR Judith Schachter *History*

ROOM/TIME McKenna / 3:40 pm

The phrase “music festival” brings to mind a variety of images. Maybe you hear a thumping, insistent beat, equal parts electric bass and hundreds of rumbling, excited voices. Or envision sun-tanned teens with dirt on their feet and bandanas around their heads dancing along to an insistent kick drum.

Or sweaty groups of young men throwing beach balls, or bottles of water, or each other into the crowd, reckless

and physical in reaction to summer sun and their favorite song. Pairs of girls weaving closer to the music, their hands firmly clasped, grounded in each other, as they get lost in the throng.

Or maybe you picture late at night, when everything goes dark but the brilliantly lit artists and raised cellphone screens, recording the moment before it passes. Musicians talking of the beautiful crowd as glow sticks rain from the sky and they dance and sing harder than before. Or of the creeping, refreshing chill the humid day made seem impossible, and the hushed loudness of an open field with thousands of slumbering bodies. Or you feel that ephemeral moment when the audience sings louder than the artist, and they stop in apparent awe, watching the masses swaying together in a familiar chorus.

Whatever you think of, the cultural references associated with music festivals extend far beyond the music around which they are centered. As there are as many different types of festivals as genres of music, the specific details shrink in the appearance of key elements and themes. Music festivals comprise of a wide but specific set of experiences, the good lumped with the bad, and the insignificant mingling with the impactful. The people within them come from diverse backgrounds, locations, and age groups. Nevertheless, music festivals have grown to be a widespread cultural phenomenon in the United States. Recent years the festival industry has experienced a boom in popularity, with events of all sizes cropping up across the country. Viewed as a microcosm, an examination of the temporary world of a festival can give guidance to larger cultural trends and values. This paper seeks to unpack music festival as an experience in an effort to determine significant elements and understand better the important role these festivals are playing in modern American culture.

IT'S A BIRD!!! IT'S A PLANE!!! IT'S A GAY???

STUDENT Jon McIntire *History*
ADVISOR Steven Schlossman *History*
ROOM/TIME McKenna / 11:40 am

My essay argues that the tortuous path that superhero comic books took in dealing with the issue of homosexuality and LGBTQ representation in the late 20th century mirrored the Gay Rights Movement's own struggles for acceptance. My research findings reinforce the efforts of other scholars to catapult the superhero comic book from its often-stigmatized role as a mindless and disposable form of lowbrow entertainment into a valid visual and textual document of sociocultural significance, and one that clearly deserves further examination and preservation. More specifically, I argue in this essay—focusing especially on the 1980s--that these early portrayals of LGBTQ characters in mainstream comics fell into one of three frequently unflattering categories:

1)the gay stereotype - portraying LGBTQ characters not as positive and well-rounded but as exaggerated caricatures, relying heavily on superficial presuppositions about the dialogue, mannerisms, and lifestyle choices often associated with gay people at the time.

2)the tortured gay - portraying LGBTQ people as a hopelessly miserable lot and/or victims incapable of escaping one form or another of anguish and suffering all due to their plight as homosexuals.

3)the gay villain - relegating LGBTQ people to roles as criminals, malcontents, and predators and, thus, perpetuating 1950s Cold War-era beliefs that being queer equated to corruption.

At times, there was some overlap between these three categories; however, in those situations, there was still one category that predominates over the other two. Regardless, this triumvirate of misrepresentative depictions removed all thoroughness, character-based complexity, and emotional depth from early portrayals of LGBTQ people

throughout the greater part of the 1980s. Ultimately (and ignorantly), this manner of portraying gay people in comics became dependent upon presumptive misconceptions and an underwhelming one-dimensionality.

LANDSCAPE, PEASANT LIVELIHOODS, AND ECONOMIC DEVELOPMENT IN HAITI

STUDENT John Devine *History*
ADVISOR Judith Schachter *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This project examines the role of international development in shaping the landscape of contemporary Haiti. More specifically, I intend to trace modern aid policy to colonial ideologies about race, rural class, and land. I also examine development that deviates from colonial ideology and determine how this impacts its effectiveness in the context of landscape shift. In the Haitian case study, deforestation and its root causes are a key issue for analysis. Modern Haiti is almost entirely deforested, and the colonial and postcolonial processes that contributed to this deforestation can reveal how Haiti might be able to effectively restore its landscape.

MILITANCY AND POLITICAL POWER: A COMPARISON OF HEZBOLLAH AND THE PROVISIONAL IRISH REPUBLICAN ARMY

STUDENT Chloe Thompson *History*
ADVISOR Colin Clarke *Institute for Politics and Strategy*
ROOM/TIME Pake / 12:00 pm

This paper examines the relationship between the militant and political arms of Hezbollah, a Lebanese terrorist group, and the Provisional Irish Republican Army, an Irish terrorist group. Hezbollah began as a militant group, intent on resisting the Israeli occupation of Lebanon that 1982. Today, Hezbollah is still an active militant group, but it is also a successful political party within the Lebanese government. The PIRA was another iteration in a long line groups and movements associated with the Irish Republican Army, and began as militant group responding to the failed civil rights movement for Catholics in the 1960s and protesting the British occupation of Northern Ireland. Eventually, it also developed a very successful political arm, known today as Sinn Fein. However, in 2005, the PIRA disarmed. The way force and social action interacted to become political power is unique in each of these groups. This paper will examine this relationship, as well as why the PIRA chose to disarm, and why Hezbollah may never do so.

RUNAWAYS, FREEDOM SEEKERS, AND FORNICATORS: THE INDENTURED SERVANT IN COURT IN 17TH CENTURY YORK COUNTY, VIRGINIA

STUDENT David Parker *History*
ADVISOR Steven Schlossman *History*
ROOM/TIME Dowd / 4:20 pm

This project explores the experiences of indentured servants in the courts of 17th century York County, Virginia. It analyzes three distinct varieties of cases discovered in archival research of the colonial records at the Library of Virginia: Runaway servants, servants who sued their masters over contract violations, and servants tried on charges of sexual immorality

THE INDIANS KEPT DANCING: PRIVATIZED RESISTANCE THROUGH SPIRITUAL EMBODIMENT ON THE KLAMATH RESERVATION FROM 1874-1877

STUDENT Noel Um *History*

ADVISOR Steven Schlossman *History*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

By comparing the Klamath's utilization of dance within the overall context of Indian assimilation, my research finds that despite its widespread popularity, public resistance through dance did not necessarily bring about significant societal change for the Klamath like it did for other tribes, mainly due to differences in tribal ideology. During what this paper will define as the "post-revitalization" period subsequent to the revitalization period of the Klamath's Ghost Dance adaptation, the Dream Dance grew into their mode of resistance that gave tribal members a greater sense of individual control over both their pasts and their futures. Post-revitalization dance built upon revitalization dance's means of achieving strength through embodied spiritual liminality during a time of instability; specifically, the Klamath Dream Dance served as a distinct departure from the Ghost Dance, in that it privatized their form of resistance, distributed power by creating an outlet for freer metaphysical expression, increased individualism over collectivism and equalized social status within the tribe.

THE PEOPLE'S DEVELOPER: BLOOMFIELD, GARFIELD, AND THE BLOOMFIELD-GARFIELD CORPORTATION

STUDENT Robert Abramson *History*

ADVISOR Steven Schlossman *History*

ROOM/TIME Dowd / 12:40 pm

In 1975, community leaders in Pittsburgh's blighted and disinvested Bloomfield and Garfield neighborhoods formed the Bloomfield-Garfield Corporation, a resident-centric, grassroots community group. In 1981, the BGC entered the real estate development scene in Garfield as a "developer of last resort," based on a belief that if the organization did not secure investment in the neighborhood, no one would. Early BGC development efforts addressed basic necessities for the neighborhood's survival like affordable housing, elder services, and retail business. Over time, however, the real estate development program at BGC grew into a set of tools that the BGC would use proactively to shape the area's future. By the early 1990s, the organization's activities broadened to include initiatives aimed at exploring what the neighborhood could grow to be.

INFORMATION SYSTEMS

CONPASS: AN INTUITIVE CONVENTION MAP MOBILE VIEWER AND BUILDING APPLICATION

STUDENT Angela Liu *Information Systems*

ADVISOR Larry Heimann *Information Systems*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Whether it is hosting a conference, organizing a festival, or planning a large private event, organizers must address the issue of navigation. Visitors often have a difficult time navigating as they are in new spaces that are potentially crowded, loud, or both. Conpass is an application that explores the issue of navigation of temporary events by allowing the creation of sharable, online maps. These maps can be filled in with additional information, such as booth opening times or descriptions, that go beyond what a paper map can provide. By allowing visitors to access maps and map information on their phone, Conpass has the potential to save organizers resources normally spent printing, distributing, or dealing with paper products while allowing users to get more out of their visit.

PIESPEAK - SHORT FILM

STUDENTS Evan Adkins *Electrical & Computer Engineering* • Max Harlynking *Information Systems* • Aliya Zhdanov *Business Administration*

ADVISOR James Daniels *English*

ROOM/TIME McConomy Auditorium / 1:00-2:30 pm

My project, Piespeak, is a lighthearted short film about a 12-year-old girl who attempts to break the world record for saying every kind of pie in the world in the fastest amount of time to prove that she can be the best at something. This film examines the effects of the pressure we put on ourselves to achieve and serves as an educational stepping stone to a future in filmmaking for myself and the other students involved. Using the skills and techniques myself and my crew have obtained from working on past films, we will create a work that will inspire, entertain, and showcase our skills in a meaningful way. Piespeak is important in that it seeks to portray a child learning to face a challenge we all must battle throughout our lives to become better as both human beings and workers- our own ability.

PORT AUTHORITY BUS RELIABILITY ACROSS PITTSBURGH NEIGHBORHOODS

STUDENTS Meghna Baskar *Economics* • Kiersten Chuc *Statistics* • Suvrath Penmetcha *Information Systems* • Rohit Srungavarapu *Business Administration* • Skye Toor *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:31 am

The purpose of our study is to observe how often Pittsburgh PAT buses actually arrive (i.e. their frequencies), compared to their expected frequencies as stated in official PAT schedules. Buses are notorious for deviating from the official PAT bus frequencies. Pittsburgh residents frequently voice their displeasure with the untimeliness of PAT buses and this study will provide statistically sound evidence to suggest whether or not PAT buses abide by their stated frequencies.

Our study focuses on six neighborhoods closest to CMU. We stratified our sample across neighborhoods and time of day. Our sample was taken from a list of all Pittsburgh bus stops and we selected stops within our neighborhoods of interest. We then randomly assigned the sampled bus stops a time of day, and record bus frequencies in-person at each stop. Our analysis includes a hypothesis test, where our null is there is stated as "no difference between the actual and stated frequencies".

Our results provide empirical evidence for the differences between the actual frequencies and the theoretical frequencies. This information is invaluable for PAT, specifically how they can better optimize their bus usage across neighborhoods, and can start the conversation about possibilities to improve bus arrival times.

REINVISIONING THE KEYBOARD AS A SPATIAL USER INTERFACE

STUDENT Duncan McIsaac *Information Systems*

ADVISOR Jennifer Mankoff *Human Computer Interaction*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Web accessibility is a heavily researched field due to its quality of life implications for people with disabilities, but as the web becomes more complex, assistive technologies have difficulty keeping up. Information contained within web content such as navigation bars or tables generally makes sense only when considered in relation to similar content surrounding it spatially. Although screen readers can effectively identify when content is inside a navigation bar or table, visually impaired people may not understand the actual spatial layout of that information. I am proposing a new form of keyboard interaction in which web content is mapped to keys on a keyboard in a way that preserves the spatial relationship between different pieces of information.

ROBOTS WITH HIGH DEGREES OF FREEDOM IN VERTICALLY CHALLENGED ENVIRONMENTS

STUDENT Jeremy Lee *Information Systems*

ADVISOR Howie Choset *Robotics Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 10:39 am

Snake robots have high degrees of freedom, allowing them to access confined spaces that are difficult to get to. By mounting snake robots on a base with wheels and a vertical lift, the snake is now able to access new environments, specifically in the vertical direction that would be otherwise inaccessible to snake robots on the ground. This provides access to robots in areas that are otherwise inaccessible by people and allows for snake robots to inspect items or objects in such confined spaces.

THE BRIDGE API

STUDENTS Jacob Correa *Information Systems* • Melanie Freeman *Information Systems* • Benjamin Lam *Self-defined* • Aditi Sarkar *Information Systems*

ADVISORS Larry Heimann *Information Systems* • Jeria Quesenberry *Information Systems*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The Bridge at CMU is a system that stores information on non•academicorganizations at CMU. Although there is an existing application programming interface (API) to access this information, students can't easily get keys to use the it due to security concerns regarding the information stored on the Bridge. We will design and develop a new API using Ruby on Rails custom built for the CMU Student Activities Office's needs that serves as an authentication middleware between developers on campus and the existing API. This will remove barriers in allowing student developers on campus to create meaningful applications relevant to Carnegie Mellon's student activities and events and provide value to the campus community.

LINGUISTICS

CLASSROOM CONVERSATIONS: AFRICAN-AMERICAN ENGLISH IN ON-TASK CLASS ACTIVITIES

STUDENT Zora Gilbert *Linguistics*

ADVISOR Barbara Johnstone *English*

ROOM/TIME McKenna / 2:00 pm

Most high school teachers and students agree that Standard American English (SAE), or "formal" English, is the expected language of the classroom (Godley, Carpenter, & Werner, 2007); however, many students do not use exclusively SAE while engaged in class discussions. In this study, I examine when and how African American high school students in Pittsburgh use African American English (AAE) during focused, on task discussions in the classroom. I show that a teacher's role in a conversation affects how students use language, and that as teachers

involve themselves more in a conversation or position themselves as an authority relative to their students, their students use less AAE. I also show that students' stances relative to various aspects of the classroom affect what varieties of language they use, and that students may be using features of AAE as a resource to communicate more than just the answer to a question.

MODERN LANGUAGES

HOW SOCIAL MEDIA LETS US UNDERSTAND HOW JAPANESE IS EMBRACING ENGLISH ORIGIN WORDS

STUDENT Tom Muneta *Modern Languages*
ADVISOR Yasufumi Iwasaki *Modern Languages*
ROOM/TIME Peter / 4:20 pm

There are an estimated 40,000+ words of English origin used in modern Japanese, for everything from casual conversation to academic papers. Japan has shown an affinity for adopting English words historically, but with the rise of the internet and social media, it is likely that this trend has become exacerbated. Using Twitter, one of the most popular social media sites in Japan, I collected a large sample of the most common words and examined their usage over time and categorized them by type to determine if any significant trends might currently taking place in Japanese.

PHILOSOPHY

CUP OF HOT COFFEE: THE CAFÉ AS AN INSTITUTION OF ART IN PITTSBURGH AND BEFORE

STUDENT Alexandre Abitbol *Philosophy*
ADVISOR Naum Kats *History*
ROOM/TIME Peter / 1:20 pm

In my research, I sought to identify the roots of café culture in Pittsburgh. I looked abroad to France and Italy to discover where café owners here found their inspiration. Using scholarly texts on the history of cafés, artists' work, and scholarly critique, I traced the character of the café lifestyle from three historical periods. I then collected oral histories from the experiences of three local café owners to illuminate the current features of café communities descending from the European Tradition.

PSYCHOLOGY

BENEFITS OF SECURITY PRIMING ON ROMANTIC JEALOUSY

STUDENT Kaylyn Kim *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Peter / 12:40 pm

A magnitude of research on romantic relationships has found that feelings of jealousy are detrimental to relationships, and often results in negative outcomes ranging from feelings of anxiety to relationship dissolution. In this research, we sought to explore the effectiveness of security priming as a potential solution to reduce negative feelings of jealousy in romantic relationships. More specifically, we studied physical touch and supraliminal (above-conscious) messaging to examine the buffering benefits of these two mechanisms when faced with a jealous situation.

BRIEF MINDFULNESS TRAINING REDUCES NEGATIVE AFFECT, ANXIETY AND STRESS: A META-ANALYSIS

STUDENT Maya Schumer *Psychology*
ADVISOR John Creswell *Psychology*
ROOM/TIME Peter / 1:40 pm

The objective of this meta-analysis was to initially determine what were the effects of short-term mindfulness meditation training. In this meta-analysis, 61 brief mindfulness training studies were examined, specifically looking at their effects on negative affect, stress, and/or anxiety. It was generally hypothesized that mindfulness training would have a small to moderate effect on these outcomes, and it was further hypothesized that there would be a moderating role of intervention/induction duration that would explain potential heterogeneity.

DISCRIMINATION OF ENHANCED ECHOES IN BLIND AND SIGHTED INDIVIDUALS

STUDENT Arley Schenker *Psychology*
ADVISOR Laurie Heller *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Echolocation, while a useful skill for visually impaired people, is difficult to learn because humans naturally suppress environmental echoes. However, if the echoes are enhanced compared to environmentally normal echoes, they may therefore help to ease echolocation learners into the learning process. Blind and sighted participants discriminated enhanced echoes in two 2-interval forced choice (2IFC) tasks, one testing distance and the other testing left/right localization. We report that blind participants had lower left/right thresholds than sighted participants, while sighted participants had marginally lower distance thresholds than blind participants. As there is a precedent for enhanced spatial hearing in blind individuals in the literature but no such precedent in sighted individuals, we find the distance result surprising. The age and hearing abilities of our participant groups likely contribute to these results, and better-matched groups would allow us to obtain more conclusive data.

EFFECT OF CLOSE PROXIMITY PICTURES TO CHILDREN'S COMPREHENSION OF TEXT

STUDENT Emily Hammer Walitzer *Psychology*
ADVISOR Anna Fisher *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Past research has shown that children can be distracted in their learning environment by different features that hinder learning outcomes. Children may be especially prone to distraction when learning to read because it requires high processing demands. Storybooks are a common form of instructional reading material for early readers. However, little research has studied how the layouts of storybooks affect the comprehension of text for children. The purpose of this study is to see how close proximity of pictures to text affects a child's comprehension of the text. Study 1 will evaluate two hypotheses: (1) beginning readers maybe more likely look at the pictures mid-word and mid-sentence than more advanced readers, and (2) children who are more likely to frequently alternate between looking at text and pictures will show lower comprehension of the text when compared to children who are less likely to alternate gaze between text and pictures. If these hypotheses are supported, Study 2 will test the possibility that as the distance increases between the pictures and the text, the beginning readers will be less prone to look at the pictures mid-word and mid-sentence, and will show improved reading comprehension. The design of this study will include an eye tracker and children's picture books. Each participant will take a post-test testing the comprehension of the text from the picture book they just read. The data from the eye tracker and the comprehension test scores will be analyzed to test these hypotheses.

I WANNA HOLD YOUR HAND: THE EFFECT OF TOUCH ON CONFLICT DISCUSSIONS IN ANXIOUSLY AND SECURELY ATTACHED INDIVIDUALS

STUDENT Mattie Hedgebeth *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In this study, we explore the possible connection between touch during a conflict discussion and attachment style using existing data. Specifically, we test whether holding hands during a conflict discussion benefited people with an anxious attachment style more than people with a secure attachment style. Fifty couples (students from Carnegie Mellon University and individuals from the surrounding Pittsburgh community) that had been in a romantic relationship for 6 or more months participated in this study. Participants were randomly assigned either to hold their partner's hand during a discussion about a disagreement (touch condition) or to hold on to two different weights during the disagreement discussion (control condition). Participants completed questionnaires about their distress immediately after the discussion, and they completed an attachment orientation scale (Experiences in Close Relationships Scale) that we used to classify participants into attachment styles. Individuals who are anxiously attached are particularly sensitive to rejection; therefore, I predict that they experience more distress after the conflict discussion overall. Anxiously attached individuals also tend to desire extreme closeness with their partners, and touch is one way to demonstrate closeness. Therefore, I hypothesize that people who are anxiously attached will benefit more from touch to prevent their distress after conflict than individuals who are securely attached. I will test for the predicted main effect of attachment style and the predicted interaction between attachment style and condition using a 2-way ANOVA. Results of this study provide information about for whom touch may be especially beneficial

INSIGNIA: HIRING WORKFLOW, STREAMLINED.

STUDENT Rameez Remsudeen *Psychology*
ADVISOR Jeffrey Eppinger *Institute for Software Research*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Insignia is a platform that streamlines the job hiring workflow by allowing users to create dynamic online resumes. By keeping applicant data current and updated, Insignia empowers employers with richer experiences and more powerful hiring tools, while simultaneously saving users valuable time and effort by abstracting the process of creating and managing resumes and job applications.

IRES TARGETING BY COMPLEMENTARY AND HOMOLOGOUS PNA

STUDENT Joe Martinez *Psychology*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Wright / 3:00 pm

The current project aimed to determine the optimal conditions for increasing the potency and selectivity of antisense PNA probes. The probes were targeted toward an internal ribosome entry site (IRES) inserted upstream of a firefly luciferase (Fluc) gene in a two-gene (bicistronic) reporter. Binding to the IRES was expected to inhibit cap-independent translation of Fluc without altering expression of Renilla luciferase (Rluc). Rluc expression was used as a ratiometric comparison to assess off-target binding by the probe. The effect of different sequences and chiral orientations on probe affinity and selectivity were measured through bioluminescence assays. Biophysical experiments were also conducted that measured hybridization stability. Determining what factors optimize probe efficacy will advance the use of PNA probes as targeting agents by minimizing off-target effects.

MATH AND THE BRAIN

STUDENT Maya Schumer *Psychology*
ADVISOR John Creswell *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Objective: To examine whether engaging in self-affirmation buffers an individual's neural and psychological responses to stress.

Background: Self-affirmation is defined as reflecting on one's important values. Findings from previous self-affirmation studies in our lab show 1) a potential neural correlate (i.e., ventral striatum activity during affirmation) (Dutcher et al. 2016) and 2) a stress buffering effect (Creswell et al. 2005). Yet no studies have tested whether ventral striatum activity during affirmation drives stress-buffering effects—which is the primary aim of my proposed research project.

Method: 40 subjects from Carnegie Mellon will participate in this single-blind, randomized controlled study that will be conducted at SIBR and involve imaging and behavioral components. Our primary outcome is stress reactivity, measured neurally and psychologically. Predictions: It is predicted that 1) self-affirmation participants (compared to control participants) will activate ventral striatum (VS) during a self-affirmation task, and VS activity in turn will predict reduced stress reactivity on a difficult math task. Conclusions: Findings from this study will advance self-affirmation literature by expanding on the understanding of self-affirmation, specifically its relationship

to stress and its neural basis. This project is supported and supervised by Dr. Creswell in the Department of Psychology, is IRB approved (IRB Protocol Number: HS15-049), and is funded by the National Science Foundation (NSF); the grant is titled "Mediators of Self- Affirmation."

PARADIGMS IN THINKING: DEVELOPING THE CORRESPONDING SOFTWARE INTERFACE

STUDENT Rae Lasko *Psychology*
ADVISOR David Klahr *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Cognitive psychologists who study the process of scientific thinking often use a paradigm in which subjects have to figure out how a complex device works. The idea is that when people confront a novel device (such as a new app for their phone, or a ATM machine in a foreign country) they generate hypotheses about how it works ("how does this button work?", and design experiments to test their hypotheses "what happens if I click on this symbol over here?"). Klahr & Dunbar, 1988) used this general approach by presenting adults and children with a commercially available programmable toy robot ("BigTrak") that had a several function keys, and a "mystery key" that could be added to the list of program steps. The subjects' challenge was to figure out how the mystery key worked. In subsequent research, Klahr and his colleagues used a computer interface instead of the "physical" BigTrak device. Results of this and related studies have been reported in the cognitive science literature (Klahr, Fay & Dunbar, 1993; Klahr, 2000).

However, Klahr's lab was unable to continue with this research paradigm because the more recent versions of the Macintosh operating system are incompatible with the programming languages in which the BigTrak simulations were written. The goal of my project was to write a program that would enable cognitive psychologists to replicate and extend this kind of "scientific discovery" research by porting all of the functionality of the "BigTrak" to a tablet interface. This required creation of a keypad and animation interface, as well as set of several different ways in which the mystery function actually worked, to allow researchers the opportunity to further explore the scientific reasoning that subjects used when trying to discovery how the mystery function worked.

PREDICTORS OF BEHAVIORAL AND RELATIONSHIP OUTCOMES DURING MUTUAL SELF-DISCLOSURE: IMPLICATIONS FOR ONE-TO-ONE PEER SUPPORT INTERVENTIONS

STUDENT Joshua Swanson *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Wright / 1:40 pm

Despite the popular use of individual social support interventions to improve the interpersonal functioning of patients with mental illness, research into the effectiveness of such programs has returned mixed results. In order to better understand potential moderators of these interventions' effectiveness, the present study involved the random pairing of two same-sex strangers who were then brought into the lab for two one-hour sessions, during which time participants took turns engaging in mutual self-disclosure. Our aim was to examine possible predictors of engagement in such types of interpersonal interactions, specifically social competence and existing levels of social support. A total of 51 same-sex pairs of college students were enrolled in this study. Although both social

competence and social support predicted positive outcomes, social competence appeared to be the more robust predictor of outcomes. Dyadic data analyses revealed that providing emotional and instrumental support to a partner predicted an increase in one's liking for and plans to communicate with this partner. The association between emotional support and relationship outcomes was stronger among males than females.

STATISTICAL LEARNING OF LANGUAGE AND ITS BASIS IN MEMORY

STUDENT Hyunho Yoon *Psychology*

ADVISOR Erik Thiessen *Psychology*

ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 10:26 am

Prior research has shown that humans can pick up "words" from a novel stream of sounds if the syllables of a word occur together at a greater statistical frequency compared to other syllables that do not make up a word (Saffran, Aslin, & Newport, 1996). This study will investigate a potential explanation for this phenomenon, in the characteristic of human memory. In particular, this experiment will study the primacy effect and effect of distributed practice by seeing whether an artificially created word that is presented only in the beginning of the exposure is learned better compared to words that are distributed equally throughout the exposure. Adult participants, after being exposed to these stimuli, will be given forced-choice trials that will measure their levels of acquisition for each word. Our goal is to see if participants have different accuracies on the test trials for the word that is presented in the beginning than for the ones that are presented throughout.

TAKE MY HAND, WE'LL MAKE IT I SWEAR: EFFECTS OF AFFECTIONATE TOUCH ON RELATIONAL PERCEPTIONS AFTER CONFLICT

STUDENTS Amelia Clark *Psychology* • Lucy Shen *Biology and Psychology* • Delancey Wu *Science and Humanities Scholars*

ADVISOR Brooke Feeney *Psychology*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Our study examines how interpersonal touch between couple members will affect relational perceptions during and after a conflict. The relational perceptions we will consider are positive perceptions of one's partner, positive perceptions of the relationship as a whole, and optimism that the disagreement will be resolved afterwards. Romantic couples will be recruited through the psychology department participant pool, the paid participant pool, and the local Pittsburgh community. Participants be randomly assigned to hold hands or to hold a neutral object (no touch) before and during a conflict discussion. We hypothesize that couples in the touch condition will have more positive relational perceptions than couples who are in the no touch condition. The implication of this study is that touch can be a strategy to buffer against stress and increase relationship satisfaction that everyone will be able to do.

USING PHOTOGRAPHS TO SURFACE PREJUDICES AND INCREASE CULTURAL SENSITIVITY VIA DOCUMENTARY PHOTOGRAPHY OF TAMIL NADU INDIA

STUDENT Rubini Naidu *Psychology*

ADVISORS Charlee Brodsky *Design* • Chante Cox-Boyd *Psychology*

ROOM/TIME Connan / 3-5 pm

Categorization is an evolved cognitive process that is used to navigate the otherwise overwhelming amount of sensory stimuli. But what happens when people are categorized? Prejudices and stereotypes become problematic when they judge and misrepresent people, groups, and cultures. These underlying thought processes, which present themselves in everyday situations, can be surfaced through the interpretation of photographs. In an increasingly interconnected world, improved sensitivity to others is an important next step in order to becoming more aware of complete stories and less dependent on judgments.

This work is presented in the form of a handmade artist book, which is a sequel to the book Journey To My Beloved India presented at last year's Meeting of The Minds which included photographs taken in India and their narratives. In addition to a psychology literature review of the aforementioned topics, images that were taken in Tamil Nadu are again incorporated in this sequel, this time involving a diverse number of people's interpretation of the photographs which are juxtaposed with the reality of what is occurring in the images.

SELF-DEFINED

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

SURVIVAL STRATEGIES IN A NEW WORLD ECONOMY: MIGRATION AND WOMEN'S PARTICIPATION IN THE PHENOMENON OF AFRICAN URBANIZATION

STUDENT Jessica Wallach *Self-defined*

ADVISORS Andrew Bausch *Self-defined* • Edda Fields-Black *History*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Circumstances are changing rapidly for African women in an increasingly globalized world, and each generation must face its own challenges with livelihood strategies like rural-urban migration. Staying in the rural area and

supporting a family through farming is no longer an acceptable option for many women and their participation in rural-urban migration reflects that reality: there is no denying the skyrocketing scale of African women's urbanization. This paper aims to understand a critical yet understudied relationship: that between female rural-urban migration and age. The implications of understanding of this relationship are especially resonant as 65% of the total population of Africa is younger than 35 and over 35% are between 15 and 35 years old (African Union Youth Commission). Through exploring the historical context and modern realities of female migrants in Africa and conducting research on the views of the Pennsylvania African Diaspora, this thesis project aims to open the door for more effective research and better targeted international development policy on new generations of female migrants.

THE BRIDGE API

STUDENTS Jacob Correa *Information Systems* • Melanie Freeman *Information Systems* • Benjamin Lam *Self-defined* • Aditi Sarkar *Information Systems*

ADVISORS Larry Heimann *Information Systems* • Jeria Quesenberry *Information Systems*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The Bridge at CMU is a system that stores information on non•academicorganizations at CMU. Although there is an existing application programming interface (API) to access this information, students can't easily get keys to use the it due to security concerns regarding the information stored on the Bridge. We will design and develop a new API using Ruby on Rails custom built for the CMU Student Activities Office's needs that serves as an authentication middleware between developers on campus and the existing API. This will remove barriers in allowing student developers on campus to create meaningful applications relevant to Carnegie Mellon's student activities and events and provide value to the campus community.

THE STATISTICS BEHIND CMU STEREOTYPES

STUDENTS Kruti Koppolu *Statistics* • Andrew Manka *Statistics* • Pooja Penninti *Self-defined* • Elan Rosenfeld *Computer Science* • Yoona Seon *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Stereotypes about specific colleges at Carnegie Mellon are widespread and can be damaging to students' abilities to cooperate, both in and out of the classroom. In particular, stereotypes about the Tepper School of Business, the College of Fine Arts, and the School of Computer Science are reiterated each year, ensuring that these opinions influence CMU undergraduates' attitudes towards each other. Using stratified random sampling on colleges, our group collected data through a Qualtrics survey about just how commonly (and how strongly) believed these oft-cited stereotypes are, and by whom they are held. We did a general exploratory analysis of our results and fit a linear regression model to the data in an attempt to measure what factors have a significant effect on a student's view of his or her peers. For example, does actually getting to know students of a particular college help to dispel or reinforce these stereotypes? With this information we hope to help inform school administrators on how to best promote understanding and collaboration between colleges.

SOCIAL & DECISION SCIENCES

DISCOURAGEMENT, GENDER, AND PROFESSIONAL TENNIS

STUDENT Steven Wang *Social & Decision Sciences*

ADVISOR Saurabh Bhargava *Social & Decision Sciences*

ROOM/TIME McKenna / 3:00 pm

How people react to defeat and/or setbacks often determines the outcome of the overall situation. Specifically, succumbing to discouragement after a loss can negatively impact future performance. In my thesis, I seek to identify scenarios that lead to discouragement in the world of professional tennis. Sports and athletics provide a useful framework for examining social and psychological phenomena in a non-experimental yet controlled environment. Using a data set of over 600,000 men's and women's professional tennis matches from 1971-2015, I find that losing a close first set by a score of 5-7, adversely affects performance in the second set of a tennis match. Players who lose the first set 5-7 are less likely to win the second set compared to players who lose the first set 4-6, a score which is mathematically identical to a score of 5-7. Finally, I also find that this effect is greater in women tennis players than in men tennis players.

EXAMINING VISUAL-SPATIAL PATHS FOR REMEMBERING STRONG SECRETS

STUDENTS Taehoon Lee *Computer Science* • Joanne Lo *Social & Decision Sciences* • David Lu *Computer Science*

ADVISOR Jason Hong *Human Computer Interaction*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Despite many advances made in the usable privacy and security community in promoting the general knowledge of standard security practices, smartphone security and authentication is still heavily underutilized. To add onto that fact, there are currently many flaws with current authentication methods as well. Current methods, while reasonably secure, may be difficult for users to remember and recall. Additionally, they provide no solutions to common social problems such as how to share your phone with friends/family while still keeping your phone.

In this project, we will be examining the feasibility of leveraging spatial memory to create a more secure and user-friendly method of authentication. I will create an authentication system that leverages spatial memory, based on the concept of a memory palace. Concretely, we will be able to define and test a well developed authentication method with improved security along with additional benefits.

ISIS AND RECRUITMENT: HOW DO DEMOGRAPHICS PLAY A ROLE?

STUDENT Tiffany Tse *Social & Decision Sciences*
ADVISOR Colin Clarke *Institute for Politics and Strategy*
ROOM/TIME McKenna / 4:40 pm

This thesis seeks to parse foreign fighters, individuals who travel abroad from their country of origin or residence to join armed non-state actors in conflict, by demographics to analyze whether these characteristics play a role in why they join ISIS. Gender, geographical location, religious history, age, socioeconomic status, and education level are all examined to better understand how ISIS recruits from each group. It is found that individuals in each demographic group have diverse reasons for joining that ISIS exploits to be able to draw as many fighters as possible. Counter strategies should look at the underlying reasons that cause these individuals to join and minimize the distribution and interactions of recruiters and possible recruits.

SENIOR HONORS THESIS

STUDENT Meredith Abrams *Social & Decision Sciences*
ADVISOR Geoffrey McGovern *Social & Decision Sciences*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Deitrich College Senior Honors Thesis investigating the relationship between federal mandatory minimum sentencing laws and plea bargain decision making.

THE EFFECTS OF MINDFULNESS TRAINING ON INFLAMMATORY MARKER LEVELS

STUDENT Alexa Smith *Social & Decision Sciences*
ADVISOR John Creswell *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Recent mindfulness meditation research has shown that mindfulness training can help reduce chronic stress, as well as reduce the risk of stress related diseases (Goyal et al., 2014). However, there has been debate in the field over what aspects of mindfulness training are driving these effects. Some argue that only monitoring of attention to present moment experiences is necessary in mindfulness training programs (Brown et al., 2004). Others argue that not only is this monitoring necessary, but there also needs to be acceptance towards anything that enters that moment-to-moment awareness (Bishop et al., 2004). This presentation will introduce an ongoing study that seeks to better understand how mindfulness training affects measures of stress and health and to determine what mindfulness training mechanisms drive these effects, specifically whether it is monitoring only or monitoring and acceptance. Many studies now show that markers of low-grade inflammation (e.g., C Reactive Protein, CRP) are elevated in stressed populations, and increase the risk for stress-related morbidity and accelerated mortality (Segerstrom et al., 2004). To do so we will measure CRP both at a baseline before the training and at the end of the participant's 14-day mindfulness training period. In this study our participants will be stressed adults (ages 18-70). We will assign them to one of three different training groups. These groups are (1) a monitoring only group, (2) a monitoring and acceptance group, and (3) a basic attention-training group, which is our control. This summer I would help insure that all study procedures and protocols are finalized and then continue this work into the

academic year where I would focus on analysis of the CRP measure of inflammation. I predict that the participants who undergo Monitoring and Acceptance Mindfulness Training will have the most reduced levels of CRP and other inflammatory markers after the 14 day training period. I conducted, and continue to conduct, this research in Dr. Creswell's Health and Human Performance Lab in the Psychology Department at CMU, initially as a SURF 2016 recipient.

THE IMPACT OF BODY-WORN CAMERA EXPERIENCE ON POLICE OFFICER PERCEPTIONS: EVIDENCE FORM PITTSBURGH AND OTHER CITIES

STUDENT Maximilian Goetschel *Social & Decision Sciences*
ADVISOR Jon Peha *Engineering and Public Policy*
ROOM/TIME Dowd / 1:00 pm

A substantial amount of research and funding has gone towards the implementation and rollout of Body-Worn Cameras (BWCs) in US police departments. Our evidence from the Pittsburgh Police Department shows that after police officers gain hands-on experience with BWCs, they are much more likely to positively perceive the technology and how it can improve policing efforts. These findings add to the growing body of literature that indicates BWC technology 'speaks for itself' for police officers with regards to decreasing citizen complaints, increasing officer safety, and whether the technology should be adopted their their entire police force, among other attributes.

THE VIRAL NATURE OF JIHADIST RECRUITMENT

STUDENT Susanna Seltzer *Social & Decision Sciences*
ADVISOR Colin Clarke *Institute for Politics and Strategy*
ROOM/TIME Dowd / 3:20 pm

This project is built upon the work of Stares and Yacoubian, who suggest looking at Islamist ideology as a 'disease' or 'virus'. Some people are vulnerable due to emotional or contextual disadvantages. Certain conditions such as prisons, social media, or lack of opportunity, allow this virus to spread more easily. Though there is no 'cure', certain preventative measures can be taken to reduce the spread of this virus, and to aid those who have been 'infected'. This is a way to combine the ideas of psychological vulnerability, recruitment tactics, and social media to create a cohesive anti-Jihadist policy strategy.

TURNING TO CONSTRUCTIVISM AND PSYCHOLOGY: THE NEED FOR INNOVATIVE RESPONSES TO EXTREMISM.

STUDENT Jennifer Tuttle *Social & Decision Sciences*
ADVISOR Martha Dunigan *Social & Decision Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

In this thesis I argue that while traditional realist theory in International Relations places a focus on power dynamics, the religious, individual, and group psychological nuances underlying terrorist activity indicate that a more refined focus on sociological and psychological variables emphasized by Constructivism and Political/Social

Psychology may provide policymakers with a more appropriate set of tools for countering terrorism. By conducting a case study on two different sides of Operation Enduring Freedom, I attempt to show that counter-insurgency strategies that attempt to analyze and respect sociological and cultural factors produce much better outcomes than their more kinetic counterpoints.

WHY NATIONS VOTE: TESTING DEMOCRATIZATION THEORIES ON 21ST CENTURY AUTOCRACIES

STUDENT Maximilian Goetschel *Social & Decision Sciences*
ADVISOR Martha Dunigan *Social & Decision Sciences*
ROOM/TIME Pake / 4:20 pm

The quantitative social science movement has given rise to new theories on how autocracies develop into democracies over time. This paper compares three of these new democratization theories and applies them to six contemporary case studies in order to discover whether these theories can effectively predict when and where autocracies will develop democratic institutions in the 21st century.

STATISTICS

A STATISTICAL ANALYSIS OF THE NATIONAL FOOTBALL LEAGUE DRAFT: VALUING DRAFT PICKS AND PREDICTING FUTURE PLAYER SUCCESS

STUDENTS Robert Citrone *Statistics* • Devin Cortese *Statistics* • Maksim Horowitz *Statistics*
ADVISOR Samuel Ventura *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We introduce a statistical framework for analyzing and optimizing the value of National Football League (NFL) draft picks. We construct a large, diverse dataset of NFL draft statistics, including player statistics at the collegiate (NCAA) level, player statistics at the professional (NFL) level, and physical and biometric measurements obtained on individual players via the NFL Scouting Combine. There are two sub-problems at the NFL draft that can be approached statistically: assessing the value of individual draft picks conditional on the position of the player chosen, and predicting the future performance of individual players at the NFL level. To predict individual player performance, we explore several statistical models, including regression trees, generalized additive models, regularized regression, generalized linear models and more. The covariates in these models are a combination of the incoming rookies' NCAA statistics and their results in the NFL Scouting Combine. The response variable we use is Pro Football Reference's Approximate Value (AV) rating, which is calculated by attributing team success to each player's individual contribution. We choose this metric because it allows us to directly compare success across positions. The purpose of the modeling is two-fold: first, to predict the success of incoming NFL players, and second, to identify which combine measurements or NCAA statistics are most important in predicting future NFL success. In order to assess the value of each draft pick conditional on the position of the player taken, we use

draft data from 14 recent seasons (1999-2013) and compare the value added at each pick number in the draft by position. We use local non-parametric regression to model the AV of each pick conditional on position and identify points in the draft when taking particular positions yields significantly higher projected AV than others.

A SURVEY OF PRICES AT ENTROPY VS. LOCAL STORES

STUDENTS Charles Gauthey *Statistics* • Jun Yong Go *Statistics* • Michael Hsun *Economics* • Dominic Liu *Business Administration*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

College campus convenience stores are perceived as being overpriced, due to their proximity and the fact that most of them accept the university's internal currency, resulting in a small monopoly. The objective of this study is to determine whether or not this is true by comparing the prices of a representative sample of goods at Carnegie Mellon University's campus convenience store, Entropy, to the prices at local chain convenience stores. While it is difficult to generalize this to other university campuses, this is still a feasible study for the students and other affiliates of CMU.

Data will be collected by systematic sampling of items at Entropy and stratified sampling of local convenience and grocery stores by brand within a two-mile radius, then sampling the same items from Entropy at these stores. After obtaining the prices of the goods at each store, data analysis will be done to determine overall pricing, price structure of specific categories of goods, and price differences among the stores. Quantifying the differences will give us empirical evidence to determine whether or not prices at Entropy are higher relative to other convenience stores and will potentially influence purchasing habits by consumers or the prices set by Entropy.

ANALYSIS OF CLASSROOM MAINTENANCE

STUDENTS Christopher Kim *Economics and Statistics* • Dorsa Massihpour *Statistics* • Harsimran Minhas *Business Administration* • Victor Vega-Gonzalez *Statistics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

College students spend much of their time in the classroom and studies have shown that classroom environments can change how students learn. Students' experiences in classrooms also shape the way they view their university. Classroom maintenance and it's effect on students' overall experience is important, which is why we were interested in surveying the current conditions of undergraduate classrooms at CMU. We have done so by observing classrooms based on different variables such as temperature, cleanliness, technology, etc. By observing discrepancies within classrooms of different sizes and different colleges, we hoped to understand variations between students' college experiences.

We initially observed classrooms and revisited these classrooms two weeks later to see if any improvements had been made. By surveying all 86 of the undergraduate classrooms twice (morning and afternoon), we limited sampling error. We then analyzed the data and saw if there were any trends between buildings, departments who use the classrooms, class size, etc.

Using our results, the CMU administration can see discrepancies in the maintenance of classrooms, the standard of their average classroom, and if they need to make improvements.

ANALYZING THE CORRELATION STRUCTURE OF THE V1 CORTEX LFP

STUDENTS Yitian Feng *Economics and Statistics* • Yifan Leng *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

We studied electrical measurements taken from a 10 by 10 array of electrodes implanted in the V1 cortex of a monkey. We focused our analysis on the Local Field Potential (LFP), a low-frequency signal summing the activity of the neurons near each electrode. We examined the correlation structure of the LFP signals across the array of electrodes, and studied its variation with different visual stimuli.

ASSESSING THE LIKELIHOOD OF ACCEPTED STUDENTS CHOOSING TO ENROLL IN COLLEGE

STUDENT Andrew Fernandes *Statistics*

ADVISOR Samuel Ventura *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

We construct statistical models for the probability of students enrolling at Dominican College (DC) of Blauvelt, New York given that they were accepted by the college for enrollment. Of particular interest are how race, ethnicity, gender, SAT scores, GPA, geographic distance from the college, and Expected Family Contribution (towards tuition, based on Federal calculations) affect likelihood of enrollment. We assess the accuracy of a variety of different statistical models (e.g. logistic regression and classification trees) in predicting individual student enrollment. To mirror DC's decision-making process, we train our models on all data leading up to a given year, then assess their accuracy in predicting student enrollment in the subsequent year. We create interactive visualizations to demonstrate how certain factors affect enrollment, including choropleth maps demonstrating how students' geographic location can influence their likelihood to enroll. Our analysis helps DC's admissions office to hone in on those applicants most likely to register and use different strategies when recruiting different types of students.

BIOGRAPHIES IN TIME: INVESTIGATING GENDER DISCREPANCIES IN THE OXFORD DICTIONARY OF NATIONAL BIOGRAPHIES

STUDENTS Hyunsang Cho *Science and Humanities Scholars* • Yuka Moroishi *Statistics* • Kristina Schiffhauer *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

We analyze the Oxford Dictionary of National Biographies and explore the impact of the gender of the subject on the specific biographical descriptions used. Using statistical analysis and text mining tools, we investigate gender neutral words that are used differentially between genders. We also examine the changes in these descriptions over time, considering both the time of the subject's life and the biography's authorship.

BUS RELIABILITY FOR CMU

STUDENTS Riddhi Adhikari *Economics* • Srishti Jain *Statistics* • Leon Ji *Business Administration* • Eric Li *Statistics* • Joshua Ragen *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In our project, we researched the relative reliability of various mobile applications in comparison to the static schedule of a few select Port Authority buses. We chose this research topic because we want to help Carnegie Mellon students make better informed decisions about their travel choices. Although there has been research on the timeliness of Pittsburgh buses before, there is a new GPS tracking system enacted in 2014 that has allowed apps like the Port Authority Transit app and the Google Maps app to track buses in real time that has not been thoroughly researched yet. We focused on bus stops and bus lines especially relevant to CMU students. We picked four bus stops that we waited for hour long blocks each to watch the timeliness of 71 and 61 line buses. We want to use our findings to make a recommendation to CMU administration to either more strongly recommend the apps or schedule to students or to focus more on alternative modes of transportation as they become available.

CMU FACULTY WORK-LIFE STUDY

STUDENTS Yayoi Furuhata *Business Administration* • Kimberly Hsieh *Mathematics* • Pavithran Nair Jayaraman *Statistics* • Sarah Shy *Statistics* • Tyler Wellener *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Studies have shown that employee satisfaction can be linked to motivation, performance, absenteeism, and turnover in the workplace. However, faculty involvement and satisfaction are often overlooked in universities. Our research analyzed how satisfied Carnegie Mellon University (CMU) professors are with various aspects of their work life. The mode of data collection was an online survey hosted by Qualtrics. We carried out the survey using a list of faculty Andrew emails obtained from an official directory. Since most professors check their emails daily, sending online surveys to the faculty via email was the most efficient way to recruit participants. We broke down our results by gender, department, number of years at CMU, and academic title to make observations about particular subgroups. Faculty satisfaction is integral to the success of the university as it gives rise to a stimulating learning environment while offering a more attractive option for prospective professors. With our data, we were be able to obtain an accurate measure of faculty job satisfaction at CMU and provide information to the university that will allow CMU to achieve its long-term objectives.

COMPARING STATISTICS BETWEEN OBSERVED AND SIMULATED GALAXY DATA

STUDENT Xinya Li *Statistics*

ADVISOR Peter Freeman *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Under the supervision of Professor Freeman, I worked on comparing the observed galaxy images from the CANDELS collaboration and simulated galaxy images from the Illustris Project. Each galaxy image is summarized

by seven statistics, which I analyzed using exploratory data analysis, the KS test, kernel density estimation, and density ratio estimation.

EVALUATING CONNECTEDNESS OF COLLEGE OF FINE ARTS STUDENTS

STUDENTS Yunwen Cai *Mathematics* • Matthew De Jesus *Economics* • Kathleen Fuh *Computer Science* • Shaan Phagura *Statistics* • Vinay Viswanathan *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

CMU is divided into individual colleges, and students often, but not always, take the bulk of their coursework within the college they belong to. We want to study CFA's connectedness to other colleges because it has specialized constituent schools (not just departments), each with their own academic requirements. Our study is part of a broader discussion of whether students from different schools are too separated. To our knowledge there are no current research studies regarding this topic.

To solve the problem we conducted an email survey on CFA students, by sending out survey links to all CFA students. We did subgroup analysis on the schools within CFA and class year. We modeled the subgroups using generalized linear models, and we compared parameters across groups.

Our results could reveal CFA students attitudes of connectedness to the campus life, and which factors have the most influence on how CFA students interact with non-CFA students. This could shape future programming and initiatives made by student government, or CMU and CFA administration to promote greater cohesion among schools.

FOR SALE @ CMU CUSTOMER SATISFACTION SURVEY

STUDENTS Richard Chiang *Mathematics* • Ken MacMann *Statistics* • Michael McCaffrey *Economics and Statistics* • Shieri Suzuka *Economics* • Margaret Tung *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We surveyed members of the Facebook group "For Sale @ CMU" about their experience using the group. With over 6,000 members and growing, many CMU students utilize this group to buy and sell various items with one another. However, because this is an unregulated online platform, there is little information about this emerging market.

To conduct this survey, we acquired a list of individual members from the "For Sale @ CMU" Facebook group. Using this list, we randomly selected 2,700 members to participate in the surveys we sent out via Facebook messages. We conducted this survey to understand the overall satisfaction of using the group, to get feedback on the communications between buyers and sellers, and to see if there is any way to improve the experience of buying and selling within CMU students using this group.

HIGH DETAIL KINECT MOTION TRACKING FOR SIGN LANGUAGE INTERPRETATION AND INSTRUCTION

STUDENTS Sean Reidy *Statistics* • Vivek Sridhar *Electrical & Computer Engineering*

ADVISOR David Kosbie *Computer Science*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Our project aims to develop a high-resolution motion tracking and gesture recognition system for the Microsoft Kinect sensor, aimed at teaching American Sign Language, which, unlike most verbal languages, is very difficult to learn and to teach. We will develop this tracking and recognition system for the purpose of teaching ASL, but with the hope that it will be applied to many other areas in the future. The language is based on motion and gestures that can be hard for one to learn without hiring an instructor. Sign language interpreters serve as a good way for the hearing impaired to communicate, but they are not always available to the individual. With over 10 million Xbox One units shipped, a solution to the issue could come from the Xbox's included 3D camera: The Kinect. With an advanced 3D camera available in millions of homes, one can have a digital sign language instructor and interpreter in their home. Building upon the current Kinect API, we plan to capture more detailed positional data about hand and finger positions in order to create a sign language instructional tool. We will build an API that allows developers to access more detailed positional data from the Kinect, and an application that can be used as an instructional tool for American Sign Language. The application will be available to Xbox One uses through the Xbox Marketplace, and the API will be available as an open-source library.

INFERRING THE RELATIONSHIP BETWEEN GALAXY MORPHOLOGY STATISTICS AND REDSHIFT

STUDENTS Shichen Yang *Statistics* • Boyan Zhang *Statistics*

ADVISOR Peter Freeman *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Galaxies are multi-dimensional astronomical objects, and our research analyzes seven statistics summarizing intensity, light distribution and asymmetry of these galaxies. The research focuses on determining the relationship between five wavelengths of observable galaxies under different photon filters and a distance metric called redshift. In particular, we are interested in whether the multivariate distribution of wavelengths (H, J, Y, i, V) changes as a function of the redshift. Our method of analysis includes linear regression, Kernel regression and Bootstrapping.

MARRIAGE EXPECTATIONS SURVEY

STUDENTS Lilia Bidzyan *Economics and Statistics* • Chun Yen Chang *Computer Science* • Lue Fang *Statistics* • Mark Moskwa *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

We conducted a survey of marriage expectations for CMU undergraduate students, as we anticipated our research would help the CMU community as a whole attain a valuable understanding of CMU undergraduate students' attitudes toward marriage. Specifically, this will be with respect to demographic information, the decision of whether or not to pursue marriage, and insight into whether future academic career and academic plans influence

these attitudes. While the CMU undergraduate population is inarguably unique in nature and divergent from the young adult population nationally, we anticipate our findings will help us compose a more informed opinion. We designed a survey containing demographic questions, questions regarding attitude towards marriage and expected age of marriage, and questions related to the rationales behind these reported expectations. We collected data from randomly selected CMU undergraduate students and compared the responses we obtained across different majors, sexes, class years, etc. in order to determine the whether there is a relationship between the preceding factors and expected age of marriage.

MODELING THE ALIGNMENT OF BCG IN GALAXY CLUSTERS

STUDENT Charles Wang *Statistics*
ADVISOR Peter Freeman *Statistics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

A galaxy cluster is a large group of galaxies that lie at intersections within the cosmic web. The biggest cluster galaxy (BCG) is generally near the center of these clusters while smaller galaxies, called satellites, tend to orbit the BCG.

Clusters are sufficiently massive to bend passing light rays from background galaxies. To fully study the effects of clusters on light rays, one must determine if and how the alignments of galaxies within each cluster are correlated.

We investigate whether the distribution of BCG alignment angles varies significantly as a function of location within the six-dimensional measurement space.

NFLSCRAPR: OPEN-SOURCE NFL DATASETS AND IMPROVED STATISTICAL MODELS FOR EXPECTED POINTS AND WIN PROBABILITY

STUDENTS Robert Citrone *Statistics* • Devin Cortese *Statistics* • Maksim Horowitz *Statistics*
ADVISOR Samuel Ventura *Statistics*
ROOM/TIME Wright / 12:20 pm

The lack of publicly available National Football League (NFL) data sources has been a major obstacle in the creation of modern, reproducible research in football analytics. While clean play-by-play data is available via open-source software packages in other sports (e.g. nhlscrapr for hockey; PitchF/x data in baseball; the NBA API for basketball), the equivalent datasets are not freely available for researchers interested in the statistical analysis of the NFL. We have created a publicly available, open-source R package called nflscrapR that allows anyone with an interest in football analytics to have easy access to NFL data from the 2009 season to present. Using a JSON API maintained by the NFL, this package scrapes, cleans, parses, and outputs clean datasets at the individual play, player, game, and season levels. These datasets allow for the advancement of NFL research in the public domain by allowing analysts to develop from a common source in order to create reproducible NFL research, similar to what is being done currently in other professional sports. Along these lines, we demonstrate how nflscrapR can be used to perform a several important tasks, such as building and evaluating win probability models and expected point models for the NFL, and creating interactive data visualization tools that allow users to explore and compare the statistics of different players. In taking the first step to show use cases of nflscrapR, we build win probability and expected points models using the play-by-plays datasets from 2009-2015. For the win probability model, we used a random forest classification model and cross validation to find the optimal set of variables and parameters to model the winner of each game. The expected points model we build uses multinomial logistic regression to predict

the probabilities of the different scoring events that occur (e.g. touchdown, field goal, etc). By weighting each of the event probabilities by their associated point values, we obtain expected point value of each play. We discuss how other researchers' models for expected points often use linear regression despite the violation of several key assumptions; we note that our multinomial logistic regression approach eliminates these common issues. Through our research and examples, we hope that this motivates other analysts to use the nflscrapR package to further contribute to research in football analytics.

OPTIMIZATION OF SPACES IN HUNT LIBRARY

STUDENTS Timothy Fitzgerald *BHA* • Dee Dee Paik *Economics* • Daniel Park *Economics and Statistics* • Siqi Yang *Statistics* • Derek Young *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Hunt Library serves as the primary location for Carnegie Mellon students to gather and work on assignments, study for tests, and in some cases, eat, and sleep. As CMU students, we have noticed that Hunt Library suffers from severe overcrowding. The library is often restructured in order to better accommodate student needs, such as the removal of open computers on the first floor in favor of whiteboard rooms. However, there does not appear to be any data supporting the efficacy of these changes.

This study answers the question: "How can we optimize the space in Hunt Library to benefit the needs of students?" Our group sampled individual floors of the library at different times of different days for two weeks and observed how different spaces in the library are utilized. We also observed the activity of library printers. After data collection, we looked for correlations between the variables we observed and noted any spaces significantly different from others in terms of usage. Our findings were summarized into recommendations for a new, more effective layout for each floor of Hunt Library, which takes into account the most common behavior patterns students engage in that were observed during our study. These will serve to better optimize Hunt Library for the needs of students.

PORT AUTHORITY BUS RELIABILITY ACROSS PITTSBURGH NEIGHBORHOODS

STUDENTS Meghna Baskar *Economics* • Kiersten Chuc *Statistics* • Suvrath Penmetcha *Information Systems* • Rohit Srungavarapu *Business Administration* • Skye Toor *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:31 am

The purpose of our study is to observe how often Pittsburgh PAT buses actually arrive (i.e. their frequencies), compared to their expected frequencies as stated in official PAT schedules. Buses are notorious for deviating from the official PAT bus frequencies. Pittsburgh residents frequently voice their displeasure with the untimeliness of PAT buses and this study will provide statistically sound evidence to suggest whether or not PAT buses abide by their stated frequencies.

Our study focuses on six neighborhoods closest to CMU. We stratified our sample across neighborhoods and time of day. Our sample was taken from a list of all Pittsburgh bus stops and we selected stops within our neighborhoods of interest. We then randomly assigned the sampled bus stops a time of day, and record bus

frequencies in-person at each stop. Our analysis includes a hypothesis test, where our null is there is stated as "no difference between the actual and stated frequencies".

Our results provide empirical evidence for the differences between the actual frequencies and the theoretical frequencies. This information is invaluable for PAT, specifically how they can better optimize their bus usage across neighborhoods, and can start the conversation about possibilities to improve bus arrival times.

PROFESSOR EXPERIENCE AT CMU

STUDENTS Tyler Barnett *Business Administration* • Blaine Cole *Economics and Statistics* • Alexandra Falk *Biological Sciences* • Benjamin Winebrake *Economics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Our project investigates the unique experiences of professors at Carnegie Mellon and analyzes the data to potentially identify gaps as well as provide useful career advice to aspiring professors. Our motivation for this project was to characterize the colleges within Carnegie Mellon based on the varying backgrounds of their respective professors. To conduct this survey, we took a census of the resumes of professors that are currently on campus in Pittsburgh. To implement the survey, we examined curricula vitae from a list of professors sampled using a stratified random sampling scheme. We stratified our sample by department, so each professor within a department had an equal chance of being selected, and each department was accurately represented. This survey will allow Carnegie Mellon to have a better profile of its professors, provide an opportunity for administration to improve its hiring process. By comparing our survey with FCE's and other sources, we could make possible connections in our analysis to better assess instructor performance. All in all, we are confident that the results of our project would be of interest to students and faculty across America.

RELATIONS OF COUPLES' COMMUNAL AND NONCOMMUNAL LANGUAGE TO SUPPORT AND SELF-CARE FOR PEOPLE WITH TYPE 2 DIABETES

STUDENT Kimberly Hochstedler *Statistics*

ADVISOR Vicki Helgeson *Psychology*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Effective diabetes management depends, in part, on support from one's spouse or romantic partner. We examined the language patients and partners use when working together to manage diabetes. We hypothesized that communal language ("we" pronouns) would be related to more partner support and better diabetes self-care, and noncommunal language ("I" and "he/she" pronouns) would be associated with less partner support and worse diabetes self-care. To address this, interviews with 125 couples in which one person was diagnosed with diabetes within the past 3 years (59% white; 41% black; 55% male; M age = 54) were transcribed. We used LIWC software to count communal and noncommunal pronouns. We also measured partner supportive and unsupportive behavior, marital quality, and patient self-care and self-efficacy. Patient use of communal pronouns was associated with greater partner instrumental ($p = .08$) and emotional support ($p < .05$) and less partner avoidance ($p < .05$), whereas patient use of noncommunal pronouns was associated with less partner instrumental and emotional support and greater partner avoidance (all p's $< .05$). Use of communal pronouns was not associated with marital quality, but noncommunal pronoun use was related to lower marital quality for patients ($p < .05$) and partners ($p = .07$). Patient use of communal pronouns was

associated with greater self-efficacy ($p = .08$), and non-communal pronoun use was associated with lower self-efficacy ($p < .05$). Although patient language was not related to self-care, partner communal pronoun use was associated with better self-care ($p < .05$) and partner noncommunal pronoun use was associated with worse self-care ($p = .06$). In sum, both communal and noncommunal language was associated with partner supportive and unsupportive behavior, but relationships were stronger for noncommunal language. That partner language was linked to better patient self-care suggests the importance of involving partners in diabetes management.

SIMPLE MODLES FOR THE STATISTICAL ANALYSIS OF INEFECTIOUS DISEASE COUNTS

STUDENT Andersen Chang *Statistics*

ADVISOR William Eddy *Statistics*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

One of the most important problems in epidemiology and the study of infectious diseases is how to measure and predict the spread of infectious diseases throughout a population of interest. There are many different ways to model the spread of diseases, with varying levels of depth and complexity. These models allow epidemiologists to answer important questions about an ongoing epidemic either by estimating critical parameters or by providing predictions about the future. We study different infectious disease models in order to determine how accurately they estimate the spread of disease across space-time and provide those predictions and estimates. In particular, we are interested in the performance of epidemiological compartment models, which uses ordinary differential equations in order to represent the transmission of infectious diseases. We analyze different ways of solving for the parameters of epidemiological compartment models and also compare how well epidemiological compartment models fit to a data set compared to a normal linear regression model.

STATISTICAL ANALYSIS OF THE CLATHRIN-COATED PIT FORMATION

STUDENTS Edward Dryer *Science and Humanities Scholars* • Cong Ma Computer *Science* • Quan Yuan *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

We analyzed Total Internal Reflection Fluorescence (TIRF) microscopy measurements of membrane protein transport. We observe intensity profiles of fluorescently-labeled clathrin-coated pits as they form and pinch off from the membrane. Previous research has shown that changes in pit formation rates and duration may be biologically interesting. We analyzed sources of measurement variation in the rates of pit formation, with the goal of quantifying and improving statistical power to detect rate changes. We also analyzed the intensity profile shapes to better understand the features that distinguish the intensity profiles of true clathrin-coated pits from noise.

STATISTICAL RATINGS FOR NATIONAL FOOTBALL LEAGUE PLAYERS WITH EXPECTED POINTS ADDED AUTHOR: DEVIN CORTESE CO-AUTHORS: MAX HOROWITZ, SAM VENTURA

STUDENT Devin Cortese *Statistics*

ADVISOR Samuel Ventura *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Rating and ranking National Football League (NFL) players according to the value they provide is a challenging problem. Players who play the same position aren't necessarily directly comparable, since they are used in varying ways. Additionally, comparing players across positions is even more difficult, since most game statistics are unique to each player position. Expected points added (Burke et al, 2015) is a way to quantify the value of each individual play in a football game. Given the characteristics of a specific play, including the football's location on the field, the down, the time remaining in the game, and several other variables, we are able to calculate the points that the possession team is expected to obtain given these characteristics (Horowitz et al, 2016). Given the expected points of a sequence of consecutive plays, we can then calculate the expected points added at the end of each play. Furthermore, we can credit these points to the players responsible for the play's result. By doing this, we obtain a distribution of the expected points added that can be attributed to each individual player. Using the resulting EPA distributions for each player, we provide statistical ratings of individual players (e.g. with their average EPA), rank players within and across positions (e.g. by their average or total EPA), and assess the variability in EPA for individual players, allowing us to quantitatively assess which quarterbacks play "safe" or "risky" styles. We demonstrate our results on all quarterbacks, running backs, and wide receivers from the 2015 NFL season.

STUDY OF DIETRICH COLLEGE GENERAL EDUCATION SATISFACTION

STUDENTS Kemal Dincer *Economics* • Philip Dominici *Statistics* • Aisha Han *BHA* • Leshaun Jones *Statistics* • Sean Yang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Dietrich college students often have mixed feelings about the interdisciplinary mantra inherent to majoring in the humanities and social sciences, and Dietrich College faculty and staff have recently shown interest in reforming the General Education program based more on their students' needs and educational ambitions. It is possible that students desire more from their classes than major-specific topics, or that they want a variety of classes in different topics that yield skills they might apply in their field of work and everyday lives (through hobbies and other commitments).

In order to observe students' opinions on various general education requirements, we surveyed: overall satisfaction towards each GenEd category, what classes students are actually taking, what classes they want to take, and how these opinions change with class year/major departments. Our survey utilized both rating-based and open-ended questions that help characterize student satisfaction and explain their feelings behind the responses. We implemented an aggregate scoring system to ultimately quantify students' opinions. Overall, Carnegie Mellon students like to know that their schoolwork is meaningful. Our results aim to improve a general education program meant to both cater to Dietrich students' specific needs and take them out of their comfort zones.

THE CMU BUBBLE

STUDENTS Zachary Cree *Statistics* • Noshin Nova *Statistics* • Mariana Robelo *Economics and Statistics* • James Yang *Computer Science* • Xiaofan Zhu *Mathematics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Carnegie Mellon is known for its rigorous coursework, but knowledge of current national and world events is also an important part of education and preparing students to become a part of society. Carnegie Mellon students are often deeply absorbed in their work so we found out how well informed they are and investigated how students can become more informed about current events.

We focused on comparing performance on a current events quiz between freshmen in different demographic groups and different majors at CMU. We conducted a stratified random sample across freshman dormitories and knocked on doors to ask selected students to take our current events quiz. We recorded their major and demographic information about the students, news sources that students used and the amount of time they spent reading the news. We then analyzed whether demographic factors, specific majors, or news sources correlated with performance on the quiz. We predicted that this investigation would reveal commonalities between groups that perform well and could lead to insight into ways to keep students well informed. Perhaps this could motivate future research to help provide easier access to news.

THE STATISTICS BEHIND CMU STEREOTYPES

STUDENTS Kruti Koppolu *Statistics* • Andrew Manka *Statistics* • Pooja Penninti *Self-defined* • Elan Rosenfeld *Computer Science* • Yoona Seon *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Stereotypes about specific colleges at Carnegie Mellon are widespread and can be damaging to students' abilities to cooperate, both in and out of the classroom. In particular, stereotypes about the Tepper School of Business, the College of Fine Arts, and the School of Computer Science are reiterated each year, ensuring that these opinions influence CMU undergraduates' attitudes towards each other. Using stratified random sampling on colleges, our group collected data through a Qualtrics survey about just how commonly (and how strongly) believed these oft-cited stereotypes are, and by whom they are held. We did a general exploratory analysis of our results and fit a linear regression model to the data in an attempt to measure what factors have a significant effect on a student's view of his or her peers. For example, does actually getting to know students of a particular college help to dispel or reinforce these stereotypes? With this information we hope to help inform school administrators on how to best promote understanding and collaboration between colleges.

MELLON COLLEGE OF SCIENCE

BIOLOGICAL SCIENCES

A COST-EFFECTIVE RE-DESIGN OF KAKUMA REFUGEE CAMP, TURKANA COUNTY, KENYA

STUDENT Arsema Thomas *Biological Sciences*

ADVISOR Afeworki Paulos *Univesity Libraries*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Over 1 million people have passed through the Kakuma Refugee Camp in Turkana County, Kenya, since its inception in 1996. During that time the property area has quadrupled, but resources such as the clinic, have remained stagnant. This proposal lays out a possible blueprint that will yield cost-cutting results, and yield a higher quality of life for refugees, through different modes of funding, reallocation of grants, and the use of incentive packages rather than food parcels.

ANALYSIS OF TRANSCRIPTION FACTOR EXPRESSION DURING EARLY EMBRYONIC DEVELOPMENT

STUDENT Apeksha Atal *Biological Sciences*

ADVISOR Charles Ettensohn *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Transcription factors (TFs) are special proteins that control gene expression in eukaryotes. They achieve such a function not only via direct influence on the DNA strand, but also via interactions with co-activator proteins, RNA polymerase II, chromatin remodeling complexes and small, noncoding RNAs. The aim of this proposed project is to identify the regions of the purple sea urchin (S. purpuratus) embryo where certain TFs are expressed. This will involve the use of whole mount in situ hybridization (WMISH) with probes that are to be made specially for the experiment and that bind specifically to the mRNAs that encode the TFs. The TF that will be examined during my project is Smad6. Future implementations of the collected data will involve figuring out how to block the activity of the TFs in question, and to study their effects on embryonic development.

ANALYZING THE FUNCTION OF STUNTED ISOFORMS IN DROSOPHILA MELANOGASTER

STUDENT Janay Parrish *Biological Sciences*

ADVISOR A. Javier Lopez *Biological Sciences*

ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:13 am

Alternative splicing is a major strategy of gene regulation in eukaryotes capable of generating various quantitative and qualitative differences in gene function. It has been demonstrated that alterations in alternative splicing patterns for certain genes correlate with neural degeneration and aging in humans. Using Drosophila melanogaster as a model organism, we have explored alterations in alternative splicing trends during aging across all genes in the genome and have identified a large number number of genes that exhibit age-associated changes, including a number of genes previously shown to impact lifespan.

This project has focused on the stunted gene (sun), which encodes the epsilon subunit of the F1ATPase. The ATPase is responsible for the generation of ATP during aerobic respiration, but although the epsilon subunit is known to be important for its assembly and function, its exact role in this complex is not known. Stunted has two alternative splicing variants whose levels of expression in proportion to one another drastically change prior to the onset of senescence. In order to better understand the roles of these two isoforms, we have generated DNA constructs to overexpress each isoform independently in Drosophila tissue culture cells and are using them to investigate the localization of each isoform and its impact on cell viability and metabolism.

BEAM: BIOSENSOR EMISSION ANALYSIS MACHINE

STUDENTS Ruchi Asthana *Biological Sciences* • William Casazza *Computational Biology* • Donna Lee *Biological Sciences* • Kenneth Li *Biological Sciences* • Wei Mon Lu *Chemical Engineering* • Dominique MacCalla *Materials Science and Engineering* • Niteesh Sundaram *Electrical & Computer Engineering* • Maxwell Telmer *Materials Science and Engineering* • Jordan Tick *Electrical & Computer Engineering* • Michelle Yu *Biological Sciences*

ADVISOR Cheryl Telmer *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Engineered sensors are all around us, biological systems contain natural biosensors that can be utilized to monitor the environment and health of ecosystems and the individuals within them. A critical part of building a sensor is the ability to detect and measure the output. To enable the design and fabrication of DIY biosensors we are creating instructions on how to build a low cost luminometer and fluorimeter. The precision, accuracy, and sensitivity of the instrument will be demonstrated using a set of luciferase and fluorescent protein reporters. The luminometer is a simple photodiode detector and signal is integrated using a Raspberry Pi and output data is processed with open source software. The fluorimeter is an extension that includs an LED light source and emission and excitation filters appropriate for the fluorescent protein to be analyzed. The entire device is encased in a 3D printed shell. To test the luminometer, the luciferases from Gaussia princeps, Renilla reniformis and Photinus pyralis were codon optimized for E. coli and expressed from a strong constitutive promoter and the Gaussia luciferase was extracellularly targeted. Fluorescent proteins including blue, green, yellow, orange and red with different promoter strengths and an estrogen sensitive system were used to calibrate the fluorimeter. To engage the public about synthetic biology and iGEM we have developed a BioLight powered by luciferase. For education purposes, a light, with parts, and a fluorimeter were provided to the "The Citizen Science Lab" in Pittsburgh and we are hopeful that this will excite the community to start building.

CHARACTERIZING KAPPA-OPIATE RECEPTOR EXPRESSING SENSORY AFFERENTS IN THE MOUSE PNS

STUDENT Zeyu Hu *Biological Sciences*

ADVISOR Sarah Ross *University of Pittsburgh*

ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 11:44 am

Peripherally selective kappa-opioid receptor (KOR) agonists are currently being used in clinical trials to modulate chronic and post-operative pain, yet little to nothing is known about the actual KOR expression patterns in the peripheral nervous system. Characterizing the KOR sensory afferent population would therefore contribute greatly

to the development of novel analgesics designed to provide pain-relief while simultaneously bypassing the addictive properties of morphine-like, mu agonists. Here, we show that the KOR is expressed in both large and small cells, two distinct populations of sensory afferents that we speculate to be C-fibers and low threshold mechanoreceptors (LTMRs). Immunohistochemistry data confirmed our hypothesis that the KOR is expressed in multiple specific subsets of primary afferents and retrograde labeling experiments revealed that the peripheral terminals of these sensory afferents include the cutaneous skin, muscle, and bladder while their central terminals terminated at both the superficial and deep laminae layers of the spinal cord. We conclude from preliminary data that the KOR is expressed in at least two subsets of primary afferents and hope to elucidate through future experiments its role in modulating pain and itch.

COMPUTATIONAL MODELING OF 3D IMAGES OF 3T3 CELLS WITH STAINING OF ORGANELLES

STUDENT Minnah Ahn *Biological Sciences*
ADVISOR Robert Murphy *Computational Biology*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:39 am

In previous years, the Murphy lab has developed NIH-3T3 cells that have been subjected to extensive CD-tagging for the cells to express different proteins via EGFP. The lab has also made models of these cell lines to observe the protein patterns. The lab has been able to develop models for unperturbed cells as well as cells that have been treated with various types of drugs. In efforts to expand this database and add input to the CellOrganizer software that the Murphy Lab has been working on, the goal of this project is to produce ample images for unperturbed as well as treated cells of various types of CD-tagged 3T3 cells that have also been stained with the DS Red-Mito mitochondrial staining and Hoechst nuclear staining. This will be differentiated from other models in that there will be 3 different organelles stained. This will enable observations not only of protein distribution in the cells, but also potential relationships between the organelles. For drug treatment, Cycloheximide and Econazole will be utilized. These drugs have been selected among the 48 drugs that have been tested in the Murphy Lab. CellOrganizer will be used to create 3D models from the collected images, and the models will be compared to identify the effects of the drugs on specific aspects of the location patterns.

DETERMINING THE MECHANISTIC BASIS OF THE DECREASE IN MOR ENDOCYTOSIS FOLLOWING CHRONIC MORPHINE TREATMENT

STUDENT Ashita Vadlamudi *Biological Sciences*
ADVISORS Shanna Bowman *Biological Sciences* • Manojkumar Puthenveedu *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Receptor trafficking directly regulates the sensitivity of a cell toward signals in its environment, in this case, opiates. Removal of receptors from the cell surface via endocytosis causes the cell to become desensitized to these environmental signals. Therefore, endocytosis is especially important for determining the signaling duration and downstream functionality of cell surface receptors. Many signaling receptors, like the mu-opioid receptor (MOR) are G-Protein Coupled Receptors (GPCRs) and are the targets of many endogenous endorphins and opiate drugs. Previously, the Puthenveedu lab identified that chronic morphine decreased the endocytosis of MOR induced by DAMGO (DG), a synthetic enkephalin, in HEK-293 cells. It is still unclear as to which cellular component(s) is/

are causing this decrease in endocytosis and why. The chronic morphine experiment is a good assay to measure endocytosis of MOR at a high resolution. Additionally, it can be used to identify the factors that lead to the decrease in MOR endocytosis as it allows for measuring the amounts of MOR and arrestin, which is a scaffolding protein that assists in GPCR endocytosis by binding to the receptor and to the adaptor protein, AP2,within the clathrin coated pits that form during endocytosis. Such an analysis will help identify the specific cellular component that is directly causing the decrease in endocytosis and further experiments may be performed to determine the cause for such behavior.

DEVELOPMENT OF ESTROGEN BIOSENSOR

STUDENT Donna Lee *Biological Sciences*
ADVISOR Cheryl Telmer *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:53 am

The goal of this project is to develop a biosensor that responds to estrogenic compounds. In the larger scheme of things, this can be developed into a real time paper sensor that will allow for the analysis of estrogen or possibly other types of compounds in water.

DISCOVERING BIOMARKERS FOR RHEUMATOID ARTHRITIS-ASSOCIATED INTERSTITIAL LUNG DISEASE USING A NOVEL PROTEIN CAPTURE METHOD

STUDENT Barclay Kaku *Biological Sciences*
ADVISOR Jonathan Minden *Biological Sciences*
ROOM**/TIME** Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Autoimmune diseases are caused by the immune system confusing its own proteins for foreign proteins, either due to genetic or environmental influences. The key difference lies with the change in protein that converts it from a normal “accepted” protein to a “targeted” auto-antigen protein that the immune system’s antibodies attacks. Rheumatoid Arthritis (RA) is one of the most prevalent autoimmune diseases, affecting 2% of our population, and 15-20% of patients with RA develop interstitial lung disease (RA-ILD), which is the leading cause of death in RA patients. We hope to identify the specific auto-antigens recognized by antibodies in the blood samples of RA patients that indicate their progression toward RA-ILD. We will use tissue culture cells to prepare a pool of potential target auto-antigens. We will isolate the target auto-antigens through their binding to patient antibodies. To discriminate between the target proteins of interest from the remaining proteins, Biotin-CDM will be used to reversibly tag target proteins only. All other proteins, such as antibodies, can then be washed away since they are not bound to Biotin-CDM. Biotin-CDM is helpful in enhancing the identity of biomarkers because contamination from other general antibodies is minimized, and we can release the target proteins from Biotin CDM by lowering the pH. We will use DIGE (Difference Gel Electrophoresis) to track the progression of RA’s development into RA-ILD.

EFFECTS OF THE MICROBIOME ON DROSOPHILA MELANOGASTER'S PROTEOME

STUDENT Anna Grace Pyzel *Biological Sciences*
ADVISOR Jonathan Minden *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 11:05 am

The gut microbiome consists of the collection of microorganisms present in the gastrointestinal tract. Germ free fruit flies, which have a diminished gut microbiome, show impairment in geotaxis, phototaxis, and courtship behaviors. In order to study proteomic changes caused by the reduction to the gut microbiome that may give rise to these changes in behavior, 2D difference gel electrophoresis was used to compare the proteomes of conventional and germ free flies. Twelve proteins showed greater than a 2.0 fold difference in abundance between germ free and conventional flies. Of these twelve proteins, six were successfully identified using mass spectrometry.

ELUCIDATING THE MECHANISM OF ANTI-CD20 B CELL DEPLETION RESISTANCE IN LUPUS

STUDENT Jillian Jaycox *Biological Sciences*
ADVISOR Jason D'Antonio *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 11:18 am

Lupus is an autoimmune disease characterized by the production of anti-nuclear antibodies and the aggregation of immune complexes throughout the body, causing heterogeneous organ damage. However, in addition to their role in autoantibody production, B cells have recently been implicated as antigen presenting cells in the activation and expansion of autoreactive T cells. These advances have generated interest in Rituximab, an anti-CD20 monoclonal antibody, as a treatment for Lupus. However, this drug has failed to improve disease in clinical trials. Previous work in our lab has shown that anti-CD20 B cell depletion is poor in lupus prone mice (MRL/lpr), but not in BALB/c (WT) mice. Further, infusion of MRL/lpr serum, specifically the IgG fraction, into BALB/c mice was sufficient to confer B cell depletion resistance to BALB/c mice. Given that clearance of opsonized targets is generally poor in lupus, these findings hint that IgG-mediated defects in macrophage phagocytosis of opsonized B cells may be the cause of poor anti-CD20 B cell depletion in lupus. Therefore, the aim of this project is to elucidate the mechanism of impaired B cell depletion by characterizing the specific autoantibodies that lead to depletion resistance and macrophage impairment. To accomplish this aim, we will use a panel of autoantibodies to investigate which are specifically responsible for poor B cell depletion. We will also investigate the roles of inhibitory and activating signaling in macrophage desensitization during lupus. The goal of this project is to improve the understanding of the roles of B cells and macrophages in lupus and to generate new approaches to improve B cell-targeted therapy in lupus patients.

EVOLUTION OF UORFS IN FRUIT FLIES

STUDENT Laura Parrella *Biological Sciences*
ADVISOR Charles McManus *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 11:31 am

During the course of this research, a method for large-scale collection of fruit fly embryos was developed and carried out. This was achieved by assessment of the current methods for embryo collection, and subsequent

adjustment based on success or failure during execution. The evolution of uORFs in several Drosophila species (D. melanogaster, D. yakuba, and D. pseudoobscura) was then examined. Collection of fruit fly embryos for ribosome profiling has not been achieved at this scale prior, according to the literature. The method developed to collect fruit flies is capable of yielding 20-100 uL of embryos depending on the species, at peak laying in optimal conditions. So far, the method has been developed and the necessary volumes of embryos collected per species. Additionally, a polysome assay has been completed for one species of Drosophila. Following, ribosome profiling assays will be completed for each species of Drosophila. Ribosomes are suspended in emetine-containing buffer, and then frozen in liquid nitrogen to inhibit ribosomal procession along messenger RNA. Embryos are then ground and nucleic acid digested, followed by a polysome assay to check for success of digestion. If successful, the ribosome protected fragments (RPFs) can then be sequenced and ribosomal occupancy assessed across species.

EXPLORING EDUCATIONAL ENTERTAINMENT: PROJECT FANTASCI

STUDENT Jamie Zhan *Biological Sciences*
ADVISOR James Wynn *English*
ROOM/TIME Peter / 2:00 pm

Achieving the perfect balance of education and entertainment has been the goal of educators the world over. This project explores the genre of science-fiction as a tool to challenge readers to learn the nitty-gritty details of basic science.

INVESTIGATING METAL-ION BINDING EFFECTS ON THE DYNAMICS OF ECORV-DNA COMPLEX USING PARAMAGNETIC RELAXATION ENHANCEMENT (PRE) AND X-RAY CRYSTALLOGRAPHY

STUDENT Masha Osman *Biological Sciences*
ADVISOR Gordon Rule *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 10:13 am

This study was conducted in order to gain a better understanding of how protein-DNA complexes form and interact. In general, non-sequence specific binding is known to occur between proteins and DNA. However, it is important to determine the interactions that take place in sequence-specific binding between proteins and DNA sequences, and additionally to observe changes in the protein itself when it binds specifically to DNA sequences. EcoRV was the restriction endonuclease of choice for our experiments because of the presence of several reference structures and the fact that it undergoes sequence-specific binding with DNA. To analyze the protein-DNA complex in solution, paramagnetic relaxation enhancement (PRE) was used in coordination with proton NMR. Lanthanides were used in the active sites instead of Mg2+ to prevent cleavage of the complex and allow for the study of the EcoRV-DNA-Lu complex in its entirety. X-ray crystallography was also utilized in order to determine the crystal structure of the complex and identify the exact locations of the active sites where metal ions bind. Through x-ray crystallography and PRE studies, we were able to solve the crystal structure of the EcoRV-DNA-Lu complex and gain an insight into the interactions within the complex that are present before cleavage.

LOW-COST PURIFIED WATER INDICATOR

STUDENTS Abhinav Gautam *Electrical & Computer Engineering* • Dominique MacCalla *Materials Science and Engineering* • Courtney Pozzi *Design* • Ashwath Sankar *Biological Sciences* • Elizabeth Starck *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Wiegand Gymnasium - BME Design / 12-2:30 pm

One in seven people have no access to clean drinking water, but current solutions are either too expensive or too culturally disruptive for many poor families. KOPO, LLC. developed the Kopo Can that purifies water while preserving the tradition of collecting water communally, a practice commonly carried out with jugs shaped like the Kopo Can. The Kopo Can disinfects water using the solar disinfection (SODIS) method that combines UV radiation and heating. Simply fill the Kopo Can with contaminated water, set it in the sun for 6 hours, and the solar exposure disinfects the water. Currently the users are told to leave the Kopo Can out for a day on a sunny day and for 2 days on a cloudy day. This reduces the efficacy of water purification where on a 12 hour sunny day, two cans of water can be purified. Plus, there is no way to tell if the Kopo Can has received enough UV radiation, which is responsible for destroying bacteria and other microorganisms. Current indicator designs on the market are either electronic based and/or are too expensive for developing countries to implement. The KOPO team approached us to create a solution that is affordable and culturally appropriate for targeted users who make less than $2 a day. Overall, we created an inexpensive, sustainable indicator, with an intuitive design that can easily indicate to users if their water has been purified using the SODIS method.

OLYMPICS AND RACE: THE RESPONSE OF THE UNITED STATES SPORTING COMMUNITY TO SOUTH AFRICAN APARTHEID AND ITS EFFECTS ON THE REGIME

STUDENT Bridget Hunt-Tobey *Biological Sciences*

ADVISOR Steven Schlossman *History*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

From 1948-1994, South Africa's government was a system of racialized segregation that resulted in major disenfranchisement and socioeconomic discrimination for people of color throughout the country. South Africa was not the only country with institutionalized discrimination during this time, but it was the most internationally well known and the most frequently criticized in worldwide media. In the international sporting community, the opposition to apartheid developed over time during the post-war period and resulted in multiple exclusions of South African teams in different sports across the world. Ultimately, South Africa underwent almost total sport isolation as a result of its discriminatory practices at home. In conducting preliminary research on this topic, I have found it difficult to find information that gives an overall picture of the international sporting world's response to South African apartheid, and to determine whether formal governmental responses were in line or not with the views of the majority of the citizenry in each country involved. Studying apartheid in sport will provide an additional mechanism of examining cultural racial discrimination in South Africa. The research question that I would like to explore is: what were the responses of the governments of the United States to segregated, South African sport in the half-century following World War II, and whether the government's position reflected or differed from the opinions held by most citizens in the U.S.? I will be determining public opinion using newspaper articles that discussed sport and

apartheid in the U.S in the given time period. I will likely focus on letters from the editor and editorials for general opinions, and I will analyze other articles to determine the newspaper's general stance on sport and apartheid.

PREDICTING EATING BEHAVIOR WITH VISCERAL AND VISUAL ASSESSMENTS OF HUNGER

STUDENT Nina Hill *Biological Sciences*
ADVISOR Kasey Creswell *Psychology*
ROOM/TIME Pake / 3:20 pm

Self-report measurements are often used to assess feeling states, and psychologists generally assume that people are able to accurately capture and express how they are feeling. Research over the past two decades, however, has shown that asking people to verbalize their feelings can actually disrupt the experience of emotion and cause individuals to 'lose touch' with their own hedonic states (Schooler, 2002). There is growing interest in identifying more basic and direct ways to assess feeling states that may be less subject to biases inherent in self-report. We recently developed a novel "visceral" measure of hunger (i.e., squeezing a handheld dynamometer) and showed that dynamometer measures of hunger were a better predictor of eating behavior than self-reported hunger on a traditional 0-100 rating scale (Creswell et al., in press). The current study aimed to extend these findings by comparing the predictive utility of the dynamometer to another commonly used self-report hunger scale (i.e., a visual analog scale; VAS). Consistent with our prior findings, we predicted that the dynamometer would be a better predictor of eating behavior than the VAS. However, the VAS and dynamometer were comparable in their ability to predict eating behavior, perhaps because the VAS did not require participants to translate their feelings into numerical representations as in our prior study. Conditions under which the dynamometer may offer a better assessment technique than traditional self-report measures will be discussed.

PRENATAL DISRUPTION REDUCES THE NUMBER OF HIPPOCAMPAL NNOS+ INTERNEURONS: IMPLICATIONS FOR LIMBIC HYPERACTIVITY IN SCHIZOPHERNIA

STUDENT Hannah Rhee *Biological Sciences*
ADVISOR Daniel Brasier *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:26 am

Transient disruption of neurodevelopment induced by exposure of the developing fetus to the mitotoxin methylazoxymethanol (MAM) in the rodent produces neuroanatomical abnormalities resembling those associated with schizophrenia. In addition, this manipulation produces hyperdopaminergia and behavioral phenotypes that are consistent with schizophrenia. Therefore, MAM exposure to the rodent provides a useful model for understanding how neuroanatomical abnormalities can give rise to altered circuits and ultimately, altered behavior and cognition. This model, which was developed in the Grace lab, has been used to describe an aberrantly active circuit from the hippocampus to dopamine neurons of the ventral tegmental area. These results suggest that novel treatments for schizophrenia should be designed to normalize hippocampal activity. However, it is unclear how hippocampal activity and cellular structure are changed by MAM treatment. In this proposal, we aim to address those questions by histological quantification of interneurons and electrophysiological recording of hippocampal pyramidal neurons.

PROFESSOR EXPERIENCE AT CMU

STUDENTS Tyler Barnett *Business Administration* • Blaine Cole *Economics and Statistics* • Alexandra Falk *Biological Sciences* • Benjamin Winebrake *Economics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Our project investigates the unique experiences of professors at Carnegie Mellon and analyzes the data to potentially identify gaps as well as provide useful career advice to aspiring professors. Our motivation for this project was to characterize the colleges within Carnegie Mellon based on the varying backgrounds of their respective professors. To conduct this survey, we took a census of the resumes of professors that are currently on campus in Pittsburgh. To implement the survey, we examined curricula vitae from a list of professors sampled using a stratified random sampling scheme. We stratified our sample by department, so each professor within a department had an equal chance of being selected, and each department was accurately represented. This survey will allow Carnegie Mellon to have a better profile of its professors, provide an opportunity for administration to improve its hiring process. By comparing our survey with FCE's and other sources, we could make possible connections in our analysis to better assess instructor performance. All in all, we are confident that the results of our project would be of interest to students and faculty across America.

ROLE OF ALTERNATIVE ISOFORMS OF THE F1-ATPASE EPSILON SUBUNIT IN AGING AND OXIDATIVE STRESS

STUDENTS Daniel Evans *Biological Sciences* • Kathryn Hanson *Chemistry*

ADVISOR A. Javier Lopez *Biological Sciences*

ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:00 am

Improvements in public health have steadily increased average life expectancy throughout the modern era. One negative consequence of this development has been the increase in prevalence of disease and dysfunction associated with advanced age. Previous research has shown that oxidative stress can alter gene expression and metabolic function and may contribute to aging. The Drosophila homolog of human mitochondrial ATPase subunit epsilon is encoded by the gene stunted. Mutation of this gene increases lifespan and resistance to oxidative stress but the mechanism is unknown. Alternative splicing of the stunted transcripts generates two alternative protein isoforms, whose ratio changes with aging and under oxidative stress. Our goal was to investigate the functional effects of the two isoforms and the change in their ratio by altering their expression experimentally. These studies could lead the way to therapeutic strategies that reduce disease-causing damage to genetic material during aging.

STRUCTURE-FUNCTION ANALYSIS OF TWIST1-E2A TRANSCRIPTIONAL ACTIVITY IN KRAS-DRIVEN NON-SMALL CELL LUNG CANCER

STUDENT Susheel Khetarpal *Biological Sciences*

ADVISOR Jason D'Antonio *Biological Sciences*

ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 10:26 am

Non-small cell lung cancer (NSCLC) remains a significant mortality burden with severely limited treatment options. A common oncogenic driver of NSCLC is mutant KRAS, which is found in 25% of adenocarcinomas of the lung. A potential target for KRAS mutant NSCLC is TWIST1, a basic helix-loop-helix transcription factor that drives tumorigenesis through oncogenic gene expression in concert with KRAS. We recently demonstrated that TWIST1 is essential for tumor maintenance in human NSCLC containing mutant KRAS, mutant EGFR, or amplified or mutant MET. Moreover, we have shown that TWIST1 cooperates with KRAS to induce adenocarcinoma of the lung in mouse models and that inhibition of TWIST1 in both a murine model and in human cell lines causes OIS or in some cases apoptosis. In the current study, we engineered domain-specific mutations in TWIST1 to determine the impact of altered DNA binding, dimerization and post-translational modifications on its transcriptional activity by luciferase reporter assays. Testing the promoter activity at three TWIST1-regulated loci involved in tumorigenesis, YBX1, SNAI2, and FLIP, we found that that DNA binding and nuclear localization were uniformly required for TWIST1 transcriptional function. However, phosphorylation, TWIST1 box function, and dimerization impacted TWIST1 activity in a locus-specific manner. Previous studies have demonstrated that TWIST1 dimerizes with E2A proteins. We have shown that silencing of E2A phenocopies loss of TWIST1 in NSCLC and demonstrated that formation of the TWIST1-E2A heterodimer results in a reciprocal stabilization of the binding partner. Therefore, we sought to determine how differential dimerization by TWIST1 might modulate tumorigenic gene expression. We generated tethered TWIST1 dimers with either TWIST1 or E2A proteins (E12 and E47) to form TWIST1-TWIST1 (homodimer) or TWIST1-E12 or –E47 (heterodimers), and tested their transcriptional activities at several TWIST1-regulated promoters. We found that TWIST1-E2A heterodimers could enhance TWIST1 transcriptional activity compared to that of the TWIST-TWIST homodimer. In addition, we determined that the TWIST-E2A heterodimer is degraded by harmine, a harmala alkaloid known to degrade TWIST1, whereas the TWIST-TWIST homodimer is resistant to harmine treatment. This suggests that the TWIST1-E2A heterodimer is the key target of harmine. Furthermore, we have found that overexpression of the TWIST1, E2A proteins, or the TWIST1-E2A heterodimer is able to partially rescue harmine induced cytotoxicity. Taken together, these data suggest that E2A is essential for TWIST1 mediated tumorigenesis and that targeting of the TWIST1-E2A axis may be an effective therapeutic strategy against oncogene driven NSCLC.

SURVEY OF PATIRIA MINIATA GENES INVOLVED IN LARVAL REGENERATION

STUDENT Katherine Huang *Biological Sciences*
ADVISORS Gregory Cary *Biological Sciences* • Veronica Hinman *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 10:39 am

Regeneration is the recreation of lost body tissues. Larval sea stars (Patiria miniata), used in this survey, regenerate rapidly when bisected into anterior and posterior halves. Studies with planarian flatworms, also extensive regenerators, found genes that modulate regeneration, and tests of whether homologous genes in sea stars have corresponding functions can show if the process of regeneration is homologous. RNA-sequencing data identified differentially expressed genes during larval sea star regeneration, and five representative homologs from the data are surveyed here: Egr and Wee1 have high expression early and low expression late in the process, while Runt, Cbfb, and Bmp3b have low expression early and high expression late or are upregulated constitutively. Because these trends occur in both anterior and posterior regenerating segments, these genes may be needed for general regenerative processes, likely including wound healing and cell proliferation. In fact, Runt and Cbfb have been found responsible for cell survival, differentiation, and proliferation during embryogenesis in the sea urchin, a closely related species. I synthesized probes for these five genes to study their spatiotemporal expressions by whole-mount in situ hybridization, then conducted the in situ experiments along with an EdU proliferation assay. The EdU assay checks that the expressions coincide with proliferating cells at the regenerating pole, to support the involvement of the genes in regeneration. The gene expression data can help formulate more specific hypotheses regarding the regenerative roles of these genes. If homologous genes play similar roles during regeneration in unlike species, there may be a common ancestral mechanism for regeneration that other animals, including humans, have secondarily lost. Long-term studies could seek to reverse this loss and lead to advancements in regenerative medicine.

SYNTHESIS OF BIOACTIVE NATURAL PRODUCTS

STUDENT John Hong *Biological Sciences*
ADVISOR Xinyu Liu *University of Pittsburgh*
ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 10:39 am

Bioactive natural products are compounds found in nature that could potentially have medicinal purposes. Compounds are isolated, separated, and screened for a certain biological activity, wherein that compounds is then purified and characterized for structural information. Once a structure is determined, the compound may be then chemically synthesized, and derivatives of that compounds may also be made for testing. Finding a short and high yield synthetic route is often very tricky for many compounds, inspiring the search for more robust reactions common among many of these compounds. Small peptide molecules are an example of a bioactive natural product that can have a certain desired biological activity. Modified unnatural derivatives of these peptide molecules can be made in search of higher levels of activity and to help determine these peptide molecules' target protein.

THE EFFECT OF GUT MICROBIOTA ON HEAT SHOCK RESPONSE

STUDENT Taechawidd Nantawisarakul *Biological Sciences*

ADVISOR Brooke McCartney *Biological Sciences*

ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 10:52 am

The microbiome refers to the collection of bacteria and fungi that live in and on our bodies. This term is customarily associated with metabolism and the immune system. However, the microbiome has also been recently associated with learning, memory, anxiety, depression, and autism. Heat shock proteins are chaperones that fold proteins that have been denatured or changed by heat stress. At a genetic level, heat shock protein (Hsp) 27, 70, and 83 have been implicated in neurological disorders including schizophrenia, Parkinson's disease and epilepsy. Quantitative PCR (qPCR) was used to quantify the expression of Hsp27, Hsp70, and Hsp83 in heat stress and non-heat stress conditions. This experiment suggested that Hsp27, Hsp70, and Hsp83 expression are all decreased in germ free flies when compared to conventional flies. Future experiments include completing biological replicates to establish statistical significance. Additionally, mechanisms of action of heat shock protein in germ free flies will be studied.

THE FRAS/FREM PROTEIN FAMILY IN S. PURPURATUS SEA URCHINS

STUDENT Xian Chang *Biological Sciences*

ADVISOR Charles Ettensohn *Biological Sciences*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The Frem2 protein was identified in the sea urchin species L. variegatus as a component of extracellular matrix fibers, which interact with migratory primary mesenchyme cells (PMCs) during development. As such, it is a potential PMC binding molecule and Frem2 containing fibers may guide PMC migration. In my project, I investigated possible orthologues of this protein in the sea urchin species S. purpuratus. My goal was to catalogue related proteins in S. purpuratus and to determine the location of expression of these proteins during development. To accomplish this, I identified possible orthologues of the L. variegatus Frem2 protein and performed whole mount in situ hybridization in order to visualize the expression of these proteins during different stages of development.

THE ROLE OF PI3 KINASE C2A IN THE CELLULAR TRAFFICKING OF THE DELTA-OPIOID RECEPTOR (DOR)

STUDENT Marlena Darr *Biological Sciences*

ADVISORS Manojkumar Puthenveedu *Biological Sciences* • Daniel Shiwarski *Biological Sciences*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The delta-opiod receptor (DOR) is a GPCR that is localized internally and on the surface of human sensory neurons. Drugs that treat chronic pain are often opioid receptor agonists, but the majority of these drugs target the mu-opioid receptor (MOR). DOR may be a better alternative target for chronic pain relief than MOR because studies have shown that DOR activation is not associated with the negative side effects and addiction that are common with MOR agonists. Previously, DOR has not been targeted clinically due to its low agonist efficacy in patients. Because DOR is retained inside of the cell, drugs are not able to activate this receptor efficiently. It may be possible to drive DOR to the surface by targeting specific components of its exocytic pathway. PI3 kinase

C2A may be one target in this pathway. PI3 Kinase C2A is sufficient to increase surface expression of DOR by phosphorylating lipids on the golgi apparatus membrane which recruits trafficking machinery that facilitate cell surface delivery. If it can be determined that this kinase is required in this pathway, it may be a good candidate as a drug target to increase surface expression of DOR. By increasing DOR expression at the surface, the efficacy of DOR agonists will increase and will allow for lower and safer doses to be used for chronic pain management.

VALIDATING ENHANCERS THAT REGULATE SKELETOGENESIS IN THE SEA URCHIN EMBRYO

STUDENT Nathalie Chen *Biological Sciences*

ADVISOR Charles Ettensohn *Biological Sciences*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

A primary goal of developmental biology is to understand how the genome directs morphogenesis. One way to understand this is by examining how the genome is used to create specialized cells with specific functions. Gene regulators have been found to be very important to development due to their ability to regulate cell-type specific gene expression. Enhancers, a type of gene regulator, are able to direct when and where a gene is expressed. This enables cells to selectively express genes required for their function during development.

As a result, studying how enhancers regulate gene expression is critical to understanding how the genome is able to direct morphogenesis. A genome-wide screening conducted in the Ettensohn lab has identified several potential enhancers associated with the development of the skeletal system in the purple sea urchin embryo (S. purpuratus), but their functions have yet to be validated. My project aims to verify one of the putative enhancers by generating a reporter construct and testing its activity by injecting it into sea urchin eggs and assaying for green fluorescent protein (GFP) expression. Verifying a putative enhancer involved in skeletogenic gene expression will contribute to our understanding of how the genome directs one type of morphological process during the development of an organism.

CHEMISTRY

A STUDY IN THE MECHANISM OF THE EPOXIDATION REACTION IN THE BIOSYNTHESIS OF VIRIDICATIN

STUDENT Justin Lee *Chemistry*

ADVISOR Yisong Guo *Chemistry*

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Biosyntheses of natural products are often facilitated by enzymes, and studying their mechanisms can assist in various industrial and pharmaceutical settings. AsqJ desaturates cyclopeptin, and then installs an epoxide group in the subsequent intermediate dehydrocyclopeptin, which leads to the formation of viridicatin, a secondary metabolite investigated for pharmaceutical applications. The objective of this study is to elucidate the mechanism behind the enzymatic epoxidation of dehydrocyclopeptin by AsqJ by observing the kinetics of the reaction and change in electronic properties of the metal active center using stopped flow UV-Vis Absorption and Mössbauer

spectroscopy. An Fe(IV)-oxo intermediate has been experimentally observed for the first time in a non-heme iron oxygenase-catalyzed epoxidation reaction.

ATTACK - A TARGETABLE K SENSOR

STUDENT Bruce Feldman *Chemistry*

ADVISOR Marcel Bruchez *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 10:26 am

A description of the synthesis and applications of a targetable potassium sensor

BLURPH: A GENETICALLY, TARGETABLE, FAR-RED RATIOMETRIC PH SENSOR

STUDENT Mackenzie Skwierczynski *Chemistry*

ADVISOR Marcel Bruchez *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 10:39 am

Malachite Green (MG) is a fluorogen which when bound to Fluorogen Activating Protein(FAP) emits in the far-red region. The brightness of the MG-FAP complex has been enhanced using fluorescent donors like Cy3 and Rhodamine that donate into the primary excitation band of the MG-FAP complex. Previously, we have shown that tandem dyes consisting of 7-hydroxycoumarin-3-carboxylic acids linked to a MG chromophore show efficient energy transfer between the coumarin and the secondary excitation band of the MG-FAP complex, to obtain a far-red emission under violet (405 nm) excitation. In this work, we show that using electron withdrawing substituents on the coumarin moiety tuned the pKa of the hydroxyl group to generate a variable fluorescence excitation ratio under different pH conditions. The coumarin-MG tandem dye(BluRpH)-FAP complex behaves as a ratiometric probe that responds to changes in the pH, and is freely cell-permeant. These properties are being used to study the trafficking of proteins from the neutral trans-golgi network (TGN) to the acidic lysosome in real-time in living cells. The fluorescence output of these experiments would indicate the pH of different organelles and that the trafficking takes place through the early and the late endosome. The synthesis of BluRpH dyes, steady-state biochemical and fluorescence behavior and the use of these probes to visualize trafficking into the lysosome will be presented.

CHARACTERIZATION OF A TANDEM FLUOROGEN-POLYMER PROBE FOR THE SENSING OF SELECT PROTEIN INTERACTIONS

STUDENT Christina Cabana *Chemistry*

ADVISOR Marcel Bruchez *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 11:44 am

Protein interactions are an essential part of living organisms; when these interactions are disrupted cells experience diseases ranging from addiction, to cancer, to neurodegenerative disorders and so on. To better understand these interactions, fluorescent proteins such as GFP are commonly used to monitor cellular proteins in vivo. However, these systems are non-specific in their activation which leads to a large amount of background signal. Fluorogen/FAP systems have been implemented in recent years to address these problems. In these systems a fluorogen activating protein (FAP) such as dK binds a non-fluorescent dye such as malachite green (MG) resulting in an

increase in fluorescence. In this study, poly(oligoethoxy)methacrylate, a water soluble and cell permeable brush polymer, was end functionalized with both MG, and a hexyl chloride ligand. In the proposed system dK will bind MG reversibly, while the hexyl chloride ligand will bind covalently to dehalogenase proteins. Protein interactions will be measured after washing off all probe not anchored to a dehalogenase enzyme. All fluorescent signal will then correspond to the simultaneous binding of hexyl chloride and MG to their corresponding proteins. To test the feasibility of this probe, dK was expressed on the surface of S. cervisae and purified from E. coli. The fluorescent properties of the polymer probe, as well as its binding affinity to dK were tested using fluorescence spectroscopy, fluorescence microscopy, and flow cytometry. The results indicated that the polymer was able to be washed from the cell surface and that it was bright enough to yield meaningful measurements about what fraction was bound. In this way, the polymer probe complex shows potential as an important tool in the sensing of protein interactions.

CHARACTERIZATION OF PYROLYSIS BYPRODUCTS OF POLYACRYLONITRILE

STUDENT Gabriella Cottiero *Chemistry*
ADVISOR Tomasz Kowalewski *Chemistry*
ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 11:05 am

In recent years, hydrogen has gained attention as a clean, high energy alternative to current fuel sources such as oil. One of the methods that is currently being investigated to produce hydrogen is photocatalytic water splitting, in which solar energy is used to convert water into hydrogen and oxygen. This process is particularly attractive due to its use of renewable, inexpensive resources to produce hydrogen. However, it typically requires the use of metal catalysts, which are often extremely expensive. This has motivated research to investigate the possibility of using a carbon-based photocatalyst. In particular, fluorescent polymer-derived nanocarbons, produced by pyrolysis of polyacrylonitrile homopolymer, have demonstrated potential as photocatalysts in a water splitting system. Because it does not require any metal catalysts, this system has a substantially reduced cost compared to others that are currently in use. Spectroscopic analysis of these polymer-derived nanocarbons has been performed, in order to better understand their structural and electronic properties.

DEVELOPING RTD-1M: OPTIMIZING AN ANTIMICROBIAL PEPTIDE

STUDENT Julia Atwood *Chemistry*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 11:05 am

Defensins are a class of antimicrobial peptides that include , , and -forms. Homo sapiens produce types of both linear defensins, and . -defensins are of interest as a starting base for a novel drug candidate because of their increased in vivo stability and demonstrated immunomodulatory, antiviral, antifungal, and antibiotic properties. The Ly Group has produced and is investigating a synthetic mimic of Rhesus Theta-Defensin I (RTD-1M/RTD-1) as a potential novel antimicrobial. RTD-1M is synthesized using PNA to maintain structural integrity during synthesis. This mimic has been shown to be as effective as RTD-1 against strains of Gram (-) and Gram (+) bacteria in a bactericidal assay, while remaining non-toxic to mammalian red blood cells in a hemolysis assay. The structural properties of several current peptide antibiotics suggest modifications to RTD-1M that may improve its antibacterial potency. Current research is aimed at optimizing synthesis and building several iterations of RTD-1M to test the impact of structural modifications.

DEVELOPMENT OF LONG-LIVED GREEN OXIDATION CATALYSTS FOR WATER TREATMENT

STUDENT Kyle Jansen *Chemistry*
ADVISOR Terrence Collins *Chemistry*
ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 11:44 am

Water pollution has become a major environmental issue of the past few decades as a result of industrial growth throughout the world. Water treatment is typically performed using chlorine-based technologies, which result in toxic byproducts, while more environmentally friendly alternatives, such as ozone, are cost prohibitive. TAML activators are cost effective, environmentally friendly catalysts that mimic naturally occurring enzymes to break down persistent pollutants in water. While the reactivity of TAML activators has been maximized through iterative ligand design, further improvements are structurally limited. As a result, a new functional group has been introduced with the dual purpose of increasing the Lewis acidity at the iron center and blocking a known intramolecular degradation process. In this project, a new class of catalysts incorporating this functional group has been synthesized and preliminary catalytic testing has shown superior breakdown of pollutants compared to TAML activators.

DISCOVERY OF PH DEPENDENT TRIPLEX FORMING BEHAVIOR IN MIXED BACKBONE PNAS

STUDENT Mallory Evanoff *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Previous research on peptide nucleic acids (PNA) has shown that these synthetic molecules can act as probes for control of gene expression, a behavior that has ramifications as both a research and potential therapeutic tool. In the Armitage Lab, we study a set of PNAs containing gamma () modified monomers. These PNAs contain a modified backbone that incorporates a diethylene glycol moiety, resulting in improved solubility, stability, and selectivity of PNA probes for right-handed oligonucleotide target sequences. We present the novel discovery that a cytosine (C) rich PNA sequence made of modified and unmodified monomers displays pH dependent triplex forming behavior when targeting complementary DNA. This behavior was monitored with thermal denaturation absorption measurements and circular dichroism (CD). This mixed backbone C-rich PNA, showing previously unreported triplex forming behavior, has the potential to be used as a probe for gene regulation in future experiments.

IMAGING LIVE CELL MRNA WITH PNA FRET PROBES

STUDENT Sukjin Jang *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 11:18 am

Ribonucleic acid, often abbreviated as RNA, is a polymeric molecule involved in various biological roles such as coding, decoding, regulation and expression of genes. RNA is further classified into various types depending on their roles. In protein synthesis, messenger RNA (mRNA) holds the genetic information that is translated into amino acid sequence in the ribosome. Transfer RNA (tRNA) then decodes the mRNA, and converts it into amino

acid sequence. Finally, ribosomal RNA (rRNA) links the amino acids. Thus, mRNA plays a crucial role as a genetic intermediary in biological systems, and studying the dynamics of mRNA is important to understand how protein synthesis is regulated. In order to study the dynamics of mRNA, mRNA must be monitored in a live cell, such that the temporal and spatial information of the RNA is captured. However, in contrast to great progress in protein imaging, there has been significantly less development in RNA imaging. Given the growing awareness of diverse functional roles of RNA in cells, the proposed project involves developing a novel live cell imaging technique for studying mRNA dynamics. The initial design of the imaging system relied on binary Förster resonance energy transfer (FRET) probes, and the basic idea of the design was to tag the targeted mRNA with PNA probes which have fluorescent dyes. The intent of the design was to lower the background noise and increase the brightness of the fluorescent tags. This project aims to further optimize the initial system developed last summer by using a different pair of PNA probes which have fluorescent dyes that are brighter, and have greater spectral resolution to improve signal-to-noise. Experiments will include (a) FRET spectroscopy studies with PNA probes and DNA/RNA target sequences; (b) melting temperature studies between the probes and the DNA/RNA targets to study the binding behaviors; (c) co-transfection of the binary PNA probes into HEK293 cells for live cell imaging. Successful completion of the project will introduce a new method of mRNA live celling imaging that has the potential for targeting endogenous mRNA.

INVESTIGATING THE NEURAL BASIS OF INDUCTIVE INFERENCE

STUDENTS Kaoon Ban *Science and Humanities Scholars* • Kevin Long *Chemistry*
ADVISORS Anna Fisher *Psychology* • Layla Unger *Psychology*
ROOM/TIME Peter / 11:40 am

The purpose of this study is to investigate the neural activity underpinning inductive inference. Inductive inference is a powerful way of generating new knowledge by generalizing information that is known about familiar things to new things. In order for inductive inference to generate reliable knowledge, the new things to which known information is generalized must be selected on the basis of some kind of relationship between them and the familiar things. Two such relationships that play a critical role in inductive inference are similarity, which links things that are overall perceptually similar, and rules, which link things that share specific features that determine the categories to which things belong. Past research suggests that, for other forms of reasoning, similarity-based processes involve posterior perceptual brain regions, whereas rule-based processes involve frontal brain regions. However, several open questions about the neural basis of inductive inference remain, including whether the distinct patterns of neural activity associated with similarity versus rule-based reasoning are characteristic of inductive inference, and the role of these distinct patterns of activity in the development of inductive inference. To address these questions, this study will measure neural activity during an inductive inference task using a non-invasive imaging technology, Near Infrared Spectroscopy (NIRS). By doing so, this study will both illuminate the neural basis of rule vs. similarity-based inference, and provide a picture of the end-point of inference development.

KINETIC STUDIES OF SARA ATRP AND ITS APPLICATION IN SYNTHESIS OF MOLECULAR BRUSHES

STUDENT Yidan Cong *Chemistry*

ADVISOR Krzysztof Matyjaszewski *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 11:31 am

To decrease the amount of copper catalyst used in traditional atomic transfer radical polymerization (ATRP), supplemental activator and reducing agent (SARA) ATRP, which uses Cu(0) to reduce Cu(II) complex as well as activate alkyl halides, was explored as an alternative synthetic method. The rate of activation of alkyl halide by Cu(0) was investigated for various ligand, solvent, and initiator systems. The mechanism of SARA ATRP was studied by computational simulations using PREDICI to compare the relative rate between disproportionation and comproportionation. According to computational result, comproportionation proceeds faster than disproportionation. Finally, performance of SARA ATRP was tested by synthesizing OEO22MA based molecular brushes in aqueous media.

LIGNIN GRAFTED POLYMERS AS A CEMENT SURFACTANT

STUDENT Emily Charleson *Chemistry*

ADVISOR Newell Washburn *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 5 / 11:18 am

Lignin is a by-product formed when using corn stover to make ethanol or in paper production. Additionally, lignin is abundant and is a greener alternative to other chemicals in surfactants and providing a use for this by-product reduces waste. Two types of lignin, lignosulfonate and kraft lignin, were used to create a lignin grafted polymers to be used as a surfactant for cement. This research investigates the effects of lignin chemistry on the resulting surfactant properties. Lignin was PEGylated with tosylated methyl polyethylene glycol (mPEG-TS) in an SN2 reaction. Varying molecular weights were used for both ligin types: 900, 2,000, and 5,000. Dialysis, a technique that utilizes osmosis, was performed in order to purify these samples. Once purified, the samples were used to determine surface tension. Both the results from lignosulfonates and kraft lignin showed that as concentration increased, surface tension decreased. This shows that lignin allows for two different phases to mix, showing that it is successful as a surfactant. Currently, emulsions with water and cyclohexane are being performed, as is interfacial surface tension.

ROLE OF ALTERNATIVE ISOFORMS OF THE F1-ATPASE EPSILON SUBUNIT IN AGING AND OXIDATIVE STRESS

STUDENTS Daniel Evans *Biological Sciences* • Kathryn Hanson *Chemistry*

ADVISOR A. Javier Lopez *Biological Sciences*

ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:00 am

Improvements in public health have steadily increased average life expectancy throughout the modern era. One negative consequence of this development has been the increase in prevalence of disease and dysfunction associated with advanced age. Previous research has shown that oxidative stress can alter gene expression and metabolic

function and may contribute to aging. The Drosophila homolog of human mitochondrial ATPase subunit epsilon is encoded by the gene stunted. Mutation of this gene increases lifespan and resistance to oxidative stress but the mechanism is unknown. Alternative splicing of the stunted transcripts generates two alternative protein isoforms, whose ratio changes with aging and under oxidative stress. Our goal was to investigate the functional effects of the two isoforms and the change in their ratio by altering their expression experimentally. These studies could lead the way to therapeutic strategies that reduce disease-causing damage to genetic material during aging.

SILOLE POLYMERS FOR ORGANIC ELECTRONICS

STUDENT Claire Dingwell *Chemistry*
ADVISOR Kevin Noonan *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This project will attempt to synthesize a silolo[2,3-c]-thiophene polymer that shows promise as an acceptor for organic electronics. These molecules are useful because they can be used in new electronics with better performance and reduced costs compared to current electronic devices.

SYNTHESIS AND CHARACTERIZATION OF FE3O4 NANOCUBES

STUDENT Alicia Wu *Chemistry*
ADVISOR Sara Majetich *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

With the aim of better understanding the self-assembly and magnetic properties of nanocubes, I will test several different approaches for Fe3O4 nanocube synthesis and characterize the resulting particles. Synthesis will be accomplished through high temperature thermal decomposition of iron precursors. Following synthesis, I will analyze the nanocubes through data from transmission electron microscopy (TEM), superconducting quantum interference device (SQUID) magnetometry, and atomic absorption (AA). TEM will allow for the visualization of the nanoparticle shape and monodispersity, SQUID magnetometry will provide insight into the magnetic properties, and AA will confirm the chemical structure of the particles. These properties – mainly shape, monodispersity, and magnetic properties – will determine the suitability of the nanocubes for single particle magnetoresistance measurements and self-assembly into ordered arrays.

SYNTHESIS OF P(HEMA)-B-PS FOR PROTON EXCHANGE MEMBRANE

STUDENT Heesung Chung *Chemistry*
ADVISOR Krzysztof Matyjaszewski *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Although fuel cell was developed more than a half century ago, it has not been commercialized because of price. The biggest factor governing price is the fuel cell membrane, where protons travel to produce electricity. However, proton exchange membrane has not seen much development to satisfy two factors: performance and price. Therefore, PEC membranes have gained much interest the past few years. In this project, pHEMA-b-PS copolymer was synthesized and post-modified to create a fuel cell membrane.

TAML ACTIVATOR-CATALYZED DEGRADATION OF DICLOFENAC BY HYPOCHLORITE: INVESTIGATION OF KINETICS, END PRODUCTS AND DEGRADATION PATHWAY

STUDENT Samuel Joyce-Farley *Chemistry*

ADVISOR Terrence Collins *Chemistry*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Sodium hypochlorite is frequently used in water treatment plants to eliminate contaminants and for disinfection. However, the reaction of sodium hypochlorite with a number of common persistent wastewater pollutants, in particular pharmaceutical compounds, can result in chlorinated products that may be more harmful than the original compound. TAML activators, iron-based catalysts originally designed to facilitate the oxidative degradation of persistent pollutants by hydrogen peroxide, seem to be able to catalyze oxidative degradation by sodium hypochlorite as well, which should promote the formation of less-harmful oxidized products over chlorinated products. Of particular interest is the pharmaceutical compound diclofenac, a pain reliever. Widespread veterinary use of diclofenac in agriculture has resulted in a dramatic decline in the vulture population of India, leading to a number of public health issues. If TAML activators are capable of redirecting the degradation of diclofenac by hypochlorite to an alternate pathway that does not produce harmful chlorinated products, it could be possible to achieve significant public health benefits by adding TAML catalysts to conventional sodium hypochlorite wastewater treatment. This proposal seeks to investigate the potential alternative degradation pathway for diclofenac both kinetically and by identification of the final products.

THERMODYNAMIC ANALYSIS OF BINDING PARAMETERS OF HYBRID BIOINORGANIC COMPLEXES

STUDENT David Vinson *Chemistry*

ADVISOR Catalina Achim *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 11:31 am

Advances in nanotechnology have come a long way in terms of improving the scope in which molecular devices can be applied. Researchers in this field have studied naturally occurring macromolecules and the range in which they can operate in molecular devices; however, scientists have expanded their molecular toolbox by developing synthetic biomolecules and the incorporation of inorganic structures in, an otherwise, completely organic system. Collaborative efforts in this field have sought to create molecular electronics that can respond to controlled changes in their external environment (changes in pH, temperature, etc.) as well as mediated changes in internal structure and how that can lead to changes in physical and chemical properties (magnetic properties, electronic properties, photochemical properties, etc.). One novel approach to generate such molecular devices is the incorporation of transition metals into nucleic acid structures. This area is of particular interests to our group and my project aims to analyze the thermodynamic parameters of these hybrid bioinorganic complexes using Isothermal Titration Calorimetry (ITC).

USE OF CONDUCTING POLYMERS TO ENHANCE ELECTRODE PERFORMANCE IN AQUEOUS ELECTROLYTE ENERGY STORAGE DEVICES

STUDENT Nicole Sansone *Chemistry*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Rangos 2&3/Sigma Xi Group 4 / 10:13 am

Aqueous alkali-ion batteries offer an economical method for large-scale energy storage demanded by current sources of renewable energy. Commonly used active materials while functional, have certain limitations when it comes to their applications in aqueous electrolyte. In this work, we investigated the use of composite electrode materials containing conducting polymers to overcome these limitations, specifically looking at factors such as the polymer used, the weight ratio of polymer to active material, and the dopant used in the polymer synthesis. Testing of polypyrrole (PPy) in composite with active material to optimize functional thickness of the electrode by improving electronic conductivity found PPy to become over-oxidized and therefore non-functional at potential windows for the cathode materials. Poly(3,4-ethylenedioxythiophene) (PEDOT) composites were found to degrade in aqueous conditions. Use of polypyrrole in the anode to coat sodium titanium phosphate (NTP) active material has showed promise in preventing functional degradation of the active material and conductive additive in aqueous conditions. When testing composites containing 20 wt% PPy, no redox reactions from the NTP were visible due to poor Na+ diffusion through the PPy coating. Composites containing 5 wt% PPy showed improved capacity retention compared to uncoated material, retaining 57% of the initial discharge capacity after 50 cycles compared to 10% in the uncoated material. Composites using PPy with a polyanionic dopant showed further improvement in cyclability, but still had limited ability to form complete coatings. NTP particles with a polydopamine adhesion layer used in an in-situ synthesis of PPy with a polyanionic dopant show excellent cyclability and high promise for further testing of conducting polymer coatings as an effective strategy for promoting battery lifetime.

PNA TO SILENCE GENE EXPRESSION

STUDENT Aria Soltani *Chemistry*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 10:52 am

There are many diseases that are caused by genetic mutations in the DNA found in every cell of our body. These are often inherited and there is nothing that can be done to prevent them from passing from one generation to another. One specific example of this is Hutchinson Gilford Progeria which is caused by a single mutation in our DNA which causes the synthesis of a faulty protein which leads to rapid aging. So rapid that those affected die of "old age" in their teenage years. To tackle this problem, I want to expand upon the work done in the Ly group on Peptide Nucleic Acid (PNA) in order to try and target these faulty sequences and prevent expression of the faulty genes by getting the PNA to mask in the incorrect sequences. In order to make it explicitly clear, I will be working on this project alone but will consult with the Ly group for advice on reaction optimization and improvement.

MATHEMATICS

BRACHISTOCHRONE PROBLEM IN NON UNIFORM GRAVITATIONAL FIELDS

STUDENTS Keven Chionh *Mathematics* • Liuyu Jin *Mathematics*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:00 am

If a particle travels at a constant speed, then the path that admits the shortest transit time between two points in space is the line segment connecting them. However, if the speed of the particle depends on the location of the particle, then the straight-line path will generally not provide the shortest time of transit between two given points. A very important situation in which the speed of a particle depends on its location occurs when the particle is acted upon by a gravitational field. The classical Brachistochrone Problem ('brachistos' is Greek for 'the shortest', and 'chronos' means 'time, delay') deals with this question in a uniform gravitational field. This research concerns the Brachistochrone Problem in non-uniform gravitational fields. In particular, we focus on on the inverse-square gravitational field directed towards a point source. Previous researchers found 'candidates' for the minimizing curves, but did not prove that they are actually minimizers. We provide a proof that these curves are in fact minimizers for certain configurations of the endpoints. We also discuss a previously unobserved phenomenon, that there are configurations of the endpoints for which a minimizer does not exist.

CHANGES IN INVESTMENT IN THE ENERGY GENERATION INDUSTRY

STUDENTS Guru Yerramilli *Mathematics* • Benjamin Zhang *Mathematics*

ADVISOR Karem Kang *Economics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The electricity market is a well documented topic in economic research with the

prominent themes being identifying the factors that influence switching from coal-fired plants to natural gas plants and outlining its consequences. We use empirical trends and fixed-effect regressions to determine what drives proposed investments for these fuel types in the United States and discover the tradeoff between them. Our results confirm the expected negative effect of factors such as prices and emissions at an absolute and relative scale on investments and bring out anomalies to reevaluate the issue of proposed investments. The empirical models used provide a reliable foundation for further studies needing the refinement of existing variables, inclusion of variables such as other fuel types, and greater detail and concentrated analysis of the tradeoff between natural gas and coal for electric power generation.

CMU FACULTY WORK-LIFE STUDY

STUDENTS Yayoi Furuhata *Business Administration* • Kimberly Hsieh *Mathematics* • Pavithran Nair Jayaraman *Statistics* • Sarah Shy *Statistics* • Tyler Wellener *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Studies have shown that employee satisfaction can be linked to motivation, performance, absenteeism, and turnover in the workplace. However, faculty involvement and satisfaction are often overlooked in universities. Our research analyzed how satisfied Carnegie Mellon University (CMU) professors are with various aspects of their work life. The mode of data collection was an online survey hosted by Qualtrics. We carried out the survey using a list of faculty Andrew emails obtained from an official directory. Since most professors check their emails daily, sending online surveys to the faculty via email was the most efficient way to recruit participants. We broke down our results by gender, department, number of years at CMU, and academic title to make observations about particular subgroups. Faculty satisfaction is integral to the success of the university as it gives rise to a stimulating learning environment while offering a more attractive option for prospective professors. With our data, we were be able to obtain an accurate measure of faculty job satisfaction at CMU and provide information to the university that will allow CMU to achieve its long-term objectives.

COMPARISON OF COMMUNITY DETECTION METHODS

STUDENTS Qiulei Bao *Mathematics* • Zhehao Yu *Mathematics*

ADVISOR Jiashun Jin *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

In the study of networks, there are several common characteristics can be found including clustering, small- world property, etc. If the nodes of a network can be grouped into sets of nodes such that each set of nodes is densely connected internally, the network is said to have community structure. If we can determine the appropriate number of communities and the components within each community, it will be of great value in various fields. Communities in social networks show probable common location, interests, communities in citation networks shows probable research topic, academic trend.

In this paper, first we would like to discuss the Spectral Clustering On Ratios-of-Eigenvectors(SCORE) method for community detection proposed by Professor Jiashun Jin due to its eciency and relative accuracy. Then we propose a way to determine a reasonable number of community in a network so that it is neither too vague to provide more information nor too specific to embody the community structure. Lastly we introduce several other community detection methods and compare them for advantages.

CONSTRAINING STELLAR MULTIPLICITY WITH APPROXIMATE BAYESIAN COMPUTATION

STUDENT Eric Alpert *Mathematics*
ADVISOR Peter Freeman *Statistics*
ROOM/TIME Wright / 12:00 pm

Since the beginning of modern astronomy, we have known the existence of binary and multiple-star systems. However, we do not know the stellar multiplicity fraction, the proportion of stellar systems with two or more stars. Astronomers have argued that constraining the value of the multiplicity fraction will improve our theoretical understanding of the Universe. From understanding the birth and evolution of stars, to improving the calibration of observational methods, constraining multiplicity will have profound impacts on the field of astrophysics. In this project we implement the advanced statistical algorithm Approximate Bayesian Approximation (ABC) to constrain the value of the stellar multiplicity fraction. We develop a forward model to simulate the data generating process as a function of multiplicity. Using the software package cosmoABC, our forward model and the APOGEE data set, we implement ABC to derive a posterior distribution of stellar multiplicity.

DEVELOPMENT OF AGENT-BASED MODELS FOR INFECTIOUS DISEASES

STUDENT Abigail Smith *Mathematics*
ADVISOR William Eddy *Statistics*
ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:52 am

If you think you're too small to have an impact, try going to bed with a mosquito." With a rise in the prevalence in the incidence of vector-borne diseases such as malaria and dengue fever, the need for exacting analysis and modeling of these diseases to inform public health action becomes increasingly necessary. Although compartment models (sets of differential equations that track the number of people in a given compartment [typically Susceptible, Infectious or Recovered] at a given time), have typically been the most established and used methods for studying the dynamics of disease, agent-based models are currently on the rise. Agent-based models focus on how individual decision making affects the dynamics of a disease. I use different agent-based modelling programs such as Netlogo and Fred to experiment with the modeling of dengue fever and study how variation of different parameters can influence the disease dynamics.

EVALUATING CONNECTEDNESS OF COLLEGE OF FINE ARTS STUDENTS

STUDENTS Yunwen Cai *Mathematics* • Matthew De Jesus *Economics* • Kathleen Fuh *Computer Science* • Shaan Phagura *Statistics* • Vinay Viswanathan *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

CMU is divided into individual colleges, and students often, but not always, take the bulk of their coursework within the college they belong to. We want to study CFA's connectedness to other colleges because it has specialized constituent schools (not just departments), each with their own academic requirements. Our study is part of a broader discussion of whether students from different schools are too separated. To our knowledge there are no current research studies regarding this topic.

To solve the problem we conducted an email survey on CFA students, by sending out survey links to all CFA students. We did subgroup analysis on the schools within CFA and class year. We modeled the subgroups using generalized linear models, and we compared parameters across groups.

Our results could reveal CFA students attitudes of connectedness to the campus life, and which factors have the most influence on how CFA students interact with non-CFA students. This could shape future programming and initiatives made by student government, or CMU and CFA administration to promote greater cohesion among schools.

FOR SALE @ CMU CUSTOMER SATISFACTION SURVEY

STUDENTS Richard Chiang *Mathematics* • Ken MacMann *Statistics* • Michael McCaffrey *Economics and Statistics* • Shieri Suzuka *Economics* • Margaret Tung *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We surveyed members of the Facebook group "For Sale @ CMU" about their experience using the group. With over 6,000 members and growing, many CMU students utilize this group to buy and sell various items with one another. However, because this is an unregulated online platform, there is little information about this emerging market.

To conduct this survey, we acquired a list of individual members from the "For Sale @ CMU" Facebook group. Using this list, we randomly selected 2,700 members to participate in the surveys we sent out via Facebook messages. We conducted this survey to understand the overall satisfaction of using the group, to get feedback on the communications between buyers and sellers, and to see if there is any way to improve the experience of buying and selling within CMU students using this group.

GALAXY MORPHOLOGY AND SYNTHESIS: APPLICATION FOR THE LARGE SYNOPTIC SKY TELESCOPE

STUDENT Joshua Brakensiek *Mathematics*

ADVISORS Peter Freeman *Statistics* • Chad Schafer *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The Large Synoptic Sky Telescope (LSST), currently under construction in Chile, will be used to give one of the most thorough studies to date of the galaxies visible in the Southern Hemisphere. Scientists believe that this volume of data will help them better understand the nature of dark energy and dark matter. To prepare for operation commencing in 2022, the LSST team has been developing an elaborate pipeline to process the forthcoming deluge of data (up to 30 terrabytes nightly). The purpose of this project is to produce realistic simulated galaxy images so that this data pipeline can be thoroughly tested. Currently, I have implemented algorithm first envisioned by Kinman Au which performs an orientation analysis of existing galaxy images, inferring the qualitative structure of galaxies from noisy data. I will present further progress made on the problem.

INVESTIGATION AND IMPLEMENTATION OF INVARIANT GENERATION IN THE KEYMAERA X SYSTEM FOR HYBRID SYSTEMS VERIFICATION

STUDENT David Bayani *Mathematics*

ADVISOR Andre Platzer *Computer Science*

ROOM/TIME Class of '87 / 3:40 pm

Program invariants are critical for the successful verification of most non-trivial programs. Unfortunately, the generation of invariants is also difficult; this is especially true in the hybrid dynamical systems domain, where future states rarely can be computed exactly. We will overview some techniques for invariant generation in hybrid dynamical systems and their implementation for use in the KeYmaera X theorem prover. We will discuss previous approaches used in KeYmaera, some approaches used by others for invariant generation, and some novel approaches to the invariant generation problem in hybrid dynamical systems.

LARGE-TIME ASYMPTOTIC BEHAVIOR FOR SOLUTIONS OF A SECOND-ORDER INTEGRO-DIFFERENTIAL EQUATION WITH WEAK DAMPING

STUDENTS Kabir Mantha *Mathematics* • Patrick Mead *Mathematics*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Let f(x) and g(x) be differentiable functions such that f(x) and g(x) are sign-preserving in x; f(x) is monotone-increasing in x; and ([integral from 0 to x] ((g(t) - f(t)) dt)) goes to infinity as x goes to positive or negative infinity. Let u(t) be a function satisfying u"(t) + g(u(t)) - ([integral from negative infinity to t] (e^(-(t - tau))f(u(tau))dtau)) = 0.

Then u(t) converges to some real-number constant U as t goes to infinity, such that f(U) = g(U).

Our proof is based on the Invariance Principle, and shows asymptotic stability of our function, which models the behavior of a mass on a viscoelastic spring with a "weakly positive" elastic modulus.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

ON DIFFERENCES THAT DIFFERENCE EQUATIONS CAN MAKE ON MODELING FRESHWATER ECOSYSTEMS AND SYSTEMS OF MANY VARIABLES.

STUDENTS Can Bostanci *Mathematics* • Zachary Singer *Science and Humanities Scholars* • Sijie Wei *Mathematics*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In mathematical modeling, "difference equations" are a unique tool that allows us to consider dynamical systems in discrete time setting. In contrast, "differential equations" model a system in continuous time fashion. The impact of "disturbances" on such systems (i.e., perturbations) is an important area of study. It is desirable to have models that are robust. Therefore it is important to test models under the influence of "foreign" factors. We therefore, as a group, studied the particular case of portraying a freshwater ecosystem with difference/differential equations and tried to make conclusions by considering disturbance factors that are largely ignored in previously established models. By applying our knowledge from recent classes such as 21-101 (Discrete Time Dynamical Systems) and 21-269 (Vector Analysis), we worked to study different possible models that are robust under disturbance and attempt to extend current theorems about difference/differential equations into a broader context. "Disturbance on Difference/ Differential Systems with Equilibria - Frequency vs. Efficiency" was our research result.

ORBIT CHECKING FOR INVERTIBLE BINARY TRANSDUCERS

STUDENT Evan Bergeron *Mathematics*

ADVISOR Klaus Sutner *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

We study iterated transductions defined by a class of invertible transducers over the binary alphabet. We present polynomial time orbit checking algorithms for a subclass of automata associated with Abelien free groups of finite rank.

PHOTOS OF BUDAPEST

STUDENT Timothy Li *Mathematics*
ADVISOR Patricia Maurides *Art*
ROOM/TIME Connan / 12-2:30 pm

Last summer, I was able to study abroad in Budapest, Hungary with the help of the Jennings Family Brave Companions Fund. As a part of my trip, I brought my black and white film camera to document the city and my experience there and also to have fun shooting some pictures. This presentation will be series of prints that I have made. I hope that this series will show what living in Budapest was like and how beautiful the city is.

SELECTIVE SAMPLING TECHNIQUES FOR ACTIVE LEARNING IN NLP

STUDENT Vijay Viswanathan *Mathematics*
ADVISOR Eric Nyberg *Language Technologies Institute*
ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:26 am

The most effective machine learning algorithms rely on labeled data for training. In the real world, despite huge amounts of noisy, unlabeled data, labeling data can be very expensive.

I compared several state-of-the-art selective sampling methods on a diverse collection datasets, to understand how to produce the fastest learning rate. I finally explored constructing a series of selective samplers to maximize the expected learning rate.

SUBRINGS OF C GENERATED BY ANGLES

STUDENT Jackson Bahr *Mathematics*
ADVISOR Gregory Johnson *Mathematics*
ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:13 am

Consider the following inductively defined set. Given a collection U of unit magnitude complex numbers, and a set initially containing just 0 and 1, through each point in the set, draw lines whose angles with the real axis are in U. Add every intersection of such lines to the set. Upon taking the closure, we obtain R(U). We investigated for which U, R(U) is a ring.

Our main result holds for when 1 is in U and |U| is at least 4. If P is the set of real numbers in R(U) generated in the second step of the construction, then R(U) equals the module over Z[P] generated by the set of points made in the first step of the construction. This lets us show that whenever the pairwise products of points made in the first step remain inside R(U), it is closed under multiplication, and is thus a ring.

THE ANALYSIS OF NON-REPLICABLE DERIVATIVE SECURITY IN INCOMPLETE MODEL

STUDENTS Ruohui Li *Computational Finance* • Liyunshu Qian *Mathematics* • Moqing Shi *Mathematics* • Xiran Zhu *Computational Finance*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:39 am

In our research, we study a family of one-period trinomial financial models that are arbitrage-free but incomplete and a non-replicable derivative security. Our main interest is in limiting situations when the model approaches a complete binomial model. We focus on the study of a call option, C, with the initial stock price as the strike price. This security is not replicable in trinomial models, and therefore has an interval of arbitrage free prices.

A reasonable way to single out a price is to use the notion of utility indifference price, p (per share). A utility indifference price p (per share) for q shares of C, is the number p having the property that an investor will be indifferent to a portfolio holding q shares of S at p and a portfolio that holds no shares of S.

Using the notion of indifference price, we have been focusing on three different utility function families: exponential, natural log and power type. For exponential utility functions, there is an explicit formula for the indifference price, and the analysis is relatively straightforward. However, for log and power utility functions, there is no explicit formula for the indifference price. Nevertheless, we are able to determine the limiting behavior of the indifference price in a number of scenarios.

Another question we consider is assuming that C can be traded in any desired quantity at a fixed price P, what would the optimal order size of C be. By optimal order size, we mean the amount of C that an investor would buy to maximize his/her expected utility. We obtain expressions for q in terms of probabilities, initial capital Z, and price P. We analyze various limits as the probabilities change in a way that the model approaches a (complete) binomial model.

THE CMU BUBBLE

STUDENTS Zachary Cree *Statistics* • Noshin Nova *Statistics* • Mariana Robelo *Economics and Statistics* • James Yang *Computer Science* • Xiaofan Zhu *Mathematics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Carnegie Mellon is known for its rigorous coursework, but knowledge of current national and world events is also an important part of education and preparing students to become a part of society. Carnegie Mellon students are often deeply absorbed in their work so we found out how well informed they are and investigated how students can become more informed about current events.

We focused on comparing performance on a current events quiz between freshmen in different demographic groups and different majors at CMU. We conducted a stratified random sample across freshman dormitories and knocked on doors to ask selected students to take our current events quiz. We recorded their major and demographic information about the students, news sources that students used and the amount of time they spent reading the news. We then analyzed whether demographic factors, specific majors, or news sources correlated with performance on the quiz. We predicted that this investigation would reveal commonalities between groups that perform well and could lead to insight into ways to keep students well informed. Perhaps this could motivate future research to help provide easier access to news.

THE CONSEQUENCES OF THE ARTIFICIAL INTELLIGENCE BOOM : A CASE ON THE RETAIL INDUSTRY

STUDENT Guru Yerramilli *Mathematics*

ADVISOR Laurence Ales *Economics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:05 am

Artificial intelligence (AI), well and truly represents the next wave of computing with firms and industries alike rushing to adopt it. However, its promise of enhanced productivity and convenience has been met with concerns about the transformation it could create in the labor market; especially in the retail industry. To better understand retail's precarious position, I use time-series trends and fixed-effect regression models to document polarization in demand for workers based on skill-level, substitutability of jobs in retail (Polanyi's paradox) and operational efficiency of firms adopting AI. In addition, I validate these findings through case studies of Panera Bread and Hointer. This research provides a reliable foundation for further studies on potentially determining the optimal decision for a firm with respect to adopting AI and also how workers can cope with the impending changes.

THE RECURRENCE SEIR MODEL FOR SPREAD OF DISEASE

STUDENTS Yangjun Sheng *Mathematics* • Kevin Zhou *Mathematics*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The mathematical modeling of infectious diseases has been used to study the mechanisms by which diseases spread, to predict the future course of an outbreak and to evaluate strategies to control an epidemic. A lot of epidemic models have been developed, many of which involve systems of differential equations, while discrete-time modeling was rarely studied. However, one advantage of discrete epidemic models over continuous epidemic models is that the number of infective people (I), susceptible people (S) and other variables often change and are measured at discrete time intervals. Our study mainly focused on a deterministic SEIR model that involved systems of recurrence equations. The main results we conclude from this model are the followings:

1) The portion of susceptible, S, will eventually be below a certain value.
2) The portion of infective people, I, will eventually be strictly decreasing.
3) If I decreases in subsequent periods, then I will only decrease beyond that point.

THE RESOLUTION LIMIT FOR DETECTING COMMUNITIES IN BENCHMARK GRAPHS

STUDENT Sonica Saraf *Mathematics*

ADVISOR Thomas Bohman *Mathematics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Detecting community structure within networks is important in a variety of practical applications including social networks, biological networks, technological networks, and many more. Modularity optimization is a popular method for detecting communities of nodes within networks. It was shown by Fortunato and Barthelemy that modularity optimization is subject to a resolution limit wherein communities smaller than a certain size cannot be

detected. We examined the resolution limit for certain classes of benchmark graphs, and discuss how the inclusion of a multiresolution parameter affects the ability to detect communities.

PHYSICS

AUTONOMOUS VISUAL ORBIT DETERMINATION

STUDENTS Jonathan Appiagyei *Electrical & Computer Engineering* • Homer Baker *Electrical & Computer Engineering* • Ashrith Balakumar *Mechanical Engineering* • Jacob Bartel *Mechanical Engineering* • Suyash Bhatt *Electrical & Computer Engineering* • Yeongwoo Hwang *Computer Science* • Felipe Oropeza *Mechanical Engineering* • Paul Pan *Electrical & Computer Engineering* • Hannah Tomio *Electrical & Computer Engineering* • Andrew Ye *Physics*

ADVISOR William Whittaker *Robotics Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:00 am

Determining the position of a spacecraft in its orbit is a fundamental task for any planetary mission. In Earth orbit, this is fulfilled by GPS location, which is relatively cheap and simple to implement. However, for destinations beyond Earth, such as the Moon and Mars, the only tracking technique is provided by bulky onboard transponders which communicate with the Earth-based Deep Space Network (DSN). Although the DSN provides highly accurate ranging, it requires human input and is a bandwidth limited commodity allocated only for NASA's premier missions. In order to allow true mission autonomy and accurate navigation for a growing number of missions, an alternative approach must be used.

Image based navigation, known as Autonomous Visual Orbit Determination (AVOD), offers a low cost, low latency alternative to overburdened conventional radio-based spacecraft tracking techniques. AVOD uses computer vision to determine discrete spacecraft positions. Quantified changes in image features enables the AVOD software to create an orbital model and predict its trajectory. This project proposes to use a weather balloon equipped with an AVOD system to determine flight trajectory as a terrestrial proof-of-concept. As the weather balloon flies, it will track ground features, allowing the software to parameterize the flight. Although this smaller scale test is not an orbiting system, it will serve as an analog to an actual orbiting craft. In the future, we plan to scale up this project to an orbital CubeSat platform.

CONTINUING THE CARBON FIBER TROMBONE

STUDENT Andrew Ye *Physics*

ADVISOR Peter Sullivan *Music*

ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 11:05 am

The ancient musical "horn" received its name from the fact that these early instruments were fashioned from animal horns. It was not until the middle ages that musicians adopted the metal instruments that we currently recognize as horns. The modern family of brass instruments is still metal based, with metalworking variations and nuances specific to each individual instrument type. However, due to the material characteristics of metal, conventional instruments are heavy and easily dented. Recently there has been an interest in instruments fabricated from alternative materials.

The most compelling motivation behind alternative-material instruments is the search for a lightweight and highly durable instrument. Ask any novice horn player if they have ever dented their instrument beyond functionality and they will likely say yes. Ask any symphony musician if the weight of their instrument could become an issue at old age and they will likely agree. Alternative-material instruments seek to enable accessibility of performance to a larger audience. The existing market options are plastic, fiberglass, and more recently, carbon fiber. As a trombonist, this recent trend sparked my interest. The objective of my project is to create a trombone entirely from carbon fiber and test if it is "better" than a plastic trombone. Last year I presented the first carbon fiber bell. Between then and now, I have created a new iteration of the bell and the hand-slide.

When testing a new instrument, a musician will often qualify the sound of the horn with words which are undefined in a scientific context (such as "mellow", "dark", or "brass-y"). In an endeavor to quantify the characteristics between trombones of different materials (brass/nickel, plastic, carbon fiber), I have gathered data on mass, frequency response, sound volume, friction of slide, and slide volume. This is to provide those who are unfamiliar with words describing musical quality with a quantitative understanding of the characteristics of the varying instruments. Between the carbon fiber and the plastic trombones, the "better" instrument is the one which has sound quality that more closely matches that of the conventional trombone.

EXPLORING THE ROLE OF DESIGN PROBLEMS IN THE PHYSICS CLASSROOM

STUDENT Paul Hamerski *Physics*
ADVISOR Kunal Ghosh *Physics*
ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 10:13 am

A feature missing in many physics courses is design work, which would better prepare science and engineering students for future work where design plays a bigger role. This realization has already led to significant changes in K-12 curricula, and we are exploring the role of design problems at a post-secondary level, where incorporating such problems allows for unique opportunities for students to create and adjust models of physics principles. This investigation takes a close look at how groups of students in a section of introductory physics at Michigan State University approach design problems, and how learning is affected. In order to inform and assist instructors and researchers, we have adapted a framework traditionally used in engineering design to characterize the problem-solving steps we observed. Our investigation highlights the utility of design, and offers up some additional questions and possible explanations on the impact of design problems in the physics classroom.

FAST RADIO BURST 110523

STUDENT Alexander Roman *Physics*
ADVISOR Jeff Peterson *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Fast Radio Bursts (FRBs) are non-repeating, bright millisecond emissions very likely at cosmological distance scales ($z > 0.1$). The progenitor is not yet known, but possible sources include highly energetic objects associated with young stellar populations, such as magnetars, or core-collapse supernova remnants.

FRB 110523 was discovered at CMU by McWilliams Center graduate student Hsiu-Hsien Lin; we report the first ever measurement of Faraday rotation in an FRB, as well as a distinct signature of two-screen scattering. The

Faraday rotation indicates high source-local magnetization, while the source-local scattering screen suggests that the event originated from the central region of its host galaxy. These two event-specific observations offer new insight to constrain source models, favoring models associated with young stellar populations, while disfavoring models involving the mergers of older neutron stars.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

NMR STRUCTURAL ANALYSIS OF PLASMODIUM FALCIPURUM THYMIDYLATE KINASE FOR ANTI-MALARIAL DRUG DISCOVERY

STUDENT Michael Woolford *Physics*

ADVISOR Gordon Rule *Biological Sciences*

ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 10:00 am

Thymidylate monophosphate kinase (TMK) is an important enzyme in cell growth and division in many pathogens, including malaria, because it is involved in the synthesis of nucleotides required for DNA synthesis.

Researchers have singled out TMK as a drug target because of its location at the convergence of salvage and de novo pathways in thymidine synthesis. The human (huTMK) and malaria (pfTMK) versions of TMK have the same function, but they have significant structural differences which can be exploited to develop selective inhibitors against malaria. In (1H-13C) NMR studies of proteins, the ILV methyl groups are highly sensitive to structure changes, which allows detection of any weakly binding compounds that can be later modified into selective inhibitors. In order to find the compounds that weakly bind to pfTMK, we are developing a high throughput method using the ILV methyl NMR spectra, which will not only allow detection, but reveal information about where and how these inhibitors are binding to the structure of pfTMK. In previous studies, I obtained the wild type methyl NMR spectra; now, I have assigned the spectra peaks of pfTMK using single residue mutants and the measurement of inter-methyl distances using NOEs.

PAGGIESPEC: A LOW-RESOLUTION, COMMERCIAL LENS, OPTICAL SPECTROGRAPH

STUDENT Shae Hart *Physics*
ADVISOR Kunal Ghosh *Physics* • Jennifer Marshall *Texas A&M University*
ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 11:18 am

This summer, we were tasked with the design, construction and testing of a low-resolution, optical spectrograph. The preliminary Aggie Spectrograph (pAggieSpec), is a low-cost instrument that uses off-the-shelf Nikon™ lenses, a Mercury calibration lamp, and two CCD cameras. pAggieSpec is the first step in the creation of an instrument that will allow institutions to provide quality tools inexpensively. We found that pAggieSpec provides reliable spectra within the 4000-6000Å range. Further testing needs to be done to extend the coverage over the full visible spectral range (4000-7000Å).

PROBING ENERGY RELEASE OF SOLAR FLARES USING COMBINED RADIO, EUV, AND X-RAY OBSERVATIONS

STUDENT Michael Prijatelj *Physics*
ADVISOR Bin Chen *New Jersey Institute of Technology*
ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 10:26 am

We investigate the release of magnetic energy stored within the solar atmosphere, the driving force and fundamental process behind solar flares. While it is widely accepted that the reconnection of magnetic field lines in the low solar corona powers solar flares, there is a dearth of direct information regarding the relative location of the magnetic energy release and the structure of the reconnecting magnetic fields. We utilize the Karl G. Jansky Very Large Array (VLA) to observe decimetric type III radio bursts produced during the impulsive phase of a C7.2 solar flare. The VLA's unique observing technique of radio dynamic imaging spectroscopy enables trajectories of flare-accelerated electron beams to be derived as a function of time. Since these electron beams propagate along magnetic field lines in the low solarcorona, we can use this method to trace newly reconnected coronal magnetic field lines in or around the reconnection region. Supported by multi-passband extreme ultraviolet imaging data from the SDO/AIA, photospheric magnetic field measurements from the SDO/HMI, and hard X-ray imaging data from RHESSI, we find that the accelerated electron beams first appear in the region trailing an erupting sigmoid which triggers the

flare in question. We find our results to be generally consistent with the standard model of eruptive solar flares, in which magnetic energy is released via reconnection of antiparallel magnetic field lines trailing behind an erupting flux rope.

TWINNING CONDITIONS IN AUSTENITE-MARTENSITE PHASE TRANSITIONS

STUDENT Weichen Yin *Physics*
ADVISOR Thomas Bohman *Mathematics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

When certain metallic alloys undergo austenite-martensite phase transition during cooling, they ex- hibit finely twinned structures, which can be modelled as deformations that minimise or almost minimise a "mesoscopic" energy function. Exact minimisers to this energy are often incompatible with certain necessary boundary conditions, such as those given by an austenite-martensite interface. However, a sequence of increasingly finer almost minimisers can be constructed, whose limit satisfies the boundary conditions and corresponds to a minimiser of a modified "macroscopic" energy function. In this project, we attempt to characterise the set of all (macroscopic) energy minimisers in the cubic-tetragonal phase transition, by finding the quasiconvex hull of the set of martensitic deformations. A restricted problem is solved analytically, but numerical methods are used for the general problem.

VARIABLER RECLUSTERING FOR MULTIPLE TOP QUARK EVENTS

STUDENT Jeremy Hyde *Physics*
ADVISOR Kunal Ghosh *Physics*
ROOM/TIME Rangos 2&3/Sigma Xi Group 6 / 11:31 am

VariableR jet reclustering is an innovative technique that allows for the reconstruction of boosted object over a wide range of kinematic regimes. Such capability enables the efficient identification of events with multiple boosted top quarks which is a typical signature for new physics processes such as the production of the supersymmetric partner of the gluon. In order to evaluate the performance of the algorithm, the VariableR reclustered jets are compared with fixed radius reclustered jets. The flexibility of the algorithm is tested by reconstructing both boosted top quarks and boosted W bosons. The VariableR reclustering method is found to be more efficient than the fixed radius algorithm at identifying top quarks and W bosons in events with four top quarks, therefore enhancing the sensitivity for gluino searches.

SCHOOL OF COMPUTER SCIENCE

COMPUTATIONAL BIOLOGY

BEAM: BIOSENSOR EMISSION ANALYSIS MACHINE

STUDENTS Ruchi Asthana *Biological Sciences* • William Casazza *Computational Biology* • Donna Lee *Biological Sciences* • Kenneth Li *Biological Sciences* • Wei Mon Lu *Chemical Engineering* • Dominique MacCalla *Materials Science and Engineering* • Niteesh Sundaram *Electrical & Computer Engineering* • Maxwell Telmer *Materials Science and Engineering* • Jordan Tick *Electrical & Computer Engineering* • Michelle Yu *Biological Sciences*

ADVISOR Cheryl Telmer Biological Sciences

ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Engineered sensors are all around us, biological systems contain natural biosensors that can be utilized to monitor the environment and health of ecosystems and the individuals within them. A critical part of building a sensor is the ability to detect and measure the output. To enable the design and fabrication of DIY biosensors we are creating instructions on how to build a low cost luminometer and fluorimeter. The precision, accuracy, and sensitivity of the instrument will be demonstrated using a set of luciferase and fluorescent protein reporters. The luminometer is a simple photodiode detector and signal is integrated using a Raspberry Pi and output data is processed with open source software. The fluorimeter is an extension that includs an LED light source and emission and excitation filters appropriate for the fluorescent protein to be analyzed. The entire device is encased in a 3D printed shell. To test the luminometer, the luciferases from Gaussia princeps, Renilla reniformis and Photinus pyralis were codon optimized for E. coli and expressed from a strong constitutive promoter and the Gaussia luciferase was extracellularly targeted. Fluorescent proteins including blue, green, yellow, orange and red with different promoter strengths and an estrogen sensitive system were used to calibrate the fluorimeter. To engage the public about synthetic biology and iGEM we have developed a BioLight powered by luciferase. For education purposes, a light, with parts, and a fluorimeter were provided to the "The Citizen Science Lab" in Pittsburgh and we are hopeful that this will excite the community to start building.

COMPUTER SCIENCE

A DOMAIN-SPECIFIC PROGRAMMING LANGUAGE FOR ROBOTS BASED ON INSTRUCTION GRAPHS

STUDENT Andrew Benson *Computer Science*

ADVISOR Jonathan Aldrich *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Instruction graphs are a recently proposed data structure that encodes a sequence of actions for a robot to perform. For example, in order for a robot to purchase coffee, a robot might move forward, looking for a barista every 5 meters, then ask for a coffee once a barista is found. An instruction graph is an explicit representation of these

actions, where each action is a vertex and edges are the transitions between them. We contribute a formalization of instruction graphs as a domain-specific programming language, prove type safety for the language, and provide an interpreter.

A NOISY-INFLUENCE REGULARITY LEMMA FOR BOOLEAN FUNCTIONS

STUDENT Christopher Jones *Computer Science*
ADVISOR Ryan O'Donnell *Computer Science*
ROOM/TIME Class of '87 / 10:40 am

We consider Boolean functions $f: \{0,1\}^n \to \{0,1\}$, which are the ubiquitous mathematical atoms of computer science. For a Boolean function f, the noisy-influence of bit i on f is a measure of how ``relevant" the i-th bit of the input is to the output. One can think of functions with all noisy-influences small as essentially random. We present a regularity lemma for Boolean functions based on noisy-influence. That is, we show how any Boolean function can be broken down into subcomponents, most of which have small noisy-influences. We then investigate some consequences of the regularity lemma.

A SENSING COLLABORATIVE BEHAVIOR EXPERIMENT

STUDENT Zhong Yu Bing *Computer Science*
ADVISOR Laura Dabbish *Human Computer Interaction*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

The goal of this study is to understand the ccorrelation between collective intelligence and physiological behaviors through the use of sensor technology such as Tobii eyetracker, Microsoft kinect, and various other technologies. My role as a research assistant primarily focuses on the use of Tobii eyetracker and the collection of data through conducting user studies.

ACCELERATING DNA READ MAPPING

STUDENT Sunny Nahar *Computer Science*
ADVISORS Onur Mutlu *Electrical & Computer Engineering* • Hongyi Xin *Computer Science*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

DNA read mapping has become an important and ubiquitous tool in the field of computationally biology, but it is still limited by slow runtime. This project focuses on a new approach to decreasing runtime and implements a highly parallel workflow for the entire pipeline.

ADVISESTUDIO

STUDENT Rohan Varma *Computer Science*
ADVISOR Chinmay Kulkarni *Human Computer Interaction*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

AdviseStudio is a system designed to explore the role that online mentoring plays in large-scale, online courses. We are specifically looking at what are the best modes that mentorship should happen through, what the different types

of online mentorship are, and how online mentorship affects students' engagement with the course. We have built a system, called AdviseStudio which acts as a third-party tool for online and in-person courses to use to facilitate online mentorship. We are testing the effectiveness of a mentor-team model where each mentee has many mentors and a mentor belongs on many mentor teams. This will potentially allow for at-scale mentorship where the number of students is many and the number of mentors is few.

ALGORITHMS FOR SOCIAL GOOD: KIDNEY EXCHANGE

STUDENT Benjamin Plaut *Computer Science*

ADVISOR Tuomas Sandholm *Computer Science*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:18 am • Class of '87 / 12:20 pm

In kidney exchange, patients exchange willing but medically incompatible donors. Given the graph of patient-donor compatibilities, finding even the maximum-cardinality set of exchanges is NP-hard. However, we can still build empirically efficient solvers and deploy them in practice. In this talk, we begin by overviewing several of the leading kidney exchange solvers. We then identify a correctness issue with one of them, and develop a provably correct fix. Finally, we show that our new solver significantly outperforms other leading solvers on both realistically generated and actual data from the United Network for Organ Sharing (UNOS) nationwide exchange, where algorithms from our group are used to match real patients and donors.

APPLICATION OF MACHINE LEARNING FOR RISK SCALE ANALYSIS OF POWER-LINE AERIAL IMAGES

STUDENT Yongjin Cho *Computer Science*

ADVISOR Jeremy Kolter *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Trees falling upon the power lines often start fires that result in enormous financial loss. Thus, it is always of interest for power lines management to check the possible candidate locations and check on a regular basis. However, manual check for every candidate locations takes substantial time and cost. This project aims to automate the calculation of likelihood of such instance for each aerial image by applying Convolutional Neural Network (CNN). CNN will be used to extract information like location of power lines, trees, and distances between trees and power lines within aerial images. This automation of analysis of power line aerial images significantly reduces the number of candidate locations for manual check, saving substantial time and cost for maintenance.

ARRAYS AND REFERENCES IN RESOURCE AWARE ML

STUDENT Benjamin Lichtman *Computer Science*

ADVISOR Jan Hoffmann *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

We seek to accurately perform static prediction of resource usage in OCaml programs. Past research successfully uses the potential method of amortized analysis to derive bounds in a manner that is integrated with the type system of the language. The soundness theorem of the language guarantees that bounds for a given program are correct with respect to the resource usage defined by a cost semantics. Resource bounds are efficiently determined

by an LP solver as part of the type inference system. However, it is notoriously hard to derive bounds for mutable structures, such as arrays and references, due to the added capacity for side effects and aliasing of heap references. As a result, existing techniques cannot produce bounds for programs whose resource consumption is dependent on data in such structures. We extend the potential method to handle mutable structures with minimal changes to the type rules while preserving the stated advantages of such a system. To do so, we introduce the notion of a reference collection, which gathers all unique locations pointed to by a reference in a given program. Apart from the design of the system, the main contribution is the proof of the soundness of the extended analysis system. We plan to implement these additions in Resource Aware ML and evaluate the new system with realistic example programs.

AUDIO BASED COGNITIVE ASSISTANCE WITH GABRIEL PLATFORM

STUDENT Jianfei Liu *Computer Science*

ADVISOR Mahadev Satyanarayanan *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Gabriel is a cognitive assistance platform for resource-intensive but latency-sensitive mobile applications. Currently only video signals, accelerometer data, and GPS data are supported for streaming. I extend the platform to support audio streaming and built an application that can demonstrate it usage.

AUTOGENERATED DIGITAL FORENSICS CHALLENGES FOR CYBER SECURITY EDUCATION

STUDENT Carolina Zarate *Computer Science*

ADVISORS David Brumley *Electrical & Computer Engineering* • Roy Ragsdale *Electrical & Computer Engineering*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Computer security is absolutely necessary for our society to function, yet educational opportunities are oftentimes lacking. CTF (Capture the Flag) competitions, such as picoCTF, offer an avenue through which people can refine their skills in security topics as diverse as binary exploitation, digital forensics, etc. The picoCTF project is geared towards educating high school students and people with little experience, through its gradual learning curve, penalty-free hint system, and companion game/story that engages competitors. From a CTF developer's standpoint, the picoCTF platform is unique in that it provides a standardized way for challenges to be developed, randomly autogenerated, and deployed. More-frequented categories such as binary exploitation already have autogeneration library support, but there are many types of challenges that are too processing-heavy to be autogenerated in real-time. The purpose of this independent study was to develop digital forensics challenges conforming to picoCTF's education goals, and create a framework through which such challenges could be autogenerated.

AUTOMATIC SPELLING ERROR DETECTION IN DIFFERENT LANGUAGES

STUDENT Natasha Vasthare *Computer Science*

ADVISOR Alan Black *Language Technologies Institute*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

This research project involves automatically detecting spelling errors in words from different languages. Without prior information about a language, the goal is to be able to accurately predict whether a given word is misspelled based only on the words seen so far and their letter patterns. The languages studied include English, Spanish, Vietnamese, Hindi, and Farsi. Low-resource languages are more often spoken than written, so spelling in the written form is not very standardized. Therefore, developing a spelling error detector for these languages would be useful for standardizing the spelling of the languages.

AUTONOMOUS VISUAL ORBIT DETERMINATION

STUDENTS Jonathan Appiagyei *Electrical & Computer Engineering* • Homer Baker *Electrical & Computer Engineering* • Ashrith Balakumar *Mechanical Engineering* • Jacob Bartel *Mechanical Engineering* • Suyash Bhatt *Electrical & Computer Engineering* • Yeongwoo Hwang *Computer Science* • Felipe Oropeza *Mechanical Engineering* • Paul Pan *Electrical & Computer Engineering* • Hannah Tomio *Electrical & Computer Engineering* • Andrew Ye *Physics*

ADVISOR William Whittaker *Robotics Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:00 am

Determining the position of a spacecraft in its orbit is a fundamental task for any planetary mission. In Earth orbit, this is fulfilled by GPS location, which is relatively cheap and simple to implement. However, for destinations beyond Earth, such as the Moon and Mars, the only tracking technique is provided by bulky onboard transponders which communicate with the Earth-based Deep Space Network (DSN). Although the DSN provides highly accurate ranging, it requires human input and is a bandwidth limited commodity allocated only for NASA's premier missions. In order to allow true mission autonomy and accurate navigation for a growing number of missions, an alternative approach must be used.

Image based navigation, known as Autonomous Visual Orbit Determination (AVOD), offers a low cost, low latency alternative to overburdened conventional radio-based spacecraft tracking techniques. AVOD uses computer vision to determine discrete spacecraft positions. Quantified changes in image features enables the AVOD software to create an orbital model and predict its trajectory. This project proposes to use a weather balloon equipped with an AVOD system to determine flight trajectory as a terrestrial proof-of-concept. As the weather balloon flies, it will track ground features, allowing the software to parameterize the flight. Although this smaller scale test is not an orbiting system, it will serve as an analog to an actual orbiting craft. In the future, we plan to scale up this project to an orbital CubeSat platform.

CAN YOUR SMARTPHONE TOUCH YOU BACK? RENDERING HAPTIC TEXTURES FROM FRICTION ON ANDROID OS

STUDENTS Sara Adkins *BCSA* • Prachi Bodas *Computer Science*

ADVISOR Roberta Klatzky *Psychology*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Despite leaping advances in smartphone and tablet technology in the past decade, the use of haptic feedback in these devices has not yet been implemented on the market. Though it is still in the early stages of development, haptics has the potential to improve the experience of using a smartphone by providing tactile feedback to the user. We worked with one such device that utilizes haptic technology, the Senseng "Feelscreen" developer's kit tablet, in order to investigate human response and sensitivity to various virtual textures. We conducted a series of trials where participants swipe across a small area of the tablet and feel a gradient texture, and are then asked to determine if the texture was increasing or decreasing in intensity as they swiped. Using signal detection, the results of our experiments showed that participants are able to determine the direction of a gradient across a small area with high accuracy. Participants responded best to texture gradients that spanned the lower range of the intensity spectrum, consistent with a Weber fraction for virtual texture perception. These findings support the feasibility of using haptics as a way for users to feel where their fingers are on the screen without looking down, and would be useful in the design of applications such as a swipe typing keyboard.

CONNECTIONS BETWEEN RAMSEY THEORY AND COMMUNICATION COMPLEXITY

STUDENTS Mohammed Jaffer *Computer Science* • Sidhanth Mohanty *Computer Science*

ADVISOR Anil Ada *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

We explore the deep link between the communication complexity of certain functions in the "number on the forehead" model and certain Ramsey theoretic constructions related to a multidimensional version of Szemeredi's theorem. In particular we examine the communication complexity of the Eval_G function for various groups G and logarithmically many players, and a conjecture of Gowers and Viola on the complexity of Interleaved Group Product for non abelian simple groups and logarithmic many players, among other problems.

CONTACT DYNAMICS LEARNING WITH RECURRENT NEURAL NETWORK

STUDENT Wenxuan Li *Computer Science*

ADVISOR Matthew Mason *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Contact dynamics is very hard due to its non-smooth nature where impact and friction is involved. Consider the simplest example a ball bouncing on a ground, its velocity follows negative to zero and to positive cycles. In my poster, I will be presenting my attempt at using Machine Learning neural networks to learn the physical models that involve contact dynamics.

DEFENSE AGAINST ADVERSARIAL MACHINE LEARNING

STUDENT Brandon Price *Computer Science*
ADVISOR Matthew Fredrikson *Computer Science*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Deep neural networks perform extremely well on image classification tasks and therefore are commonly used for this type of problem. However, these algorithms are vulnerable to adversarial samples: inputs to the network that look like they belong to one class but, the small changes to the input causes the network to output a different class with high confidence. This is a major security problem because it means an adversary could make small changes to their face to bypass facial recognition algorithms or possibly even modify street signs with small changes to confuse self-driving cars.

Researchers have attempted to solve this problem by designing specialized training algorithms for neural networks. We examine the how well an approach called distillation (Papernot et al. 2016) works as a defense against adversarial sampled. We explored a generalized class of adversaries, and show that while distillation increases makes it more complex to generate a successful attack, there are still feasible adversaries who can efficiently construct adversarial samples with a small average pixel distance from the original samples. Finally, we describe preliminary work outlining other defenses against adversarial samples as an alternative to defense distillation.

DESIGN AND IMPLEMENTATION OF CONCURRENT C0

STUDENT Max Willsey *Computer Science*
ADVISOR Frank Pfenning *Computer Science*
ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:52 am • Class of '87 / 12:40 pm

We describe Concurrent C0, a type-safe subset of C extended with contracts and session-typed message-passing concurrency. With a novel operation called forwarding, Concurrent C0 supports elegant expression of session types and message-passing concurrent programs that adhere to them. At the same time, its typing discipline enables efficient implementation that saves memory compared to traditional message passing techniques and effectively exploits parallelism. We demonstrate this via two compilers for Concurrent C0: one targeting C, and another targeting Go.

DESIGNING REFLECTION FOR THE WYVERN PROGRAMMING LANGUAGE

STUDENT Esther Wang *Computer Science*
ADVISOR Jonathan Aldrich *Computer Science*
ROOM/TIME Class of '87 / 4:40 pm

Wyvern is a "simple, typed, and pure object- oriented language." The objective of developing this language is to contribute to the field of programming languages by studying how desirable properties of a language can be produced through careful design decisions. Reflection in Wyvern aims to provide useful metaprogramming capabilities (introspection, self-modification, and intercession) while being secure and intuitive. The design was based off the work of Bracha and Ungar, who suggest adherence to the three design principles of encapsulation, stratification, and ontological correspondence. The design was followed by an implementation in the current version of the Wyvern interpreter.

EVALUATING CONNECTEDNESS OF COLLEGE OF FINE ARTS STUDENTS

STUDENTS Yunwen Cai *Mathematics* • Matthew De Jesus *Economics* • Kathleen Fuh *Computer Science* • Shaan Phagura *Statistics* • Vinay Viswanathan *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

CMU is divided into individual colleges, and students often, but not always, take the bulk of their coursework within the college they belong to. We want to study CFA's connectedness to other colleges because it has specialized constituent schools (not just departments), each with their own academic requirements. Our study is part of a broader discussion of whether students from different schools are too separated. To our knowledge there are no current research studies regarding this topic.

To solve the problem we conducted an email survey on CFA students, by sending out survey links to all CFA students. We did subgroup analysis on the schools within CFA and class year. We modeled the subgroups using generalized linear models, and we compared parameters across groups.

Our results could reveal CFA students attitudes of connectedness to the campus life, and which factors have the most influence on how CFA students interact with non-CFA students. This could shape future programming and initiatives made by student government, or CMU and CFA administration to promote greater cohesion among schools.

EVALUATING MODELS OF SUBCELLULAR LOCATION

STUDENT Rachel Kositsky *Computer Science*

ADVISOR Robert Murphy *Computational Biology*

ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 11:05 am • Class of '87 / 1:00 pm

The spatial distribution of a cell's components tells us much about its state and function. CellOrganizer is an open source software package that learns generative models of nuclear shape, cellular shape, and protein location from cell images and can synthesize in silico instances from these models. Our research involved developing methods to evaluate a model's fit for a given dataset. First, we developed a method for evaluating the reconstruction error of a model's parameterization for nuclear shape, cellular shape, and protein localization. Second, we developed a method for comparing models of nuclear shape and cellular shape by finding the likelihood of an image set given the generative model. These evaluation methods will provide users of CellOrganizer greater analytic power in their biological research by giving them a toolkit to choose the best fit model.

EXAMINING VISUAL-SPATIAL PATHS FOR REMEMBERING STRONG SECRETS

STUDENTS Taehoon Lee *Computer Science* • Joanne Lo *Social & Decision Sciences* • David Lu *Computer Science*

ADVISOR Jason Hong *Human Computer Interaction*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Despite many advances made in the usable privacy and security community in promoting the general knowledge of standard security practices, smartphone security and authentication is still heavily underutilized. To add onto that fact, there are currently many flaws with current authentication methods as well. Current methods, while reasonably

secure, may be difficult for users to remember and recall. Additionally, they provide no solutions to common social problems such as how to share your phone with friends/family while still keeping your phone.

In this project, we will be examining the feasibility of leveraging spatial memory to create a more secure and user-friendly method of authentication. I will create an authentication system that leverages spatial memory, based on the concept of a memory palace. Concretely, we will be able to define and test a well developed authentication method with improved security along with additional benefits.

EXTRACTING CURVES FROM SUBDIVISION SURFACES

STUDENT Bryce Summers *Computer Science*
ADVISOR Keenan Crane *Computer Science*
ROOM/TIME Class of '87 / 2:00 pm

Effective communication of technical ideas often demands compelling mathematical diagrams and visualizations. Just as TeX makes the best practices of professional mathematical typesetters accessible to everyday users, we aim to codify and automate best practices of professional mathematical illustrators. Currently, however, there is a functionality gap between 3D modeling software and 2D illustration software. The former allows users to manipulate 3D geometric information, while the latter allows users to manipulate aesthetic and stylistic information. In our work we wish to bridge the gap between these two types of software by extracting relevant curves from views of 3D Catmull-Clark subdivision surfaces that visually communicate geometric relationships in the form of projected 2D Bezier curves amenable to traditional aesthetic design.

EXTRACTING SYMBOLIC KNOWLEDGE FROM WORDNET GLOSSES

STUDENT Sonya Anopa *Computer Science*
ADVISOR Scott Fahlman *Language Technologies Institute*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

The Scone project seeks to provide an open-source knowledge-base system for common-sense reasoning and language understanding. However, adding new knowledge is mostly done by hand, which is tedious. This research project "reads" WordNet glosses, which are human-readable definitions for word meanings, to extract useful symbolic knowledge structures that can be added to Scone. For example, the noun-adjective relationship in a sentence (e.g. "white elephant") allows to create an intersection type for a concept - an intersection of the noun concept and the adjective concept. We also hope to generalize the tool to non-WordNet definitions.

FLEXIBLE MANAGEMENT OF SUPERPAGES TO IMPROVE PERFORMANCE

STUDENT David Lindenbaum *Computer Science*
ADVISORS Todd Mowry *Computer Science*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Superpages are a contiguous set of virtual pages mapped to a contiguous set of physical frames (typically 2MB or 1GB in size). They allow the processor to use a single TLB entry to express the virtual-to-physical mapping of a large range of addresses, thereby reducing overall TLB misses. Unfortunately, superpages reduce the flexibility for the operating system to efficiently manage memory. First, they exacerbate the internal fragmentation problem

because a large region is reserved for a process that may not need that much memory. Second, techniques like copy-on-write are much more expensive when superpages are in use because the entire superpage must be copied for even a small write.

Our work exploits a recently proposed framework called "page overlays", that allows memory management at the cache line level within pages. We extend page overlays to superpages. Our extension allows the system to track modifications to superpages at a page granularity. As with the previous framework, a bit vector is appended to each page table entry, indicating which segments of the superpage are mapped to an overlay instead. Depending on the value of the corresponding bit, the page table walk either terminates at the superpage as normal or continues to a secondary page table hierarchy containing the overlay mappings.

Our system is expected to alleviate both of the main downsides of superpages. Internal fragmentation can be reduced by only mapping part of a superpage to physical memory and using overlays for the rest of the address range. This effectively creates a smaller superpage that maps a range closer to the exact required size. Overlays can track small changes in superpages to avoid copying the full superpage or breaking it down into standard pages. Rather than doing a copy-on-write, we can create an overlay on write and only copy one page while preserving the original superpage.

HALIDE SCHEDULE GENERATION FOR THE GPU

STUDENT Oguz Ulgen *Computer Science*
ADVISOR Kayvon Fatahalian *Computer Science*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Domain specific languages for high-performance image processing has been an important area of research. Halide, like most of its competitors, requires hand-written schedules to generate efficient code. Prior work on automated schedule generation for the CPU has lead to increased programmer productivity. We attempt to extend these successes by looking into automated schedule generation for the GPU. We start by exploring Halide's default schedule generation for OpenCL, and then evaluate performance of Halide's image processing pipelines on Intel Integrated GPUs, as compared to code generation for the CPU.

HUMAN-ASSISTED REFINEMENT OF PERSONALIZED NEWS RECOMMENDATION

STUDENT Abdelwahab Bourai *Computer Science*
ADVISOR Eric Nyberg *Language Technologies Institute*
ROOM/TIME Class of '87 / 11:00 am

With the advance of machine learning from smartphones to healthcare, there have been breakthroughs in the research of both the algorithms and applications in this domain. In parallel, much research has been done on crowdsourcing and human computer interaction as well. However, very little research has been done on leveraging human interaction with the potent machine learning algorithms developed. In this project, the goal is to investigate potential ways to best combine the advances in artificial intelligence and machine learning with human knowledge and opinions in the domain of news. Contextual bandits are used to create a user model and a rankings system which can then be adjusted and manipulated directly by the user or through other indirect actions. Stacked! autoenc oders are used to condense a wide swath of news topics into broader categories for the user to interact with at first,

with further interaction allowing the bandit system to pinpoint which topics the user prefers. In addition, much deliberation and care was put into the design of the interface to ensure the system can get user feedback in as clean and efficient a manner as possible.

HUMAN-USABLE PASSWORD SCHEMAS: BEYOND INFORMATION-THEORETIC SECURITY

STUDENT Elan Rosenfeld *Computer Science*
ADVISOR Manuel Blum *Computer Science*
ROOM/TIME Class of '87 / 4:20 pm

Password users frequently employ passwords that are too simple, or just reuse passwords for multiple websites. A common complaint is that utilizing secure passwords is too difficult. One possible solution to this problem is using a password schema. Password schemas are deterministic functions which map challenges—such as the website name—to responses (passwords). Previous work has been done on developing and analyzing publishable schemas, but these analyses have been information-theoretic, not complexity-theoretic; they consider an adversary with infinite computing power.

We perform an analysis with respect to adversaries having currently achievable computing capabilities, assessing the realistic practical security of such schemas. We prove for several specific schemas that a computer is no worse off than an infinite adversary, and that it can successfully extract all meaningful information from leaked challenges and their respective responses, known as challenge-response pairs. We also show that any schema that hopes to be secure against adversaries with bounded computation must obscure information in a very specific way, by introducing many possible constraints with each challenge-response pair. These surprising results put the analyses of password schemas on a more solid and practical footing.

IDENTIFYING SECURITY-CRITICAL COMPONENTS WITH ATTACK PATH PLANNING

STUDENT Jia Jun Brandon Lum *Computer Science*
ADVISOR David Brumley *Electrical & Computer Engineering*
ROOM/TIME Class of '87 / 4:00 pm

The security of any system is only as strong as the weakest link. Ideally, we would want to ensure that every single component of a system is secure. However, it is not scalable to check for security vulnerabilities in every component. The current approach to Identifying Security-Critical Components is through attack path planning - finding out how an attacker can violate the confidentiality, integrity or availability of the system. An attack plan consists of a series of step an attacker can take to compromise the system. These steps include exploiting vulnerabilities in components of the system. However, we do not know exactly what vulnerabilities are present in the system. Our task is to (based on a potential attack plan), hypothesize which vulnerabilities are the most important to check for in a system. This is currently done by generating facts about the system using tools on system images, inferring additional information from a set of rules, and identifying attack plans via a simple backward search algorithm. This thesis first explores an alternative method of generating attack plans via a planning language PDDL. We then discuss some of the difficulties in the current approach of solving this problem. Following that, we change gears and

present a novel approach to the problem. Instead of revolving our system around the formulation of an attack plan and determining which bug hypothesis are necessary to execute the plan, we do the reverse. We take a search based approach to finding bug hypothesis that we can then use to formulate an attack plan.

IDENTIFYING UNCERTAINTY IN SELF-ADAPTIVE SYSTEMS.

STUDENT Won Gu Kang *Computer Science*

ADVISOR David Garlan *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

There are several sources of uncertainty in self-adaptive systems, but many systems do not address them as a first-class concern. We first explore the different kinds of uncertainties that arise in self-adaptive systems. Then we define the uncertainties in the Acme architecture description language.

Finally, we use the Acme models in the RAINBOW self-adaptive system to address uncertainty.

IMPLEMENTING VR AND OTHER SHADERS FOR THE SHADER COMPILER

STUDENT Gregory Rose *Computer Science*

ADVISOR Yong He *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

This presentation is a collaboration with ongoing research into creating a new compiler and shading language capable of easily moving between different optimizations, and finding the set of ideal cost-quality trade-offs. The contribution provided here is to exercise the shading system with more real-life applications, including VR shaders such as barrel distortion, in order to test the system for usability and performance under a wider set of examples.

IMPROVE OPEN QA WITH FREEBASE

STUDENT Hongyu Li *Computer Science*

ADVISORS James Callan *Language Technologies Institute* • Chenyan Xiong *Language Technologies Institute*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

This research is based on a current state-of-the-art Question Answering system on Freebase. This study includes a detailed error analysis on the QA system, and a further improvement of the current Relation Matching and Ranking approaches by adding new features to the original training model in order to obtain more accurate results. The system will be evaluated by two standard benchmarks, Free917 and WebQuestions. An analysis on the final result and the comparison with the original result will be provided.

IMPROVING EVENT COREFERENCE WITH KNOWLEDGE BASES

STUDENT Chris Ying *Computer Science*

ADVISOR Bishan Yang *Machine Learning*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Event coreference is the task of matching up different mentions of the same event in free text. This study aims to improve the performance of event coreference by incorporating prior world knowledge, in the form of knowledge bases (KB). Using entity relations from existing knowledge bases such as NELL, YAGO, and DBpedia, we can construct a KB-Text graph that links parsed entities and events in news corpora to related entities. Using various graph similarity metrics, we can cluster events in the KB-Text graph and compare it to a baseline "bag-of-entities" approach. The results show that clustering with the richer set of features from the KB-Text graph can find coreferencing events that the baseline approach would have otherwise missed.

INFORMATION EXTRACTION IN SCONE FROM SEMI-ORGANIZED SOURCES

STUDENT Shaojie Bai *Computer Science*

ADVISOR Scott Fahlman *Language Technologies Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 11:18 am

The primary goal of this research is to explore, among the various existing methods, an efficient way to extract information from external sources and build a Scone knowledge base (KB) in the area of geography and sports. In particular, I used Python and Common Lisp to develop a version of software converter, which is able to quickly identify the critical information contained in sources like webpages. One major focus as well as challenge of the extraction is for Scone to learn from the mountains of information extracted from the Internet (which is constantly updated, driven by many web engines and have lots of formats)--- and accurately cross-check the new knowledge against multiple sources, including its existing knowledge. The research completed in this project is expected to lay valuable foundation for further research on more automated ways for Scone to create information converters on its own for a variety of formats and domains.

INVESTIGATING THE COMPUTATIONAL COMPLEXITY OF #P

STUDENT Andrew Chen *Computer Science*

ADVISOR Manuel Blum *Computer Science*

ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

#P (Sharp-P) is the complexity class that counts the number of accepting paths of a non-deterministic Turing Machine. Some problems known to be #P-complete include counting the number of satisfying assignments to a general boolean formula and computing the permanent of a 0-1 matrix. #P includes all NP complete problems.

BPP is the complexity class of decision problems that can be efficiently solved by a probabilistic Turing Machine in polynomial time with bounded error. The goal of this project is to explore the difficulties that arise in approaches to proving that #SAT is contained in BPP.

LANTERN: A QUERY LANGUAGE FOR VISUAL CONCEPT RETRIEVAL

STUDENT Will Crichton *Computer Science*

ADVISOR Kayvon Fatahalian *Computer Science*

ROOM/TIME Class of '87 / 3:20 pm

Modern visual data analytics increasingly rely on sources of large, unlabeled visual datasets such home webcams, vehicle dashcams, and satellites. However, most modern tools for Big Data analytics lack primitives that are both fluent and efficient for understanding visual data. This thesis presents Lantern, a query language and runtime for describing and finding "visual concepts" in databases of images and videos. I define visual concepts as compositions of "things" (e.g. objects, faces) and spatial relations between things (e.g. above, around). I implemented a runtime for both finding visual concepts in images and tracking concepts across videos. The system scales horizontally by scheduling image processing operations across a cluster and vertically by enabling the user to accelerate their tasks over GPUs and multicore CPUs. I evaluated my prototype on several applications including object detection error analysis, face detection and blurring in video, and interactive queries for visual data exploration.

LOCAL CROWDSOURCING TO DEVELOP NAVIGATION SYSTEM FOR PEOPLE WITH VISUAL IMPAIRMENTS

STUDENT Summer Kitahara *Computer Science*

ADVISOR Jeffrey Bigham *Human Computer Interaction*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Crowdsourcing has been widely successful for small tasks that require human knowledge, but most crowdsourcing platforms are limited to online tasks such as audio transcription. In order to support NavCog, a navigation system for people with visual impairments, people need to be engaged to complete small physical tasks. These tasks include maintaining the system by replacing batteries in Bluetooth Low

Energy beacons or taking and labeling pictures of specific locations. I created Android and web applications that encourage the local crowd to perform tasks that require a physical presence or local knowledge of the environment. In the application interface, users can select from a list of tasks to complete, some of which involve taking and submitted a photo. If they see something that needs to be done, like repairing a Bluetooth Low Energy beacon, they can create a new task for others to complete. The application will guide another person to the correct location with instructions on how to complete the task.

MARRIAGE EXPECTATIONS SURVEY

STUDENTS Lilia Bidzyan *Economics and Statistics* • Chun Yen Chang *Computer Science* • Lue Fang *Statistics* • Mark Moskwa *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

We conducted a survey of marriage expectations for CMU undergraduate students, as we anticipated our research would help the CMU community as a whole attain a valuable understanding of CMU undergraduate students' attitudes toward marriage. Specifically, this will be with respect to demographic information, the decision of

whether or not to pursue marriage, and insight into whether future academic career and academic plans influence these attitudes. While the CMU undergraduate population is inarguably unique in nature and divergent from the young adult population nationally, we anticipate our findings will help us compose a more informed opinion. We designed a survey containing demographic questions, questions regarding attitude towards marriage and expected age of marriage, and questions related to the rationales behind these reported expectations. We collected data from randomly selected CMU undergraduate students and compared the responses we obtained across different majors, sexes, class years, etc. in order to determine the whether there is a relationship between the preceding factors and expected age of marriage.

MOBIUS, MULTIPURPOSE MOBILE MANIPULATOR MK 1-001

STUDENTS Aayush Bhasin *Electrical & Computer Engineering* • Mingquan Chen *Electrical & Computer Engineering* • John Choi *BCSA* • Raymond Galeza *Mechanical Engineering* • Kashish Garg *Electrical & Computer Engineering* • Ethan Gruman *Mathematics* • Raunak Sanjay Gupta *Electrical & Computer Engineering* • Ian Holst *Physics* • Marcus Horn *Mechanical Engineering* • Terence Huang *Mechanical Engineering* • Inez Khan *Physics* • Dimitrios Konstantinidis *Computer Science* • Kais Kudrolli *Electrical & Computer Engineering* • Tuan Anh Le *Electrical & Computer Engineering* • Siliang Li *Electrical & Computer Engineering* • Hannah Loy *Mechanical Engineering* • Zhichu Lu *Electrical & Computer Engineering* • Zixu Lu *Mechanical Engineering* • Sarah McAllister *Art* • Won Woo Nam *Mechanical Engineering* • Ruvini Navaratna *Physics* • Sang Hyun Park *Self-defined* • Raghav Poddar *Undecided* • Ulani Qi *Art* • Tyler Quintana *Mechanical Engineering* • Haowen Shi *Electrical & Computer Engineering* • Yuyan Sun *Electrical & Computer Engineering* • Omar Tena *Mechanical Engineering* • Yufan Wang *Mechanical Engineering* • Brendan Wixen *Mechanical Engineering* • Shanshan Xie *Physics* • Mengyun Xu *Computer Science* • Yue Xu *Physics* • Yixiu Zhao *Computer Science* • Zheyao Zhu *Mechanical Engineering*

ADVISORS David Kosbie *Computer Science* • Golan Levin *Art* • Katharine Needham *Computer Science*

ROOM/TIME Connan / 12-2:30 pm

As it stands today, access to human-size mobile manipulator robots is mostly limited to well-funded technical research institutions, often manned exclusively by a handful of engineers and scientists who find it difficult to imagine their robots being used outside of their labs in the name of art. I aim to change that. The objective of this project is to build a series of research-grade mobile manipulator platforms that anyone can use and work with. By significantly lowering the barrier to entry in both cost and difficulty in performing human-size mobile manipulation research, the Multipurpose Mobile Manipulator truly bridges gaps in technology and art in many more ways than one. The robot is named "multipurpose" for a reason. Some examples of use cases include household chores like brooming and delivering coffee, more artistic examples include exploring the artificial imagination through painting and acting, and some silly examples include lightsaber dueling. As it stands today, the Multipurpose Mobile Manipulator is a marriage of the functional and the aesthetic, the behavioral and the autonomous, the machine-like and the human-like.

PARALLEL FUNCTIONAL ARRAYS

STUDENT Ananya Kumar *Computer Science*

ADVISOR Guy Blelloch *Computer Science*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

In this paper we introduce a O(1) wait-free, parallel, functional array, that allows O(1) reads and writes to the most recent version of the array. We describe the cost dynamics and sketch out a provable implementation. We show favorable benchmarks comparing our functional arrays with regular arrays in Java.

PEDESTRIAN POSE DETECTION BY SYNTHESIS

STUDENT Brandon Houghton *Computer Science*

ADVISOR Kris Kitani *Robotics Institute*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

We present a hands-off approach to training pedestrian detection and estimation networks by using graphical modeling software to overcome the significant hurdle of labeling data for training. Through the use of 3D modeling we are able to generate hundreds of thousands of labeled training examples with precise joint and segmentation information enabling high performing networks that can generalize to real-world data. This work follows a successful paper previously published by the group wherein synthesis was used to create a pedestrian detector that could generalize to real world data after only being trained on synthetic examples.

PRIVACYPROXY: USING CROWDSOURCING TO DETECT AND MITIGATE INFORMATION LEAKAGE ON SMARTPHONES

STUDENT Kevin Ku *Computer Science*

ADVISORS Yuvraj Agarwal *Computer Science* • Jason Hong *Human Computer Interaction*

ROOM/TIME Class of '87 / 3:00 pm

Numerous studies have suggested that smartphone apps often transmit personally identifiable information (PII) in the background, without the user's knowledge. To date, most of the studies relied on either static analysis or operating system instrumentation to detect leakage based on the types of information accessed by an app. This approach has several shortcomings that prevent widespread adoption. First of all, it is very hard for an average user to run the tools to analyze an app or to modify the smartphone's OS. Secondly, without modifying the OS, there is no way to mitigate the information leakage. Furthermore, most PII access enforcement occurs at the app granularity, so there is no way to have different access policies for different parts of an app. Thirdly, apps may generate app-specific IDs to identify an user. Such practice is common among mobile analytics libraries which generate per-device IDs in order to track a user across multiple apps using the same libraries. Lastly, individual users may not be well-informed enough to make decisions about whether to allow or deny an app's access to PII. We can crowdsource this decision across peers to help users set a reasonable default policy for each app.
We present PrivacyProxy, an Android app that can be used on any device running Android 4.0 or above, without any modification to the OS. It scans through outbound network requests to build host-specific signatures - structures recording the frequencies of different values as seen in all the requests to a host. Signatures from different

users can be anonymously combined and shared such that for every new request that is sent to a host, the client can consult the signature for the host to see if other users are seeing similar values in their requests. By leveraging this information, we can detect and notify users of PII leaks. We also give users the opportunity to modify the content of a request before it leaves the device, thereby mitigating PII leaks.

QUANTUM ALGORITHMS ON MATRIX PRODUCT VERIFICATION

STUDENT Yongshan Ding *Computer Science*
ADVISOR Ryan O'Donnell *Computer Science*
ROOM/TIME Class of '87 / 12:00 pm

We studied the quantum query complexities of the problems related to matrix multiplications. The main purpose of this project is to improve the upper and lower bound for quantum algorithms that verifies a product of two nxn matrices under boolean semi-ring, from the perspectives of span-program-based quantum query algorithms and polynomial method, respectively

REFINEMENT TYPES FOR SESSION TYPED CONCURRENCY

STUDENT Cosku Acay *Computer Science*
ADVISOR Frank Pfenning *Computer Science*
ROOM/TIME Class of '87 / 10:20 am

Prior work has established the deep connection between linear sequent calculus and and session-typed message-passing concurrent computation. We extend this further by introducing intersection and union types, which are, in the presence of equi-recursive types and a natural notion of subtyping, strong enough to express many behavioral properties of concurrent processes. We demonstrate their use as refinements over existing types, and show how certain constructs can be understood as special uses of intersections and unions.

ROBOT GESTURE LIBRARY (ROGUE)

STUDENT Rachel Holladay *Computer Science*
ADVISOR Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:39 am

We present the Robot Gesture Library (RoGuE), a motion-planning approach to generating gestures. Gestures improve robot communication skills, strengthening robots as partners in a collaborative setting. Previous work maps from environment scenario to gesture selection. This work maps from gesture selection to gesture execution. We create a flexible and common language by parameterizing gestures as task-space constraints on robot trajectories and goals. This allows us to leverage powerful motion planners and to generalize across environments and robot morphologies. We demonstrate RoGuE on four robots: HREB, ADA, CURI and the PR2.

ROBOTUTOR: DEVELOPMENT OF SWAHILI FINGER-WRITING AND SPEAKING TUTOR APPLICATIONS FOR ANDROID

STUDENT Rameel Rizvi *Computer Science*

ADVISOR Jack Mostow *Robotics Institute*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

The development of finger-writing and speaking tutors begins with a careful layout of the tutor logic: an overview of the process is presented, including the design of animation state graphs as well as the resultant framework implementation. Determination of appropriate user feedback prompts for individual tutors is discussed. Creation of the Android applications is covered, with focus on UI component design.

STATISTICAL ANALYSIS OF THE CLATHRIN-COATED PIT FORMATION

STUDENTS Edward Dryer *Science and Humanities Scholars* • Cong Ma *Computer Science* • Quan Yuan *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

We analyzed Total Internal Reflection Fluorescence (TIRF) microscopy measurements of membrane protein transport. We observe intensity profiles of fluorescently-labeled clathrin-coated pits as they form and pinch off from the membrane. Previous research has shown that changes in pit formation rates and duration may be biologically interesting. We analyzed sources of measurement variation in the rates of pit formation, with the goal of quantifying and improving statistical power to detect rate changes. We also analyzed the intensity profile shapes to better understand the features that distinguish the intensity profiles of true clathrin-coated pits from noise.

TEMPO SEGMENTATION IN ELECTRONIC DANCE MUSIC

STUDENT Hemanth Kini *Computer Science*

ADVISOR Roger Dannenberg *Computer Science*

ROOM/TIME Class of '87 / 10:00 am

An algorithm for segmenting electronic dance music (EDM) songs by tempo is proposed in this thesis. Electronic dance music is a popular contemporary genre of music that is rhythmically driven and based on loops, making it ideal for tempo-based segmentation. Our algorithm is split into two parts. In the first, existing onset-detection and tempo-tracking algorithms are modified to accurately detect typical events in EDM songs. In the second, we fit a series of piecewise linear functions in order to generate a tempo graph, useful for musicologists as well as DJs. This algorithm is carefully tuned to balance runtime and accuracy of detected tempos. The algorithm is evaluated against a training set of EDM tracks, with varying as well as static tempos, and other rhythmic features.

THE CMU BUBBLE

STUDENTS Zachary Cree *Statistics* • Noshin Nova *Statistics* • Mariana Robelo *Economics and Statistics* • James Yang *Computer Science* • Xiaofan Zhu *Mathematics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Carnegie Mellon is known for its rigorous coursework, but knowledge of current national and world events is also an important part of education and preparing students to become a part of society. Carnegie Mellon students are often deeply absorbed in their work so we found out how well informed they are and investigated how students can become more informed about current events.

We focused on comparing performance on a current events quiz between freshmen in different demographic groups and different majors at CMU. We conducted a stratified random sample across freshman dormitories and knocked on doors to ask selected students to take our current events quiz. We recorded their major and demographic information about the students, news sources that students used and the amount of time they spent reading the news. We then analyzed whether demographic factors, specific majors, or news sources correlated with performance on the quiz. We predicted that this investigation would reveal commonalities between groups that perform well and could lead to insight into ways to keep students well informed. Perhaps this could motivate future research to help provide easier access to news.

THE STATISTICS BEHIND CMU STEREOTYPES

STUDENTS Kruti Koppolu *Statistics* • Andrew Manka *Statistics* • Pooja Penninti *Self-defined* • Elan Rosenfeld *Computer Science* • Yoona Seon *Economics and Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Stereotypes about specific colleges at Carnegie Mellon are widespread and can be damaging to students' abilities to cooperate, both in and out of the classroom. In particular, stereotypes about the Tepper School of Business, the College of Fine Arts, and the School of Computer Science are reiterated each year, ensuring that these opinions influence CMU undergraduates' attitudes towards each other. Using stratified random sampling on colleges, our group collected data through a Qualtrics survey about just how commonly (and how strongly) believed these oft-cited stereotypes are, and by whom they are held. We did a general exploratory analysis of our results and fit a linear regression model to the data in an attempt to measure what factors have a significant effect on a student's view of his or her peers. For example, does actually getting to know students of a particular college help to dispel or reinforce these stereotypes? With this information we hope to help inform school administrators on how to best promote understanding and collaboration between colleges.

TRANSLATING INTO MORPHOLOGICALLY RICH LANGUAGES WITH WORD-LEVEL INFLECTIONAL LSTM MODELS

STUDENT Patrick Xia *Computer Science*
ADVISOR Christopher Dyer *Language Technologies Institute*
ROOM/TIME Class of '87 / 9:40 am

A deep learning approach is used to predict word translations of individual words into morphologically rich languages. These predictions are used to augment the translation lexicons of traditional statistical translation systems. We decompose each target word into a stem and an affix, and we predict each part using a different model. To handle the prediction of stems, we obtain a list of probable candidate stems in the target language for each word in the source sentence. To handle their inflections, we train a long short-term memory network to predict their affixes, one character at a time, using features extracted from the source word (represented as a sequence of characters) and its context, which captures information about its grammatical roles in the source language. This process overgenerates candidate translations for each word in the source sentence, but these are disambiguated during decoding of the full sentence by a standard discriminatively trained translation model.

TRANSPORT LAYER IN EXPRESSIVE INTERNET ARCHITECTURE

STUDENT Tianyuan Ding *Computer Science*
ADVISOR Srinivasan Seshan *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

As several recent research efforts such as named data networking (NDN) and content-centric networking (CCN) have noted, Internet communication has become much more content-oriented over the years. Unfortunately, while there have been these efforts to improve the protocols we use to deliver content through computer network (e.g., TCP, SSL, and HTTP), their designs have often been modifications to individual protocols that often don't work well together and therefore have a low compatibility. The goal of this project is to take a holistic approach to designing a new content delivery protocol that combines features from TCP, SSL and HTTP into a single transport protocol. We plan to implement this design with the XIA (eXpressive Internet Architecture) system. XIA is a clean-slate Internet architecture that is being developed as part of an ongoing research project carried by Carnegie Mellon University and several other universities.

USE OF ELASTIC NET REGRESSION AND PENALIZED LOGISTIC REGRESSION TO IDENTITY NEURO-BIOMARKERS THAT PREDICT STRESS-RELATED RISK FOR CORONARY HEART DISEASE.

STUDENT Vivek Nangia *Computer Science*
ADVISORS Aarti Singh *Machine Learning* • Timothy Verstynen *Psychology*
ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 11:44 am • Class of '87 / 1:40 pm

Atherosclerotic coronary heart disease (CHD) is the leading cause of premature disability and death in the US. At present, there is a critical need to identify the factors and processes that confer CHD risk. Atherosclerotic CHD risk is increased by a person's tendency to express so-called 'exaggerated' cardiovascular—particularly blood

pressure (BP)—reactions to psychological stressors. Such stressor-evoked BP reactions are generated and regulated by the activity of a network of brain areas that process psychological stress and control peripheral physiology. This research looks to identify neuro-biomarkers that predict stress-related risk for syndromes such as CHD. Specifically, using elastic net regression and penalized logistic regression, we regress fMRI BOLD time series against stressor-evoked BP reactions. We attempt to create a model that is capable of predicting the magnitude of stress-evoked cardiovascular response and can identify brain regions that are associated with the cardiovascular response which correspond to well known structures in the brain.

VIRTUAL TRAFFIC LIGHTS CAN INCREASE THE MAXIMUM SPEED IN CITIES

STUDENT Valentin Moullet *Computer Science*

ADVISOR Ozan Tonguz *Electrical & Computer Engineering*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

In this study, we investigate whether it is possible to increase the speed of vehicles in urban areas from 25 mph to higher values (such as 40 mph). To this end, we check the performance improvement of Virtual Traffic Lights, a well-known new traffic control scheme, when one increases the maximum speed in terms of average commute time during rush hours, waiting time at intersections, mean maximum queue length, and throughput as the 4 important performance metrics. One concern is whether such an increase in maximum speed could cause more accidents at intersections. We quantify this with SUMO, an open-source mobility simulator developed by German Aerospace Center. We show that one way to eliminate such concerns is to increase the yellow phase from the current standard (typically 3 sec) to higher values such as 5 sec. Overall, our results show that by careful system design, the benefits of Virtual Traffic Lights can be increased substantially.

VISUALIZING SOCIAL INTERACTIONS BASED ON BRAIN ACTIVITY

STUDENT Elizabeth Ji *Computer Science*

ADVISOR Laura Dabbish *Human Computer Interaction*

ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

The goal of this project is to use the data from commercially available EEG headsets to create visualizations representing the person wearing them. A variety of visualizations were created to explore how people interpret and react to different representations of brain activity. We hope to find how this will influence social interactions where participants can see each other's brain activity.

HUMAN COMPUTER INTERACTION

CAN WE DEVELOP NEW TECHNOLOGY TO BE USED BY OLDER ADULTS? A CASE STUDY, USING AN INTELLIGENT YET UNINTIMIDATING WATCH TO REMIND OLDER ADULTS TO TAKE PILLS AND OTHER MEDICATION.

STUDENTS Yeon Soo Kim *Human Computer Interaction* • Kristina Wagner *Human Computer Interaction*

ADVISOR Anind Dey *Human Computer Interaction*

ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 11:31 am

We aim to address the disparity between technology capable of providing personalized assistance and elderly people who have a lack of personalized assistance with a small scale instance of the issue. More Economically Developed Countries (MEDC) are faced with changing demographics, in particular a proportionally larger population of Senior Citizens. Consequently, areas including Assisted Living are of increasing importance. However, Western MEDCs are not particularly economically prosperous, and most Senior Citizens cannot afford Assisted Living Programs and personalized treatment.

We will experiment on a small scale using the research question, "Elderly people are forgetful and sometimes forget to take pills, or whether or not they have taken pills", using the HCI iterative research method of 1) Prototyping 2) Implementation of product 3) User testing, to continue developing and testing our product to make necessary iterations based on feedback received from users. We wish to extend the existing conceptual models Senior Citizens have for analogue watches. We will provide a means for Seniors to mark the last time they took their pills on their watch face. We are also looking into other useful functionality (for example, reminding seniors when to take their pills by making the watch vibrate).

ROBOTICS INSTITUTE

AUTOMATICALLY MINING SOCIAL MEDIA FOR VIDEOS WITH HIGH TEMPORAL AND SPATIAL LOCALITY FOR USE IN DYNAMIC 3D RECONSTRUCTION

STUDENTS Nikhil Choudhary *Electrical & Computer Engineering* • Avi Romanoff *Robotics Institute*
ADVISOR Yaser Sheikh *Robotics Institute*
ROOM/TIME Wiegand Gymnasium - SCS Independent Study / 12-2:30 pm

Social media videos that overlap in content matter, time or space can give viewers multiple perspectives of events in the past. The search of these clusters that have high spatial and temporal proximity is usually done through manual searching on social media platforms. First, one must have knowledge of an event and then be able to conduct a thorough search for it, both which requires significant time and effort. Most commonly, researchers rely on ad hoc video capture (e.g. videos filmed by the researchers themselves), which has limited utility in simulating real world user generated videos of events.

We have created a layer of abstraction over YouTube which presents selected videos bunched together as a potential cluster to a researcher. We synthesize terms from online news and event tracking websites which form the basis for the collection of related YouTube videos based on metadata. This automated pipeline allows a small team of researchers to rapidly sift through and identify promising clusters. By automating the searches and presenting them in an efficient interface, we have reduced the time from 20 minutes on a manual search to approximately a minute on evaluating.

SCIENCES & HUMANITIES SCHOLARS

SCIENCE AND HUMANITIES SCHOLARS

APPLY SPECTRAL LEARNING OF LATENT-PCFG TO HANDWRITTEN ALGEBRA EQUATIONS

STUDENT Fan Yang *Science and Humanities Scholars*

ADVISOR Geoffrey Gordon *Machine Learning*

ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 10:00 am

In this project, we apply a recently developed spectral algorithm to estimate the parameters of a latent-variable PCFG model. We then use this learned model to parse handwritten algebra equations.

ASSESSING RESPONDENT ATTITUDES TOWARDS GEOLOCATION IN ONLINE SURVEYS

STUDENT Ernest Kin Hoe Chiew *Science and Humanities Scholars*

ADVISOR Samuel Ventura *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The internet facilitates the administration of surveys and the collection of data from respondents. Naturally, privacy concerns arise among respondents when data is collected over virtual space. Geolocation refers to the automatic identification of the physical locations of Internet users. We study respondent reactions towards the different types of geolocation presented in online surveys. This problem is especially important for the US Census Bureau, since respondents can choose to fill out the 2020 decennial census online instead of via the traditional paper census form. After coordinating with US Census Bureau researchers, we designed and administered a replica of a census form to a sample of respondents. Using the IP address of each respondent, we approximated the geographical coordinates of the respondent and displayed this location on a map on the survey. We varied the information plotted on the map as well as the map interface between the three interfaces on the Google Maps API: default road map, Satellite View, and Street View. Snapshots of responses were captured at every instant information was added, altered, or deleted by respondents when completing the survey. From our data, we determine if there are any associations between the type of geolocation presented and the behavior of respondents, such as the time taken to complete the survey, the frequency of response deletions, and the tendency of information withholding.

BIOGRAPHIES IN TIME: INVESTIGATING GENDER DISCREPANCIES IN THE OXFORD DICTIONARY OF NATIONAL BIOGRAPHIES

STUDENTS Hyunsang Cho *Science and Humanities Scholars* • Yuka Moroishi *Statistics* • Kristina Schiffhauer *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

We analyze the Oxford Dictionary of National Biographies and explore the impact of the gender of the subject on the specific biographical descriptions used. Using statistical analysis and text mining tools, we investigate gender neutral words that are used differentially between genders. We also examine the changes in these descriptions over time, considering both the time of the subject's life and the biography's authorship.

BRACHISTOCHRONE PROBLEM IN NON UNIFORM GRAVITATIONAL FIELDS

STUDENTS Keven Chionh *Science and Humanities Scholars* • Liuyu Jin *Mathematics*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:00 am

If a particle travels at a constant speed, then the path that admits the shortest transit time between two points in space is the line segment connecting them. However, if the speed of the particle depends on the location of the particle, then the straight-line path will generally not provide the shortest time of transit between two given points. A very important situation in which the speed of a particle depends on its location occurs when the particle is acted upon by a gravitational field. The classical Brachistochrone Problem ('brachistos' is Greek for 'the shortest', and 'chronos' means 'time, delay') deals with this question in a uniform gravitational field. This research concerns the Brachistochrone Problem in non-uniform gravitational fields. In particular, we focus on on the inverse-square gravitational field directed towards a point source. Previous researchers found 'candidates' for the minimizing curves, but did not prove that they are actually minimizers. We provide a proof that these curves are in fact minimizers for certain configurations of the endpoints. We also discuss a previously unobserved phenomenon, that there are configurations of the endpoints for which a minimizer does not exist.

CHARACTERIZATION OF A TANDEM FLUOROGEN-POLYMER PROBE FOR THE SENSING OF SELECT PROTEIN INTERACTIONS

STUDENT Christina Cabana *Science and Humanities Scholars*

ADVISOR Marcel Bruchez *Chemistry*

ROOM/TIME Rangos 2&3/Sigma Xi Group 3 / 11:44 am

Protein interactions are an essential part of living organisms; when these interactions are disrupted cells experience diseases ranging from addiction, to cancer, to neurodegenerative disorders and so on. To better understand these interactions, fluorescent proteins such as GFP are commonly used to monitor cellular proteins in vivo. However, these systems are non-specific in their activation which leads to a large amount of background signal. Fluorogen/FAP systems have been implemented in recent years to address these problems. In these systems a fluorogen activating protein (FAP) such as dK binds a non-fluorescent dye such as malachite green (MG) resulting in an increase in fluorescence. In this study, poly(oligoethoxy)methacrylate, a water soluble and cell permeable brush

polymer, was end functionalized with both MG, and a hexyl chloride ligand. In the proposed system dK will bind MG reversibly, while the hexyl chloride ligand will bind covalently to dehalogenase proteins. Protein interactions will be measured after washing off all probe not anchored to a dehalogenase enzyme. All fluorescent signal will then correspond to the simultaneous binding of hexyl chloride and MG to their corresponding proteins. To test the feasibility of this probe, dK was expressed on the surface of S. cervisae and purified from E. coli. The fluorescent properties of the polymer probe, as well as its binding affinity to dK were tested using fluorescence spectroscopy, fluorescence microscopy, and flow cytometry. The results indicated that the polymer was able to be washed from the cell surface and that it was bright enough to yield meaningful measurements about what fraction was bound. In this way, the polymer probe complex shows potential as an important tool in the sensing of protein interactions.

COMPARATIVE GENOMIC APPROACH FOR THE IDENTIFICATION OF VIRULENCE DETERMINANTS IN THE HUMAN PATHOGEN STREPTOCOCCUS PNEUMONIAE

STUDENT Ashwin Panda *Science and Humanities Scholars*
ADVISOR Natalia Hiller *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 11:05 am

In this project, methods involving comparative genomics were used to identify differences between related strains of S. pneumoniae that display variable phenotypes. Computational approaches were used to compare the genomes of multiple strains and determine the genetic differences between them. Two strains that displayed variable phenotypes and differed from each other by laboratory passages were compared. Finding differences between the genomes of these strains allows for single nucleotide polymorphisms to be linked to phenotypic differences between the strains. In the long term, identification of these genetic differences may provide useful insights into how to counteract these novel strains of the pathogen.

DIFFERENTIATING STARS AND GALAXIES IN SDSS AND WISE DATA

STUDENT Siqi Guo *Science and Humanities Scholars*
ADVISOR Peter Freeman *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Current wide-field surveys like the Sloan Digital Sky Survey (SDSS; York et al. 2000) are collecting data on hundreds of millions of astronomical objects. These objects are first observed using wide-band filters. For instance, for SDSS, the number of filters is five (see figure below illustrating the SDSS filters). Just given brightness in these five bands, it can be difficult to determine whether objects are stars or galaxies. A galaxy may be worthy of high-resolution follow-up observations to estimate how far away it is, whereas a star is generally not worth the expenditure of telescope time. In this project, we construct a regression model with which we attempt to identify those portions of brightness-space where the probability that an object is a star is substantially higher than the mean probability.

ELUCIDATING THE TRAFFICKING MECHANISM OF INTRACELLULAR POOLS OF THE DELTA OPIOID RECEPTOR IN NEURONAL CELLS

STUDENT Andrew Dates *Science and Humanities Scholars*
ADVISORS Manojkumar Puthenveedu *Biological Sciences* • Daniel Shiwarski *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 11:18 am

Much research has focused on the development of a new non-addictive analgesic drugs that targets the opioid receptors in nerve cells to inhibit pain sensation. Nearly all such studies have focused on the Mu Opioid Receptor (MOR). MOR serves as the primary receptor for classic analgesic drugs such as heroin and morphine. While commonly prescribed, MOR agonists tend to be highly addictive. We instead investigate the use of the Delta Opioid Receptor (DOR) and its agonists as novel and promising targets for developing a non-addictive analgesic drug. DOR localizes primarily to the Trans-Golgi Network (TGN) rather than the cell surface in neuronal cells. In contrast, MOR is localized to the surface and is avalible to associate with agonists present outside the cell. Our lab is currently investigating how DOR is trafficked from intracellular compartments to the cell surface, and whether this can be regulated. Why and how DOR is localized to this intracellular compartment is still not well understood. Previous experiments have identified that TC10, a Rho family small GTPase, appears to traffic in similar patterns to that of DOR, possibly in the same transport vesicles, between the TGN and the cell surface. We hypothesize that an interaction between DOR and TC10 could be the biochemical mechanism regulating DOR surface trafficking in neuronal cells. To study this, I will employ immunoprecipitation and western blotting techniques to detect complexation of DOR and TC10 in transport vessicles to elucidate the mechanism of DOR TGN export.

INFORMATION EXTRACTION IN SCONE FROM SEMI-ORGANIZED SOURCES

STUDENT Shaojie Bai *Science and Humanities Scholars*
ADVISOR Scott Fahlman *Language Technologies Institute*
ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 11:18 am

The primary goal of this research is to explore, among the various existing methods, an efficient way to extract information from external sources and build a Scone knowledge base (KB) in the area of geography and sports. In particular, I used Python and Common Lisp to develop a version of software converter, which is able to quickly identify the critical information contained in sources like webpages. One major focus as well as challenge of the extraction is for Scone to learn from the mountains of information extracted from the Internet (which is constantly updated, driven by many web engines and have lots of formats)--- and accurately cross-check the new knowledge against multiple sources, including its existing knowledge. The research completed in this project is expected to lay valuable foundation for further research on more automated ways for Scone to create information converters on its own for a variety of formats and domains.

INVESTIGATING THE NEURAL BASIS OF INDUCTIVE INFERENCE

STUDENTS Kaoon Ban *Science and Humanities Scholars* • Kevin Long *Chemistry*

ADVISORS Anna Fisher *Psychology* • Layla Unger *Psychology*

ROOM/TIME Peter / 11:40 am

The purpose of this study is to investigate the neural activity underpinning inductive inference. Inductive inference is a powerful way of generating new knowledge by generalizing information that is known about familiar things to new things. In order for inductive inference to generate reliable knowledge, the new things to which known information is generalized must be selected on the basis of some kind of relationship between them and the familiar things. Two such relationships that play a critical role in inductive inference are similarity, which links things that are overall perceptually similar, and rules, which link things that share specific features that determine the categories to which things belong. Past research suggests that, for other forms of reasoning, similarity-based processes involve posterior perceptual brain regions, whereas rule-based processes involve frontal brain regions. However, several open questions about the neural basis of inductive inference remain, including whether the distinct patterns of neural activity associated with similarity versus rule-based reasoning are characteristic of inductive inference, and the role of these distinct patterns of activity in the development of inductive inference. To address these questions, this study will measure neural activity during an inductive inference task using a non-invasive imaging technology, Near Infrared Spectroscopy (NIRS). By doing so, this study will both illuminate the neural basis of rule vs. similarity-based inference, and provide a picture of the end-point of inference development.

ON DIFFERENCES THAT DIFFERENCE EQUATIONS CAN MAKE ON MODELING FRESHWATER ECOSYSTEMS AND SYSTEMS OF MANY VARIABLES.

STUDENTS Can Bostanci *Mathematics* • Zachary Singer *Science and Humanities Scholars* • Sijie Wei *Mathematics*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In mathematical modeling, “difference equations” are a unique tool that allows us to consider dynamical systems in discrete time setting. In contrast, “differential equations” model a system in continuous time fashion. The impact of “disturbances” on such systems (i.e., perturbations) is an important area of study. It is desirable to have models that are robust. Therefore it is important to test models under the influence of “foreign” factors. We therefore, as a group, studied the particular case of portraying a freshwater ecosystem with difference/differential equations and tried to make conclusions by considering disturbance factors that are largely ignored in previously established models. By applying our knowledge from recent classes such as 21-101 (Discrete Time Dynamical Systems) and 21-269 (Vector Analysis), we worked to study different possible models that are robust under disturbance and attempt to extend current theorems about difference/differential equations into a broader context. “Disturbance on Difference/Differential Systems with Equilibria - Frequency vs. Efficiency” was our research result.

RELATIONS OF COUPLES' COMMUNAL AND NONCOMMUNAL LANGUAGE TO SUPPORT AND SELF-CARE FOR PEOPLE WITH TYPE 2 DIABETES

STUDENT Kimberly Hochstedler *Science and Humanities Scholars*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Effective diabetes management depends, in part, on support from one's spouse or romantic partner. We examined the language patients and partners use when working together to manage diabetes. We hypothesized that communal language ("we" pronouns) would be related to more partner support and better diabetes self-care, and noncommunal language ("I" and "he/she" pronouns) would be associated with less partner support and worse diabetes self-care. To address this, interviews with 125 couples in which one person was diagnosed with diabetes within the past 3 years (59% white; 41% black; 55% male; M age = 54) were transcribed. We used LIWC software to count communal and noncommunal pronouns. We also measured partner supportive and unsupportive behavior, marital quality, and patient self-care and self-efficacy. Patient use of communal pronouns was associated with greater partner instrumental ($p = .08$) and emotional support ($p < .05$) and less partner avoidance ($p < .05$), whereas patient use of noncommunal pronouns was associated with less partner instrumental and emotional support and greater partner avoidance (all p's $< .05$). Use of communal pronouns was not associated with marital quality, but noncommunal pronoun use was related to lower marital quality for patients ($p < .05$) and partners ($p = .07$). Patient use of communal pronouns was associated with greater self-efficacy ($p = .08$), and non-communal pronoun use was associated with lower self-efficacy ($p < .05$). Although patient language was not related to self-care, partner communal pronoun use was associated with better self-care ($p < .05$) and partner noncommunal pronoun use was associated with worse self-care ($p = .06$). In sum, both communal and noncommunal language was associated with partner supportive and unsupportive behavior, but relationships were stronger for noncommunal language. That partner language was linked to better patient self-care suggests the importance of involving partners in diabetes management.

ROLE OF ALTERNATIVE ISOFORMS OF THE F1-ATPASE EPSILON SUBUNIT IN AGING AND OXIDATIVE STRESS

STUDENTS Daniel Evans *Biological Sciences* • Kathryn Hanson *Science and Humanities Scholars*
ADVISOR A. Javier Lopez *Biological Sciences*
ROOM/TIME Rangos 2&3/Sigma Xi Group 1 / 10:00 am

Improvements in public health have steadily increased average life expectancy throughout the modern era. One negative consequence of this development has been the increase in prevalence of disease and dysfunction associated with advanced age. Previous research has shown that oxidative stress can alter gene expression and metabolic function and may contribute to aging. The Drosophila homolog of human mitochondrial ATPase subunit epsilon is encoded by the gene stunted. Mutation of this gene increases lifespan and resistance to oxidative stress but the mechanism is unknown. Alternative splicing of the stunted transcripts generates two alternative protein isoforms, whose ratio changes with aging and under oxidative stress. Our goal was to investigate the functional effects of the two isoforms and the change in their ratio by altering their expression experimentally. These studies could lead the way to therapeutic strategies that reduce disease-causing damage to genetic material during aging.

SENIOR HONORS THESIS - PERCEPTUAL EXPERIENCE OF BLINDSIGHT

STUDENT Sneha Kannoth *Science and Humanities Scholars*
ADVISOR Wayne Wu *Center for the Neural Basis of Cognition*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

The research question that I would like to discuss is the perceptual experience of individuals with blindsight. In other words, my question, at hand, is what is it like to view the world via blindsight. I want to explore the perceptual experience of blindsight via the visual streams processes theory, attentional spotlight theory, and theory of consciousness. Mainly, I am aiming to discuss whether the blindsight experience is visually conscious or visually unconscious.

SENIOR HONORS THESIS: COLLECTED ESSAYS

STUDENTS Sophie Zucker *Science and Humanities Scholars*
ADVISOR Jane Bernstein *English*
ROOM/TIME Pake / 3:00 pm

What makes a story worth telling? Since the 1980's, the memoir has exploded as a genre, with "women's memoirs," "teen memoirs," and the like becoming commonplace. As a twenty-one-year-old college senior embarking on my own honors thesis in creative writing, I had to ask myself: what makes the collection of essays I was embarking on interesting and worthwhile? How does it contribute to the field? This talk will be a summary of genre and the methodology I took when approaching this project, as well as a discussion of theme.

SIMPLE MODLES FOR THE STATISTICAL ANALYSIS OF INEFECTIOUS DISEASE COUNTS

STUDENT Andersen Chang *Science and Humanities Scholars*
ADVISOR William Eddy *Statistics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

One of the most important problems in epidemiology and the study of infectious diseases is how to measure and predict the spread of infectious diseases throughout a population of interest. There are many different ways to model the spread of diseases, with varying levels of depth and complexity. These models allow epidemiologists to answer important questions about an ongoing epidemic either by estimating critical parameters or by providing predictions about the future. We study different infectious disease models in order to determine how accurately they estimate the spread of disease across space-time and provide those predictions and estimates. In particular, we are interested in the performance of epidemiological compartment models, which uses ordinary differential equations in order to represent the transmission of infectious diseases. We analyze different ways of solving for the parameters of epidemiological compartment models and also compare how well epidemiological compartment models fit to a data set compared to a normal linear regression model.

SLACKTIVISM IS A MYTH: HOW SOCIAL MEDIA HAS AFFECTED SOCIAL JUSTICE MOVEMENTS

STUDENT Satvika Neti *Science and Humanities Scholars*

ADVISOR Geoffrey McGovern *Social & Decision Sciences*

ROOM/TIME Pake / 4:40 pm

Social media has become an invaluable tool for social change, but what affect has it actually had on social movements, specifically on organization and the success of these movements? The main question this paper seeks to answer is: How has social media affected the success of social movements? This paper explores first the existing literature about organization of social movements, breaking them down into collectively organized, traditional movements; connectively organized, social media movements; and hybrid movements, which have elements of both. Then we turn to the literature on measuring success in social movements. We use this literature to form a hypothesis that social media movements are more conducive to creating cultural success while traditional movements are more conducive to creating political success, and then explore this hypothesis through various case studies. We use the Occupy Wall Street movement as our connective action movement, and the Black Lives Matter movement as our hybrid movement. We then use all of these ideas to form emerging theory on how the organizations of social movements lead to different kinds of success.

STATISTICAL ANALYSIS OF THE CLATHRIN-COATED PIT FORMATION

STUDENTS Edward Dryer *Science and Humanities Scholars* • Cong Ma *Computer Science* • Quan Yuan *Statistics*

ADVISOR Max G'sell *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

We analyzed Total Internal Reflection Fluorescence (TIRF) microscopy measurements of membrane protein transport. We observe intensity profiles of fluorescently-labeled clathrin-coated pits as they form and pinch off from the membrane. Previous research has shown that changes in pit formation rates and duration may be biologically interesting. We analyzed sources of measurement variation in the rates of pit formation, with the goal of quantifying and improving statistical power to detect rate changes. We also analyzed the intensity profile shapes to better understand the features that distinguish the intensity profiles of true clathrin-coated pits from noise.

STATISTICAL LEARNING OF LANGUAGE AND ITS BASIS IN MEMORY

STUDENT Hyunho Yoon *Science and Humanities Scholars*

ADVISOR Erik Thiessen *Psychology*

ROOM/TIME Rangos 2&3/Sigma Xi Group 7 / 10:26 am

Prior research has shown that humans can pick up "words" from a novel stream of sounds if the syllables of a word occur together at a greater statistical frequency compared to other syllables that do not make up a word (Saffran, Aslin, & Newport, 1996). This study will investigate a potential explanation for this phenomenon, in the characteristic of human memory. In particular, this experiment will study the primacy effect and effect of distributed practice by seeing whether an artificially created word that is presented only in the beginning of the exposure is learned better compared to words that are distributed equally throughout the exposure. Adult

participants, after being exposed to these stimuli, will be given forced-choice trials that will measure their levels of acquisition for each word. Our goal is to see if participants have different accuracies on the test trials for the word that is presented in the beginning than for the ones that are presented throughout.

STEADY STATE VISUALLY EVOKED POTENTIALS TO EXPLORE NEURAL BASIS OF FACE AND OBJECT RECOGNITION

STUDENT Adam Dickter *Science and Humanities Scholars*

ADVISOR Marlene Behrmann *Psychology*

ROOM/TIME Dowd / 11:40 am

Common electroencephalogram (EEG) measure scalp activity at electrodes placed on the surface of the skull. In a typical study, a large number of trials are run and the onset of stimulus presentation is used to separate the continuous data into discrete trials. The data (e.g. amplitude of response at a particular time point post-stimulus onset) is then averaged across all the trials. An alternative, novel EEG approach, known as steady state visually evoked potentials (SSVEP), uses periodic visual stimulation (target appears say at 6Hz) and many targets can be presented in a short time period. Continuous data are transformed into the frequency domain for analysis and preliminary studies favor this more powerful approach. Here, we will use SSVEP to examine the differential neural response evoked by different object categories and the extent to which this response differs across the two hemispheres.

STUDY OF DIETRICH COLLEGE GENERAL EDUCATION SATISFACTION

STUDENTS Kemal Dincer *Economics* • Philip Dominici *Science and Humanities Scholars* • Aisha Han *BHA* • Leshaun Jones *Statistics* • Sean Yang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Dietrich college students often have mixed feelings about the interdisciplinary mantra inherent to majoring in the humanities and social sciences, and Dietrich College faculty and staff have recently shown interest in reforming the General Education program based more on their students' needs and educational ambitions. It is possible that students desire more from their classes than major-specific topics, or that they want a variety of classes in different topics that yield skills they might apply in their field of work and everyday lives (through hobbies and other commitments).

In order to observe students' opinions on various general education requirements, we surveyed: overall satisfaction towards each GenEd category, what classes students are actually taking, what classes they want to take, and how these opinions change with class year/major departments. Our survey utilized both rating-based and open-ended questions that help characterize student satisfaction and explain their feelings behind the responses. We implemented an aggregate scoring system to ultimately quantify students' opinions. Overall, Carnegie Mellon students like to know that their schoolwork is meaningful. Our results aim to improve a general education program meant to both cater to Dietrich students' specific needs and take them out of their comfort zones.

SUBRINGS OF C GENERATED BY ANGLES

STUDENT Jackson Bahr *Science and Humanities Scholars*

ADVISOR Gregory Johnson *Mathematics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 9 / 10:13 am

Consider the following inductively defined set. Given a collection U of unit magnitude complex numbers, and a set initially containing just 0 and 1, through each point in the set, draw lines whose angles with the real axis are in U. Add every intersection of such lines to the set. Upon taking the closure, we obtain R(U). We investigated for which U, R(U) is a ring.

Our main result holds for when 1 is in U and |U| is at least 4. If P is the set of real numbers in R(U) generated in the second step of the construction, then R(U) equals the module over Z[P] generated by the set of points made in the first step of the construction. This lets us show that whenever the pairwise products of points made in the first step remain inside R(U), it is closed under multiplication, and is thus a ring.

TAKE MY HAND, WE'LL MAKE IT I SWEAR: EFFECTS OF AFFECTIONATE TOUCH ON RELATIONAL PERCEPTIONS AFTER CONFLICT

STUDENTS Amelia Clark *Psychology* • Lucy Shen *Biology and Psychology* • Delancey Wu *Science and Humanities Scholars*

ADVISOR Brooke Feeney *Psychology*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Our study examines how interpersonal touch between couple members will affect relational perceptions during and after a conflict. The relational perceptions we will consider are positive perceptions of one's partner, positive perceptions of the relationship as a whole, and optimism that the disagreement will be resolved afterwards. Romantic couples will be recruited through the psychology department participant pool, the paid participant pool, and the local Pittsburgh community. Participants be randomly assigned to hold hands or to hold a neutral object (no touch) before and during a conflict discussion. We hypothesize that couples in the touch condition will have more positive relational perceptions than couples who are in the no touch condition. The implication of this study is that touch can be a strategy to buffer against stress and increase relationship satisfaction that everyone will be able to do.

THE ANALYSIS OF NON-REPLICABLE DERIVATIVE SECURITY IN INCOMPLETE MODEL

STUDENTS Ruohui Li *Computational Finance* • Liyunshu Qian *Science and Humanities Scholars* • Moqing Shi *Mathematics* • Xiran Zhu *Science and Humanities Scholars*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:39 am

In our research, we study a family of one-period trinomial financial models that are arbitrage-free but incomplete and a non-replicable derivative security. Our main interest is in limiting situations when the model approaches a complete binomial model. We focus on the study of a call option, C, with the initial stock price as the strike price. This security is not replicable in trinomial models, and therefore has an interval of arbitrage free prices.

A reasonable way to single out a price is to use the notion of utility indifference price, p (per share). A utility indifference price p (per share) for q shares of C, is the number p having the property that an investor will be indifferent to a portfolio holding q shares of S at p and a portfolio that holds no shares of S.

Using the notion of indifference price, we have been focusing on three different utility function families: exponential, natural log and power type. For exponential utility functions, there is an explicit formula for the indifference price, and the analysis is relatively straightforward. However, for log and power utility functions, there is no explicit formula for the indifference price. Nevertheless, we are able to determine the limiting behavior of the indifference price in a number of scenarios.

Another question we consider is assuming that C can be traded in any desired quantity at a fixed price P, what would the optimal order size of C be. By optimal order size, we mean the amount of C that an investor would buy to maximize his/her expected utility. We obtain expressions for q in terms of probabilities, initial capital Z, and price P. We analyze various limits as the probabilities change in a way that the model approaches a (complete) binomial model.

THE ROLE OF AVERAGENESS AND EXPOSURE ON INFANTS' PREFERENCE FOR BIRACIAL FACES

STUDENT Emily Kim *Science and Humanities Scholars*

ADVISOR David Rakison *Psychology*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

This project consists of a three study examination on whether biracial individuals are perceived as more attractive than uniracial individuals. Previous studies have shown that the more average a face is, the more attractive it will be rated by adults and the more it will be preferred (relative to unattractive faces) by infants. Under the assumption that biracial faces are an average of two different populations, previous studies found that adults rated biracial faces (consisting of a combination of an Asian face and a Caucasian face) as more attractive than uniracial faces. To find whether infants have this same preference, mathematically averaged facial composites will be created by morphing either sixteen Caucasian, sixteen Asian or sixteen biracial faces (made from Caucasian and Asian faces). Infants will be exposed to pairs of faces where one of the faces is the mathematically averaged face and the others are individual faces of varying attractiveness. Based on the assumption that infants need to be exposed to a number of faces to perceive an attractive average of faces, this study will be repeated for Caucasian and Asian faces for older infants who have either been exposed to faces of both races or faces of only one race to examine whether infants' exposure to either or both races would influence their preferences. The results of these studies will provide important information about the evolved mechanisms underlying the human development of attractiveness stereotypes.

THE STATISTICS BEHIND CMU STEREOTYPES

STUDENTS Kruti Koppolu *Statistics* • Andrew Manka *Statistics* • Pooja Penninti *Self-defined* • Elan Rosenfeld *Computer Science* • Yoona Seon *Science and Humanities Scholars*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Stereotypes about specific colleges at Carnegie Mellon are widespread and can be damaging to students' abilities to cooperate, both in and out of the classroom. In particular, stereotypes about the Tepper School of Business, the College of Fine Arts, and the School of Computer Science are reiterated each year, ensuring that these opinions influence CMU undergraduates' attitudes towards each other. Using stratified random sampling on colleges, our group collected data through a Qualtrics survey about just how commonly (and how strongly) believed these oft-cited stereotypes are, and by whom they are held. We did a general exploratory analysis of our results and fit a linear regression model to the data in an attempt to measure what factors have a significant effect on a student's view of his or her peers. For example, does actually getting to know students of a particular college help to dispel or reinforce these stereotypes? With this information we hope to help inform school administrators on how to best promote understanding and collaboration between colleges.

VAGINAL DELIVERY OF AN INTEGRASE INHIBITOR FOR HIV PREVENTION

STUDENT Emily Pond *Science and Humanities Scholars*

ADVISOR Lisa Rohan *Magee-Womens Research Institute*

ROOM/TIME Rangos 2&3/Sigma Xi Group 2 / 11:31 am

Topical drug delivery systems, or microbicides, have become a focal point in the development of HIV prevention strategies. In designing vaginal microbicides, both the medical efficacy of the formulation and the acceptability of the platform to users must be considered. An understanding of the relationship between the vaginal environment and the components of the delivery platform is thus implicit in the successful design of a microbicide. This project sought to examine the pharmacokinetics of antiretroviral drug MK-2048, a compound designed to inhibit the activity of the HIV integrase enzyme. Integrase is responsible for the integration of viral DNA into the host genome, thus allowing the propagation of HIV infection. Dissolution testing using a CE 7smart USP Apparatus 4 (SOTAX) with an online UV-Vis spectrophotometer was performed to obtain a drug release profile on the MK-2048 vaginal films. Dissolution tests were performed in vaginal fluid simulant (VFS) to generate a biologically relevant environment. The release profile obtained indicated total release of the drug from the film over 24 hours; these data were used to confirm the efficacy of the vaginal film platform and characterize the in vitro behavior of MK-2048. Dissolution testing results were also used to inform later tissue permeability studies, in which the penetration of MK-2048 into human ectocervical tissue was examined using a Franz cell system. The excised tissue samples were examined by way of H&E staining to observe any morphological changes induced by drug exposure. LC/MS analysis was used to measure extracted MK-2048 amounts from the tissue. These two testing results combined make for a thorough portrait of MK-2048 as a robust integrase inhibitor and a promising new tool in the fight against HIV.

TEPPER SCHOOL OF BUSINESS

BUSINESS ADMINISTRATION

A SURVEY OF PRICES AT ENTROPY VS. LOCAL STORES

STUDENTS Charles Gauthey *Statistics* • Jun Yong Go *Statistics* • Michael Hsun *Economics* • Dominic Liu *Business Administration*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

College campus convenience stores are perceived as being overpriced, due to their proximity and the fact that most of them accept the university's internal currency, resulting in a small monopoly. The objective of this study is to determine whether or not this is true by comparing the prices of a representative sample of goods at Carnegie Mellon University's campus convenience store, Entropy, to the prices at local chain convenience stores. While it is difficult to generalize this to other university campuses, this is still a feasible study for the students and other affiliates of CMU.

Data will be collected by systematic sampling of items at Entropy and stratified sampling of local convenience and grocery stores by brand within a two-mile radius, then sampling the same items from Entropy at these stores. After obtaining the prices of the goods at each store, data analysis will be done to determine overall pricing, price structure of specific categories of goods, and price differences among the stores. Quantifying the differences will give us empirical evidence to determine whether or not prices at Entropy are higher relative to other convenience stores and will potentially influence purchasing habits by consumers or the prices set by Entropy.

ANALYSIS OF CLASSROOM MAINTENANCE

STUDENTS Christopher Kim *Economics and Statistics* • Dorsa Massihpour *Statistics* • Harsimran Minhas *Business Administration* • Victor Vega-Gonzalez *Statistics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

College students spend much of their time in the classroom and studies have shown that classroom environments can change how students learn. Students' experiences in classrooms also shape the way they view their university. Classroom maintenance and it's effect on students' overall experience is important, which is why we were interested in surveying the current conditions of undergraduate classrooms at CMU. We have done so by observing classrooms based on different variables such as temperature, cleanliness, technology, etc. By observing discrepancies within classrooms of different sizes and different colleges, we hoped to understand variations between students' college experiences.

We initially observed classrooms and revisited these classrooms two weeks later to see if any improvements had been made. By surveying all 86 of the undergraduate classrooms twice (morning and afternoon), we limited sampling error. We then analyzed the data and saw if there were any trends between buildings, departments who use the classrooms, class size, etc.Using our results, the CMU administration can see discrepancies in the maintenance of classrooms, the standard of their average classroom, and if they need to make improvements.

BUS RELIABILITY FOR CMU

STUDENTS

Riddhi Adhikari *Economics* • Srishti Jain *Statistics* • Leon Ji *Business Administration* • Eric Li *Statistics* • Joshua Ragen *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In our project, we researched the relative reliability of various mobile applications in comparison to the static schedule of a few select Port Authority buses. We chose this research topic because we want to help Carnegie Mellon students make better informed decisions about their travel choices. Although there has been research on the timeliness of Pittsburgh buses before, there is a new GPS tracking system enacted in 2014 that has allowed apps like the Port Authority Transit app and the Google Maps app to track buses in real time that has not been thoroughly researched yet. We focused on bus stops and bus lines especially relevant to CMU students. We picked four bus stops that we waited for hour long blocks each to watch the timeliness of 71 and 61 line buses. We want to use our findings to make a recommendation to CMU administration to either more strongly recommend the apps or schedule to students or to focus more on alternative modes of transportation as they become available.

CMU FACULTY WORK-LIFE STUDY

STUDENTS Yayoi Furuhata *Business Administration* • Kimberly Hsieh *Mathematics* • Pavithran Nair Jayaraman *Statistics* • Sarah Shy *Statistics* • Tyler Wellener *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Studies have shown that employee satisfaction can be linked to motivation, performance, absenteeism, and turnover in the workplace. However, faculty involvement and satisfaction are often overlooked in universities. Our research analyzed how satisfied Carnegie Mellon University (CMU) professors are with various aspects of their work life. The mode of data collection was an online survey hosted by Qualtrics. We carried out the survey using a list of faculty Andrew emails obtained from an official directory. Since most professors check their emails daily, sending online surveys to the faculty via email was the most efficient way to recruit participants. We broke down our results by gender, department, number of years at CMU, and academic title to make observations about particular subgroups. Faculty satisfaction is integral to the success of the university as it gives rise to a stimulating learning environment while offering a more attractive option for prospective professors. With our data, we were be able to obtain an accurate measure of faculty job satisfaction at CMU and provide information to the university that will allow CMU to achieve its long-term objectives.

PIESPEAK - SHORT FILM

STUDENTS Evan Adkins *Electrical & Computer Engineering* • Max Harlynking *Information Systems* • Aliya Zhdanov *Business Administration*

ADVISOR James Daniels *English*

ROOM/TIME McConomy Auditorium / 1:00-2:30 pm

My project, Piespeak, is a lighthearted short film about a 12-year-old girl who attempts to break the world record for saying every kind of pie in the world in the fastest amount of time to prove that she can be the best at something. This film examines the effects of the pressure we put on ourselves to achieve and serves as an educational stepping stone to a future in filmmaking for myself and the other students involved. Using the skills and techniques myself and my crew have obtained from working on past films, we will create a work that will inspire, entertain, and showcase our skills in a meaningful way. Piespeak is important in that it seeks to portray a child learning to face a challenge we all must battle throughout our lives to become better as both human beings and workers- our own ability.

PORT AUTHORITY BUS RELIABILITY ACROSS PITTSBURGH NEIGHBORHOODS

STUDENTS Meghna Baskar *Economics* • Kiersten Chuc *Statistics* • Suvrath Penmetcha *Information Systems* • Rohit Srungavarapu *Business Administration* • Skye Toor *Mechanical Engineering*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 11:31 am

The purpose of our study is to observe how often Pittsburgh PAT buses actually arrive (i.e. their frequencies), compared to their expected frequencies as stated in official PAT schedules. Buses are notorious for deviating from the official PAT bus frequencies. Pittsburgh residents frequently voice their displeasure with the untimeliness of PAT buses and this study will provide statistically sound evidence to suggest whether or not PAT buses abide by their stated frequencies.

Our study focuses on six neighborhoods closest to CMU. We stratified our sample across neighborhoods and time of day. Our sample was taken from a list of all Pittsburgh bus stops and we selected stops within our neighborhoods of interest. We then randomly assigned the sampled bus stops a time of day, and record bus frequencies in-person at each stop. Our analysis includes a hypothesis test, where our null is there is stated as “no difference between the actual and stated frequencies”.

Our results provide empirical evidence for the differences between the actual frequencies and the theoretical frequencies. This information is invaluable for PAT, specifically how they can better optimize their bus usage across neighborhoods, and can start the conversation about possibilities to improve bus arrival times.

PROFESSOR EXPERIENCE AT CMU

STUDENTS Tyler Barnett *Business Administration* • Blaine Cole *Economics and Statistics* • Alexandra Falk *Biological Sciences* • Benjamin Winebrake *Economics* • Annie Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Our project investigates the unique experiences of professors at Carnegie Mellon and analyzes the data to potentially identify gaps as well as provide useful career advice to aspiring professors. Our motivation for this project was to characterize the colleges within Carnegie Mellon based on the varying backgrounds of their respective professors. To conduct this survey, we took a census of the resumes of professors that are currently on campus in Pittsburgh. To implement the survey, we examined curricula vitae from a list of professors sampled using a stratified random sampling scheme. We stratified our sample by department, so each professor within a department had an equal chance of being selected, and each department was accurately represented. This survey will allow Carnegie Mellon to have a better profile of its professors, provide an opportunity for administration to improve its hiring process. By comparing our survey with FCE's and other sources, we could make possible connections in our analysis to better assess instructor performance. All in all, we are confident that the results of our project would be of interest to students and faculty across America.

COMPUTATIONAL FINANCE

THE ANALYSIS OF NON-REPLICABLE DERIVATIVE SECURITY IN INCOMPLETE MODEL

STUDENTS Ruohui Li *Computational Finance* • Liyunshu Qian *Mathematics* • Moqing Shi *Mathematics* • Xiran Zhu *Computational Finance*

ADVISOR William Hrusa *Mathematics*

ROOM/TIME Rangos 2&3/Sigma Xi Group 8 / 10:39 am

In our research, we study a family of one-period trinomial financial models that are arbitrage-free but incomplete and a non-replicable derivative security. Our main interest is in limiting situations when the model approaches a complete binomial model. We focus on the study of a call option, C, with the initial stock price as the strike price. This security is not replicable in trinomial models, and therefore has an interval of arbitrage free prices.

A reasonable way to single out a price is to use the notion of utility indifference price, p (per share). A utility indifference price p (per share) for q shares of C, is the number p having the property that an investor will be indifferent to a portfolio holding q shares of S at p and a portfolio that holds no shares of S.

Using the notion of indifference price, we have been focusing on three different utility function families: exponential, natural log and power type. For exponential utility functions, there is an explicit formula for the indifference price, and the analysis is relatively straightforward. However, for log and power utility functions, there is no explicit formula for the indifference price. Nevertheless, we are able to determine the limiting behavior of the indifference price in a number of scenarios.

Another question we consider is assuming that C can be traded in any desired quantity at a fixed price P, what would the optimal order size of C be. By optimal order size, we mean the amount of C that an investor would buy to maximize his/her expected utility. We obtain expressions for q in terms of probabilities, initial capital Z, and price P. We analyze various limits as the probabilities change in a way that the model approaches a (complete) binomial model.

ECONOMICS

MCDONALD'S VS. CHIPOTLE: THE RISE OF FAST CASUAL RESTAURANTS (A COMPARISON OF THE NET RATES OF ENTRY FOR MCDONALD'S & CHIPOTLE)

STUDENTS Charlton Cheng *Economics* • Michael Hsun *Economics* • Michelle Ong *Economics*
ADVISOR Karam Kang *Economics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Fast food restaurants like McDonald's are no stranger to Americans and are often seen as a quick meal option despite the lack of quality. However, in recent times, there has been a shift in consumers' dining patterns to a new genre of quick-meal restaurants, that is, fast casual restaurants. Restaurants like Chipotle, Subway, Panera offer healthier food options which are gaining much appeal and market share. In our study, we compare the factors that affect the market entries for fast food and fast casual restaurants like McDonald's and Chipotle respectively. Our results show that the net entry of McDonald's positively correlates with obesity rates while the net entry of Chipotle negative correlates with obesity rates. Additionally, both types of restaurants also have significant correlations with other demographic as well as health indicator variables like median age, median income, percentage of uninsured people and percentage of children in poverty.

IDeATe PRESENTATIONS

IDeATe PRESENTATIONS

IDeATe (INTEGRATIVE DESIGN, ARTS, AND TECHNOLOGY)

WIEGAND GYMNASIUM—12-2:30 PM

IDeATe (Integrative Design, Arts, and Technology) serves as a network for students who are seeking opportunities to pursue interdisciplinary, collaborative work in fields that combine technology and arts expertise. IDeATe offers a special focus on new creative industries in eight areas that students can pursue as a minor: Game Design, Animation and Special Effects, Media Design, Learning Media, Sound Design, Innovation & Entrepreneurship, Intelligent Environments, and Physical Computing. Many students also take IDeATe courses as electives to round out their Carnegie Mellon experience.

The courses listed below are some of the IDeATe offerings from Spring 2016. Students from these courses are excited to showcase some of their work as part of the Meeting of the Minds festivities.

15-323 COMPUTER MUSIC SYSTEMS AND INFORMATION PROCESSING WITH ROGER DANNENBERG

This course presents concepts and techniques for representing and manipulating discrete music information, both in real time and off line.

53-471 GAME DESIGN, PROTOTYPING, AND PRODUCTION WITH TOM CORBETT

This is a lecture and project based course focused on the design and development of video games.

60-410 MOVING IMAGE MAGIC: VISUAL EFFECTS AND MOTION GRAPHICS WITH SUZIE SILVER

This course serves as an introduction to the creation of extraordinary cinematic visions using a variety of analog and digital tools and techniques.

IDeATe PRESENTATIONS

15-294 RAPID PROTOTYPING TECHNOLOGIES WITH DAVE TOURETZKY

This mini-course introduces students to rapid prototyping technologies with a focus on laser cutting and 3D printing.

53-312 GUEST EXPERIENCE AND THEME PARK DESIGN WITH SHIRLEY SALDAMARCO

Students will research the history of the Themed Entertainment Industry and study key phases including conceptualization, design, building, management and delivery involved in creating the total themed entertainment experience. The class will focus on the importance of creating the total guest experience.

53-230 PROGRAMMING FOR GAME DESIGNERS WITH DAVE CULYBA

This course takes a practical approach to programming and how it can be used to make one a better game designer.

18-540/05-540 RAPID PROTOTYPING OF COMPUTER SYSTEMS WITH DAN SIEWIOREK AND ASIM SMAILAGIC

This is a project-oriented course which will deal with all four aspects of project development; the application, the artifact, the computer-aided design environment, and the physical prototyping facilities.

76-374 MEDIATED NARRATIVE WITH RALPH VITUCCIO

This course is designed to expose students to a range of multidisciplinary perspectives on narrative.

60-125/126 INTRODUCTION TO 3D ANIMATION/INTRODUCTION TO PERFORMANCE CAPTURE AND RENDERING WITH SPENCER DIAZ

Students in Spencer Diaz's Intro to 3D Animation/Intro to Performance Capture focused this semester on creating 3D characters and animations using Autodesk Maya and motion capture technology. They will be demonstrating their assignments and final projects throughout the course.

IDeATe PRESENTATIONS

05-292 LEARNING MEDIA METHODS WITH MARTI LOUW

Learning Media Methods brings together students from across the disciplines to consider the design of mediated learning experiences though a project-based inquiry course.

15-322 INTRODUCTION TO COMPUTER MUSIC WITH JESSE STILES

In this course, students will learn the fundamentals of digital audio, basic sound synthesis algorithms, and techniques for digital audio effects and processing.

57-344 EXPERIMENTAL SOUND SYNTHESIS WITH JESSE STILES

In this course we will explore a variety of experimental approaches to music, sound design, and sonic artwork.

53-409 GAME DESIGN WITH JESSE SCHELL

The goal of this course is to prepare you for a career involving design of computer games and other interactive experiences. Students in this course will read and write about game design, and design many games of their own.

48-528 RESPONSIVE MOBILE ENVIRONMENTS/62-492 MARS HABITAT: BUILDING AN ATMOSPHERE WITH DARAGH BYRNE AND CHRISTINA CIARDULLO

An interdisciplinary group of students will come together to design and fabricate pressure volume structures for a proposed Mars Habitat.

16-457 REALITY COMPUTING WITH PYRY MATIKAINEN AND JOHN FOLAN

This iteration of the reality computing course will focus on “design realization:” the translation from digital design to fully realized tangible artifact.

SPECIAL COMPETITIONS

SPECIAL COMPETITIONS

THE ALLEN NEWELL AWARD FOR EXCELLENCE IN UNDERGRADUATE RESEARCH

Open only to students in SCS. This endowed award, established in 1993, is presented annually by the School of Computer Science. Allen Newell had a long, rich and distinguished scientific career that contributed to multiple subdisciplines in computer science. Still, each individual endeavor was pursued with a characteristic style that his colleagues, students, and friends recognized as essential to Allen. Owing to the breadth and scope of Allen's contributions, this award recognizes extraordinary undergraduate research in his scientific style rather than computer science research in a particular area. The criteria by which a research project is judged is predicated, foremost, on the belief that a good idea is not enough. The qualities that transform a good idea into good science can be captured in three maxims attributable to Allen:

1) Good science responds to real phenomena or real problems.

2) Good science is in the details.

3) Good science makes a difference.

ALUMNI AWARD FOR UNDERGRADUATE EXCELLENCE IN COMPUTER SCIENCE

Open only to students in SCS. The Alumni Award for Undergraduate Excellence in Computer Science, established in 2003, is granted on behalf of Carnegie Mellon School of Computer Science alumni. The Award recognizes technical excellence in research and development. The Award is also intended to promote awareness within the undergraduate community that graduation represents both the end of an important phase of life and the beginning of a new phase within the vibrant Carnegie Mellon University School of Computer Science community as an alumnus. The Alumni Award recognizes such factors as contribution to the state of the art; technical excellence; potential societal impact; accessibility; quality of the written, oral, and poster presentations; and generated excitement among the alumni community participating in the process.

Kevin Dowling, *MCS '83, SCS '94, SCS '97*

Hate Alismail, *CMUQ '09, SCS '11*

David Murray, *SCS '06, CFA '06*

Andrew Maas, *SCS '09*

SPECIAL COMPETITIONS

AWARD FOR ARTISTIC EXCELLENCE

The Award for Artistic Excellence is sponsored by engineers in support of the arts and the Center for the Arts in Society at Carnegie Mellon. Awards will be given to outstanding visual and performing arts presentations.

Marian Aguiar, *Associate Professor, English*

Krista Campbell, *Associate Director of Stewardship for Foundation Relations*

Margaret Cox, *Assistant Director, Miller Gallery*

David Danks, *Professor and Department Head, Philosophy*

Catherine Davidson, *Director of Communications*

Sharon Dilworth, *Associate Professor, English*

Laurie Eisenberg, *Teaching Professor, History*

Sarah Emory, *Language Development Specialist, ICC*

Edda Fields-Black, *Associate Professor, History*

Jennifer Keating-Miller, *Assistant Dean for Educational Initiatives, Dietrich College*

John Modell, *Professor Emeritus, History*

Candace Skibba, *Assistant Teaching Professor of Hispanic Studies, Modern Languages*

Susanne Slavick, *Andrew W. Mellon Professor of Art, School of Art*

Susan Tolmer, *CFA Advancement Director for Architecture & Art, CFA Dean's Office*

Joanna Wolfe, *Director, Global Communications Center, Teaching Professor of English*

THE BOEING BLUE SKIES AWARD

Boeing is pleased to sponsor The Boeing Blue Skies Award, created to encourage undergraduate students to present innovative research with applications involving technologies in wireless communications, networking protocols, sensors, controls and algorithms, cyber security, data analytics, and autonomous vehicles. The Blue Skies Award is designed to reward students who dream big and deliver creative solutions to aerospace challenges through sound engineering principles and innovative technology applications.

Kelly Dowdy, *Director, Information Technology*

Rob Houle, *Project Lead, Information Technology*

SPECIAL COMPETITIONS

CIT HONORS RESEARCH POSTER COMPETITION

All students conducting research through the Carnegie Institute of Technology Honors Program participate in the CIT Honors Research Poster Competition.

Kelvin Gregory, *Civil and Environmental Engineering*

Albert Presto, *Mechanical Engineering*

Satbir Singh, *Mechanical Engineering*

Rich Stern, *Electrical and Computer Engineering*

Newell Washburn, *Biomedical Engineering*

John Wesner, *Mechanical Engineering*

Michael Bockstaller, *Material Science and Engineering*

Kris Dahl, *Chemical Engineering/BME*

Chrysanthos Gounaris, *Chemical Engineering*

Paulina Jaramillo, *Engineering and Public Policy*

B. Reeja Jayan, *Mechanical Engineering*

Alan McGaughey, *Mechanical Engineering*

Jayshree Ranka, *(TSB), Technology Management Consultant*

Scott Whalen *(CHE and Econ '81), Director, Global Oral Care R&D and Glad Joint Venture at Proctor and Gamble*

Christopher Martin *(ECE BS/MS '00/'01), Director, Engineering and R&D at Bosch Research and Technology Center*

SPECIAL COMPETITIONS

DIETRICH HUMANITIES PRIZE

The Dietrich Humanities Prize is awarded to student projects that best exemplify the humanities as they are understood at Carnegie Mellon: that the study of philosophy, history, language, and cultures enriches our experience and offers a template for understanding both traditional disciplinary legacies and new directions in scholarly inquiry. In addition to concrete emphasis on problem solving, the humanities at Carnegie Mellon seek ongoing dialogues with - not isolation from - the arts, sciences and technologies.

Marian Aguiar, *Associate Professor, English*

Krista Campbell, *Associate Director of Stewardship for Foundation Relations*

Margaret Cox, *Assistant Director, Miller Gallery*

David Danks, *Professor and Department Head, Philosophy*

Catherine Davidson, *Director of Communications*

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Susan Tolmer, *CFA Advancement Director for Architecture & Art, CFA Dean's Office*

Joanna Wolfe, *Director, Global Communications Center, Teaching Professor of English*

SPECIAL COMPETITIONS

MATHEMATICS POSTER COMPETITION

This competition is sponsored by the Department of Mathematics, through the generosity of alumnus David Simmons. Its purpose is to encourage undergraduate projects and research in mathematics, and to educate the CMU community about the wide range of opportunities in mathematics.

Clinton Conley, *Assistant Professor, Mathematics*

Gautam Iyer, *Associate Professor, Mathematics*

Ian Tice, *Assistant Professor, Mathematics*

THE OSHER LIFELONG LEARNING INSTITUTE AWARD

The goal of the Osher Award is to recognize undergraduate research projects that address issues facing the elderly. The award is open to students who have developed products, approaches, and solutions to a variety of issues that can make life easier and better for senior members of our society and address their quality of life and health issues. All majors and projects that cross a range of disciplines are welcome.

Raja Sooriamurthi, *Teaching Professor, Information Systems, Member of the Board*

John Olmsted, *President, Osher Lifelong Learning Center Board*

Joe Shirk, *Past President*

Alice Chen, *Member*

PSYCHOLOGY DEPARTMENT COMPETITION

The department of Psychology is proud to sponsor a poster/presentation competition for all undergraduate students who are presenting research that involves psychological science.

Kasey Creswell, *Assistant Professor, Psychology*

Anna Fisher, *Associate Professor, Psychology*

Vickie Helgeson, *Professor, Psychology*

Charles Kemp, *Associate Professor, Psychology*

Erik Thiessen, *Associate Professor, Psychology*

Laurie Heller, *Associate Teaching Professor, Psychology*

SPECIAL COMPETITIONS

SIGMA Xi POSTER COMPETITION

The Sigma Xi poster competition is an independently sponsored event within the Undergraduate Research Symposium. Coordinated by the Carnegie Mellon Chapter of Sigma Xi, a national honor society for those engaging in scientific research, the competition is open to students presenting posters in quantitative sciences.

Ilhem Faiza Hakem, *Materials Science & Engineering*
Joe Ayoob, *Pitt - Computational and Systems Biology*
Maggie Braun, *Biological Sciences/MCS Dean's Office*
Natalie McGuier, *Biological Sciences*
Amanda Robinson, *Department of Psychology*
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Lisa Porter, *Materials Science & Engineering*
Kaustubh Sinha, *Biological Sciences*
Robert Heard, *Materials Science & Engineering*
Raja Sooriamoorthi, *Information Systems*
Deanna Matthews, *Engineering and Public Policy*
Gloria Silva, *Chemistry*

SPECIAL COMPETITIONS

SRC-URO POSTER COMPETITION

This competition, sponsored by SRC (Semi-Conductor Research Corporation), seeks to recognize significant and creative work supported by the SRC-URO (Semi-Conductor Research Corporation – Undergraduate Research Opportunities) program, and to encourage students to develop and practice visual and oral presentation skills suitable for academic conferences and industrial research venues. Three prizes will be awarded.

SRC-URO POSTER COMPETITION (CONTINUED)

Dilsun Kaynar, *Assistant Teaching Professor, SCS*

Treci Bonime, *Director for Undergraduate Studies, SCS*

Claire Le Goues, *Assistant Professor, Institute for Software Research*

STATISTICS POSTER COMPETITION

This competition is sponsored by the Department of Statistics. Its purpose is to encourage undergraduate projects and research in statistics, and to educate the CMU community about the wide range of opportunities in statistics. The competition is open to any student or team of students who have completed a project under supervision or with guidance of a Statistics faculty member.

Cosma Shalizi, *Associate Professor, Statistics*

Howard Seltman, *Senior Research Statistician, Statistics*

Gordon Weinberg, *Adjunct Professor*

STATISTICS ORAL PRESENTATION COMPETITION

This competition is sponsored by the Department of Statistics and is limited to students working on an Honors Thesis in Statistics.

Jared Murray, *Visiting Assistant Professor, Statistics*

Howard Seltman, *Senior Research Statistician, Statistics*

SPECIAL COMPETITIONS

UNDERGRADUATE ECONOMICS PROGRAM (UEP) COMPETITION

A goal of the Undergraduate Economics Program is to encourage students to think creatively and bring together their formal training with their passions.

UNDERGRADUATE ENVIRONMENTAL RESEARCH AWARD

The Green Design Institute and the Steinbrenner Institute for Environmental Education and Research will award the Undergraduate Environmental Research Award to an undergraduate whose research includes a strong environmental component.

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