CARNEGIE MELLON UNIVERSITY

MEETING OF THE MINDS

UNDERGRADUATE RESEARCH OFFICE | CMU.EDU/URO

CARNEGIE MELLON UNIVERSITY

MEETING OF THE MINDS

UNDERGRADUATE RESEARCH OFFICE | CMU.EDU/URO

WELCOME

WELCOME TO OUR 20TH MEETING OF THE MINDS.

That 's right—it is our 20th anniversary and we are especially happy to celebrate this milestone with all of you. Meeting of the Minds is a true campus-wide event that touches all faculty, staff and students who are associated with our university.

Twenty years ago, a far-thinking Associate Vice Provost, Barbara Lazarus—joined by an adventuresome graduate of Carnegie Mellon and founding director of the URO, Jessie Ramey—created our campus-wide research symposium aptly named Meeting of the Minds. It started very small with a handful of students. It has grown to be a hallmark of Carnegie Mellon and a model for others.

There is a great deal to see and hear today. The abstracts in this booklet provide a good map to begin your journey. Be prepared for the descriptions to come alive in novel and interesting ways. Whether you travel through the poster displays or attend a few oral presentations, watch a performance or contemplate our art installations, you will be dazzled by the diversity and quality of the projects our undergraduates are showcasing. Feel free to visit people you know and those you don't know. This is a chance to introduce yourself to different academic parts of our campus.

There are two important times to keep in mind. At 2:30, President Subra Suresh will deliver a short keynote address in the first floor Kirr Commons area. We will also hold a drawing for participating students for a smart watch and a Fitbit, and make announcements for the final rounds of particular competitions. Plus we will have a special celebration for our 20th anniversary.

At 5:00 pm, our Awards Ceremony begins in McConomy Auditorium. Winners of the 18 Meeting of the Minds competitions will be announced and prizes will be awarded. A list of all competitions is included near the end of this program booklet.

Thank you again for coming, and please enjoy our 20th annual Meeting of the Minds.

TABLE OF CONTENTS

TABLE OF CONTENTS

SPECIAL THANKS

WE EXTEND OUR THANKS TO:

- ALUMNI RELATIONS
- COLLEGE OF ENGINEERING DEAN'S OFFICE
- SCHOOL OF COMPUTER SCIENCE DEAN'S OFFICE

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

Many thanks to Kourtney Bandish, Amy Burkert, Suzanne Choi, Catherine Copetas, Thomas Cortina, Joanna Dickert, Marcia Gerwig, Jen Keating-Miller, M. Stephanie Murray, Matt Lambert, Kurt Larsen, Catherine Spence, Shoba Subramanian, Joanne Ursenbach, Jen Weidenhof, MediaTech, Cohon University Catering Staff, Cohon University Center Staff, AlphaGraphics, A.G. Trimble Company, MissElaineous 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 or so to answer questions. Students participating in the Sigma Xi poster competition will be by their posters from 10 a.m. until 12:00 noon in **Rangos 1 and 2**. Students participating in the CIT poster competition will be by their posters from 12 noon to 2:30 p.m. in **Rangos 3**. 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. 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 five 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.** 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

BIOMEDICAL ENGINEERING

CARNEGIE MELLON'S GLOBAL MEDICAL BRIGADES GOES TO NICARAGUA

STUDENTS Neil Carleton *Chemical Engineering* | Nadia Florman *Mechanical Engineering* | Tiffany Fu *Materials Science Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Megan Pudlo *Biomedical Engineering* | Anna Zhang *Chemical Engineering*

ADVISOR Jason D'Antonio | *Biological Sciences*

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

This year, Global Medical Brigades engineering students received a CIT travel grant to visit rural Nicaragua over Spring Break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and explores sanitation and environmental engineering applications that are vital to developing countries.

INCREASING ENGINEERED CARDIAC MUSCLE TISSUE ALIGNMENT IN 2D

STUDENT Sean Kim | *Biomedical Engineering*

ADVISOR Adam Feinberg | *Biomedical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:45 am

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. One of the key factors in developing such engineered cardiac tissue in vitro 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 surfaces with extracellular matrix (ECM) proteins micropatterned on them 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. Two new patterns were developed; a pattern of 10μmwide lines of fibronectin with 4μmspacing, and a software-generated fiber-like pattern that mimics ECM structure in native chick myocardium. Statistical analysis showed that 10μmx 4μm pattern produced greater cell alignment compared to the 20μmx 20μm(control pattern), while the synthetic biomimetic pattern showed a statistically insignificant difference. The findings of this study show that the alignment of cardiac muscle cells in 2D can be improved by controlling the structure of the ECM protein.

PATTERNING BIOMIMETIC HYDROGEL-BASED SCAFFOLDS FOR CARDIAC TISSUE ENGINEERING

STUDENT Madeline Monroe | *Biomedical Engineering*
ADVISOR Adam Feinberg | *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

In developing a regenerative solution to treating cardiac disease, an important factor is generating a scaffold that will allow for cardiac cells (cardiomyocytes) to form functional tissue. A preferred method is engineering a scaffold that closely resembles the cardiac tissue extracellular environment, both in terms of composition and structure. However, this is a challenge due to the fact that the extracellular matrix is a complex three-dimensional system comprised of a network of many proteins, including fibronectin (FN), which forms the basement membrane of the extracellular matrix. Contributing to this goal, the aim of my research was to develop a scaffold fabrication method that integrated aligned FN into hydrogels that could be stacked to form functional cardiac tissue. Fibronectin was transferred onto hydrogel scaffolds through the use of established methods such as microcontact printing and gelatin transfer. This resulted in biomimetic hydrogel (fibrin and collagen) scaffolds lined with FN. In the future, the method I developed will enable the construction and analysis of more complex scaffolds, which can lead to the development of a viable cardiac construct.

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*
ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

CHEMICAL ENGINEERING

ANALYSIS OF MECHANICAL AND THERMOMETRIC PROPERTIES OF PEG-BSA

STUDENT Maggie Chen *Chemical Engineering*
ADVISOR Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Peter / 1:20 pm

For my research, I analyzed the properties of PEG-BSA, a protein-polymer conjugate. Different molecular weights of polyethylene glycol (PEG) were pegylated onto bovine serum albumin (BSA) and I evaluated the mechanical and thermometric properties of this protein-polymer conjugate. This experiment used several analytical methods: Dynamic Light Scattering (DLS), Matrix-assisted laser desorption/ionization (MALDI), Differential Scanning Calorimetry (DSC), and Nanoindentation. DLS was used to determine the hydrodynamic radius of the particles in solution. MALDI was used to determine the number of PEGs grafted onto the BSA. DSC was used to determine the particles' melting point and glass transition temperature. Nanoindentation was used to determine the hardness of the thin films of the functionalized protein. The significance of this research is that the properties of solid proteins are not as well known as the properties of proteins in solution. By determining these properties, they can have applications in polymer functionalized materials such that protein-polymer conjugates may be used in hazmat suits. Hazmat suits currently do not use protein-polymer conjugates in their material but they can be applied in hazmat suits such that the protein-polymer conjugate can react with toxic chemicals to prevent the toxic chemicals from going through the suit.

ANTI-MUC1 CHIMERIC ANTIGEN RECEPTOR THERAPY

STUDENT James Ham *Chemical Engineering*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Peter / 2:00 pm

One promising new cancer treatment that has shown recent success in the clinic is the use of chimeric antigen receptors (CAR) to re-target a patient's T cells to kill cancer cells. CARs are synthetic proteins that can bind to molecules specific to tumors and initiate T cell signaling to kill cancer cells. By combining the natural ability of T cells to kill cancer cells with the targeting specificity of antibodies, CARs offer a versatile and effective method for treating cancer. The current success has been in treating leukemias, malignancies of the blood and currently there is much research that needs to be done to expand CAR therapy to treat solid tumors. MUC1, which is a protein that is abnormally made in many breast, colon, and pancreatic cancers, was targeted. Lentiviral vectors encoding CARs with several different antibody fragments that target MUC1 were constructed then transduced into immortalized T cells. In vitro assays confirmed correct CAR expression and T cell activation from both peptide and incubation with MUC1+ cells.

ANTIBACTERIAL PERFLUOROCARBON VENTILATION (APV)

STUDENT Marissa Morales *Chemical Engineering*
ADVISOR Keith Cook *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Although many acute respiratory infections can readily be treated with either systemic or inhaled antibiotics, improved treatment is still needed. Current treatment involves systemic antibiotics as well as inhaled antibiotics in the form of aerosols. Inhaled antibiotics are able to yield high antibiotic concentrations in the lungs with low systemic concentrations, but there is still uneven drug distribution in the distal and infected parts of the lung. Antibacterial perfluorocarbon ventilation (APV) treatment can overcome the shortcomings of inhaled antibiotics. During APV treatments, an emulsion containing a disperse phase of antibiotics within perfluorocarbon (PFC) liquids is used during either partial or total liquid ventilation. Past research has found APV as an effective method for aqueous drug delivery to the lungs, yet the physical means of drug delivery and the emulsion composition's effects on this delivery are still not completely understood. This research project will focus on characterizing the pharmacokinetics of partial APV with various PFC-antibiotic emulsion compositions. In short, Sprague Dawley rats will be treated using APV with variable emulsion formulations and the antibiotic concentrations in the blood and lung tissue will be measured at various time points following treatment.

CARNEGIE MELLON'S GLOBAL MEDICAL BRIGADES GOES TO NICARAGUA

STUDENTS Neil Carleton *Chemical Engineering* | Nadia Florman *Mechanical Engineering* | Tiffany Fu *Materials Science Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Megan Pudlo *Biomedical Engineering* | Anna Zhang *Chemical Engineering*
ADVISOR Jason D'Antonio *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This year, Global Medical Brigades engineering students received a CIT travel grant to visit rural Nicaragua over Spring Break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and explores sanitation and environmental engineering applications that are vital to developing countries.

CHARACTERIZATION OF IgG ANTIBODY TRANSPORT THROUGH PROTEIN A CHROMATOGRAPHY MEDIA

STUDENT Erica Green *Chemical Engineering*
ADVISOR Todd Przybycien *Biomedical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:00 am

Protein A chromatography (PAC) is a selective purification method that is used to refine antibodies for pharmaceutical development. The technique utilizes the specific binding interactions between Staphylococcal Protein A (SPA) and IgG-Class monoclonal antibodies (mAbs) to remove process contaminants such as virus particles, DNA, and host cell proteins to obtain purified antibody. The addition of polyethylene glycol (PEG) to the SPA ligands in the media by a PEGylation process increases the selectivity of PAC and the purity of the antibody product. However, the PEGylation of ligands has been shown to reduce the static binding capacity (SBC) of the

media. Static binding isotherm experiments performed on PEGylated media and non-PEGylated media reveal that the SBC is lower for the PEGylated media. This phenomenon can be explained by results of kinetic binding experiments done with SPA covered tips. Comparison of the dissociation constant (KD) between the antibody and both non-PEGylated and PEGylated media show that PEGylation decreases the KD of the SPA. This is thought to occur because PEGylation of SPA inhibits antibody binding sites. Despite the decreased binding between SPA and the antibody, characterization experiments of SPA ligands done by high performance liquid chromatography (HPLC) and inverse size exclusion chromatography (iSEC) reveal that the improved purity of antibodies obtained by PEGylated media can outweigh the lowered SBC.

CONVERSION OF A CONSUMER LEVEL ADDITIVE MANUFACTURING SYSTEM FOR SMALL SCALE FILAMENT WINDING

STUDENTS Robert Dioso *Electrical & Computer Engineering* | Theodore Lee *Electrical & Computer Engineering* | Wei Mon Lu *Chemical Engineering*

ADVISOR Eric Brockmeyer *Architecture*

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

Filament Winding is a process where Glass, Carbon, or Aramid filaments are wound around a mandrel after being soaked in either polyester or epoxy glues. When cured, this process creates a extremely strong part. usually, these parts take the forms of tanks and for complicated profiles, mandrels can be almost impossible to remove. In Additive Manufacturing, the advent of consumer level 3D printers as well as extremely soluble filaments such as polyvinyl alcohol that are soluble in water allow small mandrels with complicated profiles containing both concave and convex curves. Previously, because of the small scale of consumer level 3D printers, filament winding parts at this scale has been impractical because of the sheer size of filament winders. Our goal is to build and test a head for a consumer level 3D printer that already comes with a 4th rotational axis that will allow it to be used for small scale filament winding on the same scale as the printer can print.

DESIGNING AND IMPLEMENTING AN ENZYMATIC FUEL CELL CAR

STUDENTS Joetsaroop Bagga *Chemical Engineering* | Isaiah Edmonds *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Joshua Kubiak *Materials Science Engineering* | Rinko Maeshima *Chemical Engineering* | Johnathan Roppo *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 the current energy crisis, alternative fuel is an active area of research worldwide. In an attempt to learn more about and potentially implement a greener approach to this issue, our group has been actively testing and improving upon the design of an enzymatic fuel cell. The purpose of our ongoing project is to construct a fuel cell powered by the oxidation of maltodextrin by glucose oxidase coupled with the reduction of potassium permanganate. Our goal is to optimize the power generated by multiple fuel cells in series to produce output capable of powering a VEX motor for national ChemE Car competitions.* These competitions require the motor to produce at least 1.1 Watts of power. Our research attempts to determine whether enzymatic reactions are a viable source of power given increasing energy demands in the 21st century.

Over the last year and a half, we have researched and refined possible approaches and constraints to this project, making immense progress in the Spring 2015 semester by constructing and testing a prototype fuel cell (see Figure 1). We measured and compiled data via Arduino to construct power curves (see Figure 2). Our design successfully generated consistent voltage outputs with magnitudes comparable to those of other enzymatic fuel cells in present-day research. These results have encouraged us to continue testing and optimizing the concentrations of the reactants in the cell and thus optimize the generated power. Over the semester we also plan to develop a correlation between glucose concentration and power output through experimentation. Finally, we plan to establish conclusions on the feasibility of our design with respect to our required power needs.

DETERMINATION OF ACTIVITY AND CYTOTOXICITY OF DNASE DELIVERED FROM BLOOD PLASMA BASED BIOMATERIALS (PBMs)

STUDENT Mariah Ondeck *Chemical Engineering*
ADVISOR Phil Campbell *ICES*
ROOM/TIME Rangos 3 / 12-2:30 pm

Bacterial infection is a common complication in open bone fractures. Biofilms, which are composed of DNA, are created by bacteria and greatly enhance resistance against antibiotic treatments. DNase degrades DNA, potentially reducing the biofilms so that the antibiotics can be more effective against the bacteria. In respect to the bone injuries, Carmell Therapeutics is using PBMs, which increase the rate of bone healing. Carmell is developing a second-generation bone repair product that will also fight infections by delivering DNase and an antibiotic to eliminate both the biofilm and the bacteria. In order to determine if DNase delivered via PBMs would be active, a new fluorescence based assay was developed. Additionally, the results in a prior pilot animal bone study suggested that DNase delivered from PBMs caused cytotoxic effects. Therefore, this project also investigated the cytotoxicity of DNase in two model cell lines: human MG63 preosteoblasts and mouse NIH 3T3 fibroblasts. Cytotoxicity was determined by scanning electron microscopy, live/dead assay, and cell viability assays. It was determined that DNase was not cytotoxic to either cell line over the range of concentrations that we would expect to use clinically (0-50 g/mL). Additionally, we developed and optimized a fluorescence-based DNase assay that has the ability to detect DNase levels as low as 0.3 g/mL, which also reduces the test time from ~ 24 hours (for current DNase assays) to as little as 10 minutes.

DEVELOPMENT OF A LOW-COST SPINAL ORTHOTIC FOR SCOLIOSIS

STUDENTS Seth Cordts *Mechanical Engineering* | Olivia Dippo *Materials Science Engineering* | Lucas Friedman *Materials Science Engineering* | Cherry Park *Chemical Engineering* | Juan Portela *Mechanical Engineering*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Bracing has been proven to prevent the progression of scoliosis. This can prevent the need for surgery and improve the quality of life of the patient inflicted by scoliosis. However, because of the shape of the torso and types of scoliosis vary from person to person, current braces are made custom to each individual and are very expensive to purchase. We aim to create a brace for scoliosis that can be adjusted for multiple users and could eventually be manufactured in large quantities to reduce the cost. This device will consist of rigid components as well as a

strapping system to apply the required three point loads to adjust the scoliosis. We will design the brace to be as effective as current braces while being more comfortable and cost effective. This will make it easier for humanitarian organizations to buy this brace and supply it to developing countries that lack the funds and resources to purchase their own brace.

DEVELOPMENT OF BROAD-SPECTRUM ANTIBIOTICS

STUDENTS Julia Atwood *Chemistry* | Emily Harwitz *Chemistry* | Cat Mao *History* | Adam Simpson *Chemical Engineering*

ADVISOR Danith Ly *Chemistry*

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

Bacterial infections are of rising concern in the world today. Antibiotics are of massive importance in controlling and eliminating potentially deadly infections, but due to widespread resistance are difficult to profitably research and produce. New classes of antibiotics, with different targets and mechanisms, must be sought and invested in to prevent a relapse to infection mortality of the pre-antibiotic era. The isolation and research of natural antimicrobial peptides offers intriguing drug leads. These molecules demonstrate potent antimicrobial activity in living systems and some have been shown to be immunomodulatory. Resistance to antimicrobial peptides so far has been slower to develop than in conventional drugs and may be combated further by synergistic effects when peptides and conventional drugs are used in combination. RTD-1 is a cyclic antimicrobial peptide in the theta defensin family isolated from rhesus macaque and baboons. It has been found to be effective against viruses, fungi and both gram-negative and gram-positive bacteria. Though effective by itself as an antimicrobial agent, the peptide is difficult to synthesize because of three disulfide cross-linkages that are necessary for the tertiary structure of the peptide. This obstacle was overcome by the incorporation of Peptide Nucleic Acid (PNA) monomers in a mimic of RTD-1, called RTD-1M. Previously, RTD-1M demonstrated similar antibiotic properties to native RTD-1 and low toxicity to human red blood cells.

We present the synthesis of a series of RTD-1M molecules with modifications to increase bactericidal potency and decrease production time and cost. These iterations will be tested via a combinatorial strategy and compared to currently available antibiotics and native RTD-1. Successful versions of RTD-1M could be developed into a novel oral therapeutic of a promising antibiotic class.

DYNAMICS OF DISCHARGING ELECTROLYTE CELLS

STUDENT Alexandra Frankel *Chemical Engineering*
ADVISOR Aditya Khair *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

While the dynamics of charging electrolyte cells are well-studied, the dynamics of discharging cells are less so. Discharging cells exhibit unique nonlinear behavior at large voltages, namely the existence of a reverse peak in the discharging current, which is not seen in charging cells. The linear and slightly nonlinear dynamics of the discharging electrolytic cell at small and moderate voltage were determined analytically and compared to numerical simulations of the discharging electrolytic cell. The reverse peak was determined to be a purely nonlinear phenomenon that could not be predicted by linear RC timescale dynamics. The reverse peak time scale was however further developed as a starting point for future work in determining the dynamics behind the reverse peak.

ELECTROPHORETIC SEPARATION OF n-alkyl MODIFIED DNA IN ENTANGLED MICELLE NETWORKS

STUDENT Palak Pujara *Chemical Engineering*
ADVISOR James Schneider *Chemical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:45 am

Traditional DNA separation is performed using physical entangled polymer solutions. Under an applied voltage, the DNA will electrophoresis through the pore spaces created by the entangled polymer strands, resulting in elution of small DNA lengths first. While this procedure is easy to implement, it is time consuming due to the high viscosity of the polymer solutions that make loading into small bore capillaries difficult, and limitations on electric field strength that limit velocity. Micelle end-labeled free-solution electrophoresis (ELFSE) is an established alternative DNA separation mechanism which avoids the limitations posed for polymer systems. Covalent attachment of an n-alkyl group to DNA creates specific interactions with micelles present in the running buffer, adding additional friction to the electrophoresing DNA. In ELFSE, the longer lengths elute first as they can overcome the additional friction of the micelle much easier than shorter lengths. As micelles grow in size and concentration, they form an entangled network that mimics traditional polymer solutions, countering the effectiveness of ELFSE. This project characterizes how DNA migrates through these micelle networks, explores the effects of micelle network formation on ELFSE migration of n-alkyl modified DNA, and presents advancements on micelle buffer formation for greatly improved micelle ELFSE separations.

ENANTIOMERIC SEPARATION OF CHIRAL DRUGS USING TETRAHEXAHEDRAL GOLD NANOPARTICLES

STUDENT Darwin Yang *Chemical Engineering*
ADVISOR Nisha Shukla *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:00 am

Gold nanoparticles modified with D- and L-cysteine become chiral and are capable of selectively adsorbing enantiomers of a chiral probe molecule. This concept can be applied to the separation of chiral drugs such as propranolol hydrochloride (PPL). Binding events of R- or S-PPL to the cysteine coated nanoparticles can be

detected through a change in the optical rotation of the system. A Langmuir adsorption model was developed that allows equilibrium constants of binding to be calculated from a series of optical rotation measurements. The results from this mathematical analysis show that L-cysteine coated gold nanoparticles bind to R-PPL with a 2.2 times greater affinity than S-PPL. The opposite is true for D-cys/Au due to chiral symmetry. This observed difference in affinities demonstrates the feasibility of a novel method of chiral drug separation using gold nanoparticles.

ENGINEERS WITHOUT BORDERS - PLASTIC THATCH

STUDENTS Emmett Horton *Civil and Environmental Engineering* | Aakash Parekh *Chemical Engineering* | Deepak Ravi *Mechanical Engineering* | David Sparks *Materials Science Engineering* | Stephanie Tjan *Civil and Environmental Engineering* | Julia Tucker *Mechanical Engineering* | Meghana Valluri *Self-defined* | Angela Wu *Civil and Environmental Engineering* | Alexander Yu *Electrical & Computer Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

The primary goal and focus of the PET Thatch project is to design a semi-automated system that will convert waste plastic bottles into reusable plastic pieces for construction material and roofing structures. PET Thatch is divided into 4 main groups: cutting, decontouring, fusing, and roof design. The specific goals of this semester were to create an efficient method for removing the contours from the waste plastic bottles, to build a sample roof for testing purposes, and continue looking for ways to integrate the four groups.

EZ-ECMO: NOVEL EXPANDABLE CATHETER FOR EXTRACORPOREAL MEMBRANE OXYGENATION

STUDENT Erica Green *Chemical Engineering* | Palak Pujara *Chemical Engineering* | Christian Schultz *Mechanical Engineering* | Darwin Yang *Chemical Engineering* | Ariana Zito-Wolf *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:15 am

Extracorporeal membrane oxygenation (ECMO) is a last resort treatment for patients with cardiopulmonary failure. ECMO is a form of respiratory dialysis where blood is removed from the body, oxygenated, and returned via catheters. Catheter insertion is a time consuming process that requires the use of dilators to stretch the blood vessels to the required size. The dilations can be dangerous and complicated, which is why our team is collaborating with Dr. Rittenberger and Dr. Guyette from UPMC Emergency Medicine to design a catheter that can be inserted at a small diameter and expanded to the desired size once in the femoral artery. By eliminating the need for serial dilation, the EZ-ECMO catheter will decrease the risks associated with this procedure and, as a result, increase the survival rate.

HORIZONTAL RIBBON GROWTH (HRG)

STUDENTS Eamon Cullinane *Chemical Engineering* | George Degen *Chemical Engineering*

ADVISOR Erik Ydstie *Chemical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:30 am

Typical silicon solar cells are made from silicon wafers. The most widely used production method for silicon wafers involves the formation of a cylindrical ingot, which is then sliced and processed into wafers. However, this slicing process results in the loss of the silicon material, which contributes to the cost of the wafer. To address this problem,

a continuous Horizontal Ribbon Growth (HRG) method has been developed to avoid the need to slice wafers, which is implemented with a patented apparatus. The HRG process involves melting silicon pellets in a crucible then solidifying and pulling the top layer of the silicon using a planar silicon seed. The seed will pull out the top layer as silicon hardens, creating a continuous formation process as the silicon is continuously melted. This research works on developing a machine/theory that will result in successfully pulling silicon.

HOW QUICKLY DOES SILVER-NANOPARTICLE PAPER DECONTAMINATE WATER?

STUDENTS Uriel Eisen *Design* | Brandon Ortiz *Chemical Engineering*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Water-related illness kills more children than malaria, AIDS, and measles combined. One promising method to provide clean water is to use silver nanoparticle-embedded paper as an antibacterial filter. This recently developed technology is inexpensive and reduces e. coli over a million fold to EPA-safe levels [1]. Yet it remains unclear how quickly silver nanoparticles work, or how effective such a filter would be under non-ideal conditions. In this project, we attempt to find the minimal effective time for bactericidal efficacy under two models of accelerated filtering: high pressure before the filter, and vacuum filtration. We will measure deactivation of e. coli in two ways: counting colonies plated on agar from the filtrate, and IDEXX Colilert Quanti-tray, an EPA-approved semiautomated quantification method for potable water testing. We hope to determine the effect of flow rate on filter efficacy, better understand the properties of nanomaterials, and gain insight into how this technology could best be deployed to prevent waterborne disease in the developing world.

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 Rangos 1 & 2/Sigma Xi Group 3 / 10:00 am

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. Previous studies have shown that certain synthesized chemicals can greatly increase the permeability of the tight junctions between intestinal epithelial cells, allowing absorption of larger drugs. The high toxicity of these synthesized chemicals, which includes detergents and acids, however, have prevented them from being used in oral delivery applications. This project seeks to identify safe and effective permeation enhancers by examining naturally occurring molecules derived from edible fruits.

Previous work on this project has already shown that extracts derived from apples, oranges, and strawberries are nontoxic to Caco-2, or human intestinal epithelial, cells. Furthermore, TEER assays have shown that the electrical resistance of the Caco-2 monolayer increases over time when exposed to apple and orange extracts, but greatly decreases over time when exposed to strawberry extracts. These results suggest that strawberry extracts can significantly increase the permeability of the Caco-2 monolayer, while apple and orange extracts can decrease the permeability of the Caco-2 monolayer.

This semester, this project will focus on lyophilizing the fruit extracts to create powder forms of each extract. TEER assays will be repeated to determine whether the powder extracts can affect Caco-2 monolayer permeability the way aqueous fruit extracts did. Converting the extracts to powder form now may also prove useful in future pharmaceutical applications (i.e. drug encapsulation). In addition, mass spectrophotometry (MALDI) will be used to identify compounds within the fruit that are affecting the permeability of the Caco-2 monolayer. In conclusion, this whole study aims to identify and examine the effects of fruit derived molecular permeation enhancers that can increase the permeability of the intestinal epithelium and therefore be used for oral delivery applications.

MEASUREMENT OF FILM GROWTH BY SURFACE-INITIATED ATOM TRANSFER RADICAL POLYMERIZATIO

STUDENT Jordan Green *Chemical Engineering*
ADVISOR Robert Tilton *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Surface chemistry has applications in a variety of fields, specifically for lubricants in biomedical devices and detection assays for antibodies. The ability to manipulate surface characteristics, specifically polarity, aides in the creation of controlled friction systems. In addition, the ability to functionalize a surface with a unique matrix, such as a dextran matrix, aids in the immobilization and characterization of proteins. These surface chemistry modified chips can be used to predict the early onset of several diseases including cardiovascular disease.The specific goal of this study is to characterize the mechanisms behind several surface modification procedures such as the silanization of silica surfaces utilizing (3-Aminopropyl) triethoxysilane (APTES) and polyethylene glycol (PEG) silane, and the addition of a dextran matrix onto an APTES coated surface. The study also focuses on the addition of nanoparticles and their effect on surface properties.

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 / 12-2:30 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.

MULTIPLEXED LET-7 MICRORNA DETECTION VIA SANDWICH HYBRIDIZATION CAPILLARY ELECTROPHORESIS

STUDENT Soyoung Kim *Chemical Engineering*
ADVISOR James Schneider *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

MicroRNAs (miRNAs) refer to a class of short, non-protein-coding RNAs that have critical roles in gene regulation. Their abnormal expressions are directly associated with a myriad of diseases including cancer. With recent discoveries highlighting their roles as tumor suppressors and oncogenes, quantitative analysis of multiple miRNAs can be a promising means of diagnosis and treatment of cancer as well as other diseases.

In the Schneider group, we have developed a sandwich hybridization assay for miRNA detection via rapid, gel-free electrophoresis. This method involves hybridization of miRNA with an alkane modified synthetic nucleic acid probe, a fluorescently labeled DNA probe, and non-ionic surfactant micelles that act like a parachute to slow down the electrophoresis of the complexes according to their lengths. This micelle-assisted separation provides run times that are 10-100 times faster than conventional gel-based methods.

Here, we extend the application of this method towards multiplexed detection of let-7 miRNA family members. We demonstrate separation of 6 let-7 miRNAs in a single 5 minute separation. We also tested the binding between perfect match and single-base mismatches that exists between the let-7 family. Such mismatches occur when one target is hybridized with probes complementary to another target.

Although an increased temperature of 40°C is necessary to obtain selectivity between individual targets, we were able to accomplish selectivity at 25°C with multiplexed detection using competitive hybridization for perfect match binding probes for each miRNA. We also report detection limits as low as 100pM of miRNA.

OPTIMAL INVESTMENTS

STUDENTS Keenan Gao *Mathematics* | Nathan Wu *Chemical Engineering*
ADVISOR William Hrusa *Mathematics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 10:30 am

This project seeks to understand optimal investments in a one stock binomial model through the relationship dynamic of a hedge fund agent and a client with differing utility functions. We introduce a price commission scheme for the agent and analyze how each entity's behavior changes as the parameters of the scheme vary. Through this analysis, we can understand the conditions when the agent and client's utility functions are simultaneously maximized and create an equal objective for investing the market.

OPTIMIZATION OF A BATTERY POWERED CAR WITH MANOMETER STOPPING MECHANISM

STUDENTS Anna Bandecca *Chemical Engineering* | Jonathan Berman *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Jaewoo Kim *Materials Science Engineering* | Joshua Kubiak *Materials Science Engineering* | Johnathan Roppo *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer 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 and optimize a vehicle that is powered and stopped with the use of chemical reactions, which will require many interdisciplinary skills and techniques. The car will compete in the 2015 American Institute of Chemical Engineers (AIChE) National Chem- E-Car Competition. At the competition, the car will be given a set distance it needs to move as well as a given weight it must bear. A lab-made battery will power the car, and a manometer system will stop the car. Mechanical, electrical, and chemical engineering must be combined with programming, circuitry, and modeling in order to successfully run and stop the car.

The 2015 AIChE National Chem-E-Car Competition is an annual competition in which college students design and build small, shoebox-sized cars that are powered by a chemical energy source and will carry a specified load over a given target distance. For the national competition, we hope to further ensure the stability, reliability, and success of the car.

OPTIMIZING A BLEACH-BASED CLOCK REACTION USING MATHEMATICAL MODELING

STUDENTS Alexandra Cerny *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Neil Jassal *Electrical & Computer Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Mechanical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

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

The Chem-E-Car competition is a program for collegiate members of the American Institute of Chemical Engineers (AIChE) that revolves around the design and creation of a small chemically powered car. The judging of these cars is based on how accurately and effectively the car can reach a certain distance and stop on the mark within a two-minute time period. The Chem-E-Car Data Acquisition, Transfer, and Analysis, and Bleach Clock subgroups of the Chem-E-Car team are collectively applying for a SURG grant in order to optimize the car to succeed at the National Competition in November 2015.

The team spent the last semester designing and implementing a more modular testing interface for the movement mechanisms for multiple cars, building a new array of sensors, and beginning automation of chemical injection. Faster testing procedures were also initially developed by integration of wireless Bluetooth data transfer to the Arduino microcontrollers. The team also developed a system for computer-automated chemical injection, or "autoinjection," to increase accuracy of the run during competition.

The team has decided to use a new stopping mechanism consisting of bleach and a disodium salt after complications arose last semester with each component of the store-bought dye reacting at different stages. After a successful semester of testing the bleach-food dye stopping mechanism, the team will continue to improve upon this process to create an accurate data curve that can be utilized for the competition. The measurements from the resulting time trials of this reaction have been recorded and are currently being used in the process of modeling the data. The goals for this semester will be to observe the effects of stirring speed on the kinetics of the bleach reaction to limit its impact on the times of our reaction.

OPTIMIZING NANOPARTICLE FORMATION FOR DELIVERY OF CANCER THERAPEUTICS

STUDENT George Degen *Chemical Engineering*
ADVISOR Kathryn Whitehead *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

The goal of this research is to optimize the formulation of nanoparticles for delivery of therapeutics to lymphoma cells for treatment of non-Hodgkin lymphoma. The therapeutic used is based on RNA interference, a natural cellular process that involves small pieces of RNA called short interfering RNA (siRNA). To treat lymphoma, siRNA can be delivered to the cancer cells to suppress tumor growth. This research attempts to optimize the composition of a nanoparticle delivery system for preferential siRNA delivery to lymphoma cells.

QUANTIFICATION OF SWIMMING ORGANISMS' EFFECTIVE DIFFUSIVITY UTILIZING ASYMPTOTIC EXPRESSIONS FOR SQUIRMER VELOCITY PROFILES AT SMALL, NON-ZERO REYNOLDS NUMBERS

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

The method for simulating the effective diffusivity of a group of swimmers uses MATLAB to solve the swimmers' differential equations of motion and velocity fields. The simulation first initializes the swimmers' starting positions and trajectories inside a dimensionless box whose size is scaled by the swimmer radius. A tracer particle starts at the origin. Inter-swimmer forces are neglected, so the swimmer trajectories do not change. At each time step, the swimmer velocity profiles are calculated and, via a linear superposition, the net velocity profile is computed. The tracer particle position is changed according to the net velocity profile. For each set of parameters passed to the simulation, the number of simulation repetitions is specified and the average tracer particle diffusivity computed after all repetitions complete. For a range of swimmer characterization parameters and Reynolds numbers, the diffusivities were calculated for a large number of repetitions.

QUANTIFICATION OF THE STRENGTH OF SURFACTANT GRADIENT INDUCED MARANGONI CONVECTION AT AN OIL/WATER INTERFACE

STUDENT Samuel Winslow *Chemical Engineering*
ADVISORS Aditya Khair *Chemical Engineering* | Robert Tilton *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

The method for simulating the sorption kinetics and fluid dynamics of surfactant flowing past an oil/water interface uses COMSOL to solve the set of vector and differential equations describing momentum and mass transport. A Langmuir isotherm was assumed to model the surfactant sorption kinetics to and from the interface, with parameters taken from experimental work. The simulation includes equations describing the bulk convective-diffusive behavior of water with a surfactant concentration. Analogous equations are included to describe the dynamics of the interface, along with a constitutive equation relating surface concentration to surface tension. In the simulation, surfactant-free flow is allowed to reach steady state in the flow cell, before adding surfactant

via a sharp step function at the inlet. The model dynamics are then tracked using a finite element method. The magnitude of the surface velocity at the interface is then calculated for a range of bulk surfactant concentrations and compared to surfactant-free, solely shear-driven flow at the interface.

QUANTIFYING ENANTIOSPECIFIC SEPARATION OF PHARMACEUTICALS ON CHIRAL Au NANOCRYSTALS

STUDENT William Records *Chemical Engineering*
ADVISOR Nisha Shukla *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:45 am

Chiral pharmaceuticals, such as penicillamine, have been important subject of separations research. Spherical gold nanoparticles modified with enantiomerically pure D- and L-cysteine have been shown to separate chiral probe molecules, including propylene oxide. The adsorption of chiral probes has been quantified using a simple model. In this project, tetrahexhedral and hexoctahedral gold nanocrystals were synthesized, modified with enantiomerically pure D- and L-cysteine, and used in the enantiospecific separation of chiral penicillamine. The adsorption equilibrium constants of each enantiomer on the Au nanocrystals were quantified using optical polarimetry and the previously developed model.

SENSITIVE DETECTION OF DNA BY TRANSIENT ISOTACHOPHORETIC FOCUSING AND MICELLE ELECTROKINETIC CHROMATOGRAPHY

STUDENT Ariana Zito-Wolf *Chemical Engineering*
ADVISOR James Schneider *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Capillary electrophoresis (CE) is an excellent analytic technique that creates rapid, highly resolved separations based on a sample's electrophoretic mobility (). However, CE is limited by its low detection sensitivity. To increase sensitivity, we have investigated the use of an electrophoretic pre-concentration technique known as isotachophoresis (ITP). ITP functions by creating segregated regions within a capillary of buffers with different ionic mobilities; a leading electrolyte (LE) of high μand a trailing electrolyte (TE) of low μ.The different regions generate a gradient in electric field strength (E) upon application of an electric potential. The LE and TE can be designed such that the mobility of target nucleic acid is between the two; this means it moves quickly through the TE region (high E), then abruptly slows when it reaches the LE region (low E). The result is focusing of DNA at the LE-TE interface, allowing for an extremely large increase in signal relative to traditional injection methods.

ITP is very efficient at stacking a single analyte, however, achieving separation of multiple analytes is more challenging. By its very nature, ITP tends to stack any sample present into one large peak, thus the LE-TE interface must be disrupted to induce separation. We have seen that increasing capillary length results in cleaner and larger signals, due to the increased time for stacking to occur, and that larger injection times result in larger signal, as more sample is being injected, at the expense of separation resolution. By optimizing these trade-offs, we have been able to achieve highly resolved DNA separations in conjunction with large signal increase. This method has great potential, as it can be tailored for any specific DNA length through the choices of LE, TE, and adjusted to allow for separation or not. We hope to use this method to achieve detection of trace miRNA present in biological samples.

TESTING FOULING MECHANISMS IN REVERSE OSMOSIS DESALINATION PLANTS

STUDENTS Sara Kelly *Chemical Engineering* | Alexandra Newby *Chemical Engineering*
ADVISOR Meagan Mauter *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

As fresh water reserves become more scarce and the population of the world increases, technologies for desalinating water effectively and economically are becoming vital. Reverse osmosis (RO) is a critical technology that desalinates seawater and brackish water, addressing this water scarcity problem.. However, RO requires a large amount of energy, which increases the cost to utilize this technology. In particular, fouling of the semi-permeable membrane leads to increased energy needed to desalinate the water and therefore increased cost. This fouling occurs either by the natural organic matter adsorbing to the surface of the membrane or by salts and particulate matter building up on the surface of the membrane. It is hypothesized that there is an optimal flowrate can lead to minimized fouling. In order to determine this optimal flowrate, we are building an RO test system which can measure both the effectiveness of an RO plant and the fouling of the membrane over time. This system will also be used in conjunction with quartz crystal microbalance and dissipation (QCM-D) technology to determine the best membrane materials for RO membranes.

THE STABILITY AND INTERACTIONS OF COATED NANOPARTICLES

STUDENT Kelsie Eiler *Chemical Engineering*
ADVISOR Nisha Shukla *ICES*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Understanding the interactions and structure of Au Nanoparticles with a variety of chiral coatings.

CIVIL AND ENVIRONMENTAL ENGINEERING

A HEAT VULNERABILITY INDEX AND ADAPTATION SOLUTIONS FOR PITTSBURGH, PENNSYLVANIA

STUDENTS Kathryn Bradford *Civil and Environmental Engineering* | Miriam Hegglin *Civil and Environmental Engineering*
ADVISOR Kelly Klima *Engineering and Public Policy*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 11:30 am

With increasing evidence of global warming, many cities have focused attention on response plans. A heat vulnerability index could help inform decisions, such as the optimal location of cooling centers. Here we focus on Pittsburgh, Pennsylvania and ask two questions. First, where are Pittsburgh's most vulnerable populations, and

what are the top factors contributing to that vulnerability? Second, where can the City locate additional cooling centers to reduce the vulnerability? We use national census data, GIS modeling, and statistical analysis, to determine vulnerability scores and optimal cooling center placement. We find that Glen Hazel, North Oakland, and Homewood South are the most vulnerable census tracts. North Oakland was identified as the optimal location for an additional cooling center, despite the fact that it was not ranked as the most vulnerable census tract. This implies that geospatial optimization is an essential tool for decision makers needing to efficiently allocate limited resources to serve the largest need. The remaining optimal cooling center locations differ depending on whether the City chooses to construct a new building or repurpose an existing building.

ENGINEERS WITHOUT BORDERS - PLASTIC THATCH

STUDENTS Emmett Horton *Civil and Environmental Engineering* | Aakash Parekh *Chemical Engineering* | Deepak Ravi *Mechanical Engineering* | David Sparks *Materials Science Engineering* | Stephanie Tjan *Civil and Environmental Engineering* | Julia Tucker *Mechanical Engineering* | Meghana Valluri *Self-defined* | Angela Wu *Civil and Environmental Engineering* | Alexander Yu *Electrical & Computer Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

The primary goal and focus of the PET Thatch project is to design a semi-automated system that will convert waste plastic bottles into reusable plastic pieces for construction material and roofing structures. PET Thatch is divided into 4 main groups: cutting, decontouring, fusing, and roof design. The specific goals of this semester were to create an efficient method for removing the contours from the waste plastic bottles, to build a sample roof for testing purposes, and continue looking for ways to integrate the four groups.

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*

ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in

water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

ELECTRICAL & COMPUTER ENGINEERING

3D MODEL STATE ESTIMATION IN A 2D IMAGE BY BAYESIAN FILTERING WITH FIRST-ORDER PARTIAL DERIVATIVES

STUDENT Matthew Sebek *Electrical & Computer Engineering*
ADVISOR George Kantor *Robotics Institute*
ROOM/TIME Rangos 3 / 12-2:30 pm

We present a 3D model-based visual tracking approach using Bayesian filter-based state estimation. We use point features to estimate inter-frame motions, and perform a refinement process to improve the correspondences between the sampled model points and the image points. For better tracking performance, we employ first-order partial derivatives to model the velocity. This allows for more aggressive tracking than a zero-mean velocity assumption.

A COMPUTATIONAL APPROACH TO STUDYING MELODIC STRUCTURES IN INDIAN CLASSICAL MUSIC

STUDENTS Vivek Shankar *Computer Science* | Anirudh Sridhar *Electrical & Computer Engineering*
ROOM/TIME Peter / 12:20 pm

The goal of this project is to analyze an audio recording of Indian Classical Music and correctly identify the piece's raga. A raga is a class of melodic structures which is more prominently characterized by the mood it conveys rather than its mere notes. A basic filtering mechanism for deciding a raga based on its constituent notes has been designed and implemented through a fourier analysis of the audio file as well as finding candidates for the correct raga from a database. In addition, we characterize key melodic structures beyond single-frequency notes called gamakas which include, but are not limited to, note oscillations, curved or ornamented phrases, and accentuated stresses. We attempt to extend our basic interface to include these more complex characterizations of Indian Music. By emulating an experienced listener's process, we hope to shed light on the underlying mechanisms of the deeper threads of music and understanding.

A LIGHT TOUCH

STUDENTS Marlena Abraham *Computer Science* | John Lareau *Electrical & Computer Engineering*
ADVISOR Paolo Pedercini *Art*
ROOM/TIME Connan / 3-5 pm

While virtual reality is an incredible emerging technology, especially for games, it is very easy for small inconsistencies to shatter their illusion. Uncomfortable jolts back to the real world often manifest when the player reaches out to touch something in front of them. They find that not only can they not feel anything, they cannot even see their hands.

This project seeks to create an experience that accounts for both of these problems. The environment invites you to reach out and the hardware allows you to touch.

AN ALGORITHM FOR RENDERING IMAGES THAT SUPPORT DEPTH PERCEPTION FROM STEREO WHILE EXCLUDING PICTORIAL GRADIENTS: VERIFICATION WITH A STEREO MICROSCOPE AT 7.5x MAGNIFICATION

STUDENT Evaline Ju *Electrical & Computer Engineering*
ADVISOR John Galeotti *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The displays used in Augmented Reality (AR) systems are inherently subject to optical distortion as a consequence of their physical implementation, and considerable effort has been expended to understand the impediments caused by optical distortions and to minimize their effects. In such studies it is difficult to disambiguate between different simultaneous distortions to the different cues for depth and slant. This research tested an algorithm developed by our group for rendering 2D images that supported slant perception with stereo cues but without confounding pictorial cues. The algorithm was previously used to measure slant thresholds for surfaces viewed under a stereo microscope with 5x magnification. The present experiment extended these results to 7.5x magnification, to test whether increased magnification would impair the ability to perceive surface slant. Participants viewed a series of image pairs under 7.5x magnification, for each pair reporting which image appeared more slanted. The experiment demonstrated that participants could accurately determine slant with both eyes open (stereo viewing), but when participants closed one eye their slant perception was severely diminished (presumably due to a lack of pictorial cues). Moreover, the results showed that the greater magnification had no negative impact on the slant threshold and demonstrated the robustness of the rendering algorithm.

AUTOGRADING WITH DOCKER CONTAINERS

STUDENTS Mihir Pandya *Electrical & Computer Engineering*
ADVISOR David O'Hallaron *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Autolab is a platform for students to submit programmatic assignments and get immediate, autograded feedback that is configured by the course instructors. Presently, the systems runs student code on Linux Virtual Machines. A guarantee Autolab must provide is that all the jobs run under the same conditions. This requires the system to clean up and restore the state of a VM after each job is completed, in order to reuse that VM for another job.

Furthermore, if a VM cannot be cleaned up, it becomes useless and the system must destroy that VM and create another one in its place, which is both expensive and time-consuming. For my independent study, I will explore the idea of running jobs in Docker containers. Docker containers are Linux containers that provide image support. This can allow Autolab to continue supporting course-specific images while providing the isolation between jobs to ensure that they run under the same conditions. Should docker containers provide the aforementioned benefits, I will work on a Distributed Docker architecture that will allow Autolab to run jobs in docker containers on a selection of machines that can be accessed over the network.

BICYCLE COLLISION WARNINGS WITH SHARED TRAJECTORY TRACKING

STUDENT Ian Hartwig *Electrical & Computer Engineering*
ADVISOR Anthony Rowe *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

The upcoming rollout of Dedicated Short Range Communication (DSRC) in cars gives us a unique opportunity to prevent or warn of impending car and bicycle collisions. We investigate the possibility of sharing commonly available position and trajectory information in vehicles and smartphones (GPS, odometry, RSSI) in a way that we can generate trajectory information in a timely and accurate manner. With this information available, drivers and cyclists can be alerted and take corrective action.

CHELADA - CONTEXTUALLY AWARE PERSONAL ASSISTANT

STUDENTS Arman Bolat *Electrical & Computer Engineering* | Bryan Tan *Electrical & Computer Engineering*
ADVISOR Jason Hong *Human Computer Interaction Institute*
ROOM/TIME Rangos 3 / 12-2:30 pm

Chelada is a contextually aware personal assistant that is able to push useful information to a user based on his or her context, such as location, weather, and time. Users are able to receive information from feeds, which contain conditions and corresponding actions that are triggered by the user's context. For example, a user buys a plane ticket from an airline website. The airline website notices that the user has a Chelada account, so it subscribes the user to a feed. On this feed, the airline sends important personalized information to the user, such as confirmation numbers, online check-in links, flight updates, directions to the airport, and transportation options at the arriving city. This information is not static - it is dependent on the user's context (for example, the user's home location, or time of arrival at airport). The project also has a web application that allows users to create and share feeds.

CONSTRUCTING HARDWARE MODELS OF CELL STIMULI-RESPONSE NETWORKS

STUDENT Niteesh Sundaram *Electrical & Computer Engineering*
ADVISOR Natasa Miskov-Zivanov *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

The AIM Cancer research group seeks to automate the design and analysis of models of cell signaling networks, and to compare the models against experimental data from a biology wet lab. This honors research project was concerned with developing hardware implementation of these models in System Verilog and running them in parallel on a Filed Programmable Gate Array (FPGA). Cellular signaling pathways in a particular system were

modeled as series of numbered boolean rules. As biological models are stochastic in nature, a significant portion of the work focuses on determining new simulation methods to run the modeled pathways and developing new pseudo random number generators (RNGs) in order to select the rules in a stochastic fashion. Four new methods (namely, random order asynchronous, general asynchronous, group asynchronous, and synchronous) of running the rules were developed and compared against one another. A new RNG method to select the rules was also developed that increased accuracy and sped up the run time of the model by approximately a factor of four.

CONVERSION OF A CONSUMER LEVEL ADDITIVE MANUFACTURING SYSTEM FOR SMALL SCALE FILAMENT WINDING

STUDENTS Robert Dioso *Electrical & Computer Engineering* | Theodore Lee *Electrical & Computer Engineering* | Wei Mon Lu *Chemical Engineering*
ADVISOR Eric Brockmeyer *Architecture*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Filament Winding is a process where Glass, Carbon, or Aramid filaments are wound around a mandrel after being soaked in either polyester or epoxy glues. When cured, this process creates a extremely strong part. usually, these parts take the forms of tanks and for complicated profiles, mandrels can be almost impossible to remove. In Additive Manufacturing, the advent of consumer level 3D printers as well as extremely soluble filaments such as polyvinyl alcohol that are soluble in water allow small mandrels with complicated profiles containing both concave and convex curves. Previously, because of the small scale of consumer level 3D printers, filament winding parts at this scale has been impractical because of the sheer size of filament winders. Our goal is to build and test a head for a consumer level 3D printer that already comes with a 4th rotational axis that will allow it to be used for small scale filament winding on the same scale as the printer can print.

COST BENEFIT ANALYSIS OF FACTS DEVICES

STUDENTS Arushi Chawla *Electrical & Computer Engineering*
ADVISOR Ines Azevedo *Engineering and Public Policy* | Gabriela Hug *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

A flexible alternating current transmission system (FACTS) is a system composed of power electronic devices used for the AC transmission of electrical energy. It is meant to enhance controllability and increase power transfer capability of the network. FACTS is defined by the IEEE as "a power electronic based system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability."

This project deals with the cost benefit analysis of FACTS devices while working on power flow control. While these devices provide a lot of benefits to the system in terms of added flexibility, they also require a significant investment. As the cost of such devices decreases the benefit per dollar of investment increases which means that at some point the benefits achieved are greater than the cost making these devices cost effective. A key question is going to be how the cost of these devices will change over the years to come. An answer to this question can be found by contacting experts in the field to get an idea about future costs. The benefit analysis is the other part of the analysis. This is done by running extensive MATLAB simulations in order to determine the cost savings while maximizing the utility of these devices.

DIGITAL FEEDBACK CONTROL FOR POWER SUPPLY DESIGN

STUDENTS Nishant Pol *Electrical & Computer Engineering* | Sicong Wang *Electrical & Computer Engineering*
ADVISOR Shawn Kelly *ICES*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Precise power regulation and control is critical when designing and testing electronic systems. The ability to generate and monitor arbitrary waveforms is very useful when testing and optimizing circuits powered by non-ideal sources such as batteries or capacitors which have limitations on how much and how fast power is delivered to the circuit. Traditionally, power regulation has been focused on analog feedback which works well for generating steady DC or simple periodic power. Recent advances in microprocessors and data converters, however, allow for efficient and dynamic real-time processing of analog signals. Dynamic processing allows the power supply to generate more complex waveforms to emulate a battery or capacitor. We will investigate how digital signal processing can be applied to high-power waveforms generated by a power supply and the benefits of a digital approach, such as dynamic control and monitoring that is difficult to do with a pure analog approach.

DISTRIBUTED KEY-VALUE SERVERS USING RASPBERRY PIS

STUDENT Xiaofan Li *Electrical & Computer Engineering*
ADVISOR Kayvon Fatahalian *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

With distributed servers, the main bottleneck is the database because it has to maintain consistent states. People have done various things trying to improve it (like prof. David Anderson here at CMU) but still, it's hard to avoid the overhead of rehashing or large migration of data across platforms. However, the features of raspberry pis are that it's small/portable in size, not super fast (CPU) but potentially scalable. So I thought maybe it can help with this problem!

EFFICACY OF COMMERCIAL ELECTRONICS FOR SPACE MISSIONS

STUDENT Luke Metro *Electrical & Computer Engineering*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

This research investigates the efficacy of consumer-grade electronic components for high performance, low cost space missions. Spacecraft, landers, and rovers incorporating computers, cameras, batteries, sensors, and motion controllers, will be tested. These are traditionally exotic, slow, and expensive, since they are specialized to endure mechanical shock, vibration, thermal cycling, operation in vacuum, and radiation exposure. This research embarks to develop electronics using commercial components that are cheaper, more accessible, and more powerful.

This research investigates the efficacy of consumer-grade electronic components for high performance, low cost space missions. Spacecraft, landers, and rovers incorporating computers, cameras, batteries, sensors, and motion controllers, will be tested. These are traditionally exotic, slow, and expensive, since they are specialized to endure mechanical shock, vibration, thermal cycling, operation in vacuum, and radiation exposure. This research embarks to develop electronics using commercial components that are cheaper, more accessible, and more powerful.

ENGINEERS WITHOUT BORDERS - PLASTIC THATCH

STUDENTS Emmett Horton *Civil and Environmental Engineering* | Aakash Parekh *Chemical Engineering* | Deepak Ravi *Mechanical Engineering* | David Sparks *Materials Science Engineering* | Stephanie Tjan *Civil and Environmental Engineering* | Julia Tucker *Mechanical Engineering* | Meghana Valluri *Self-defined* | Angela Wu *Civil and Environmental Engineering* | Alexander Yu *Electrical & Computer Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

The primary goal and focus of the PET Thatch project is to design a semi-automated system that will convert waste plastic bottles into reusable plastic pieces for construction material and roofing structures. PET Thatch is divided into 4 main groups: cutting, decontouring, fusing, and roof design. The specific goals of this semester were to create an efficient method for removing the contours from the waste plastic bottles, to build a sample roof for testing purposes, and continue looking for ways to integrate the four groups.

ETCHY: CNC LASER ETCHER

STUDENTS Korey Haug *Mechanical Engineering* | Taylor Hughes *Mechanical Engineering* | Matthew Lee *Electrical & Computer Engineering* | Ryan Oh *Electrical & Computer Engineering*

ADVISOR Bonita Olson *Mechanical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:30 am

Etchy is a CNC Laser Etcher that can take any image and etch it into common materials: balsa, acrylic, etc. This project was originally created as a Build 18 project in one week.

EXTERNAL UNIT FOR RETINAL PROSTHESIS

STUDENTS Shahana Ganesharajah *Mechanical Engineering* | Adriana Garcia *Design* | Stowe Hammarberg *Design* | Meghan Kaffine *Electrical & Computer Engineering*

ADVISOR Shawn Kelly *ICES*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:30 am

Our team is working with Professor Shawn Kelly, Ph.D. from Carnegie Mellon University to develop a retinal prosthesis that can compete with the Argus II on the US market. Our prosthesis will consist of 2 main units, the implant and the external device. The implant will consist of a thin film of electrodes, a copper coil, and a microprocessing chip. It will be placed on the eye through a small incision in the conjunctiva, and implanted on the back of the retina. There, it will use electrical impulses to stimulate the healthy nerve cells of the retina, and deliver 256 pixel vision to patients with severe Age-Related Macular Degeneration and Retinitis Pigmentosa. Though this is a limited number, it is a large step from the Argus II. The external component, which our group is directly responsible for, will consist of a headpiece which will contain a corresponding copper coil and micro camera, a wearable housing unit for the telemetry circuits, processing unit and batteries, a small remote for switching between distant and zoomed in modes, and a charger for the entire prosthesis. The external component will provide power and video feed for the implanted components.

Our prosthesis will differ and improve on the Argus II's concept, by using induction for delivering data and power to the implant, instead of radio frequency, will feature a more attractive and subtle design for everyday wear, and increased pixel resolution.

FIGHTING ANTIBIOTIC RESISTANCE WITH PARALLEL COMPUTING

STUDENT William Ehrett *Electrical & Computer Engineering*
ADVISOR Radu Marculescu *Electrical & Computer Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Antibiotic resistance in pathogens is of growing concern worldwide, particularly in developed countries in which antibiotics have frequently and persistently been overused. In many organisms, antibiotic resistance is realized through the formation of structures called biofilms, which are heavily dependent on network effects and communication among bacteria. We explore computational methods for simulating and analyzing biofilms at previously untenable scales, including structures with millions of individual bacteria. In particular, this work is centered on exploiting the massive parallelism of GPU architectures using CUDA and OpenCL. Our primary application is biofilm simulation and visualization; however, the framework we develop is generalizable to any use case involving systems that can be modeled with interacting particles.

HUMAN ECHOLOCATION

STUDENTS Spencer Barton *Electrical & Computer Engineering* | Rudina Morina *Electrical & Computer Engineering* | Brandon Perez *Electrical & Computer Engineering* | Arley Schenker *Psychology*
ADVISOR Laurie Heller *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:00 am

Echolocation is no longer just for the bats. Humans have the ability to learn this skill too, and for a number of blind people echolocation has already proven itself as a useful navigation tool. However in order for this ability to be useful to the blind community at large the training process needs to become more accessible. Our work begins with the creation of realistic artificial echoes which we used to build a curriculum. We encompass this curriculum in a mobile application.

IMPLEMENTATION OF SECURE JTAG VIA STATISTICAL LEARNING IN CHIP ON AN FPGA

STUDENT Julian Binder *Electrical & Computer Engineering*
ADVISORS Shawn Blanton *Electrical & Computer Engineering* | Donald Thomas *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

IEEE 1149.1, commonly known as the joint test action group (JTAG), is the standard for the test access port and the boundary-scan architecture. The JTAG is primarily utilized at the time of the integrated circuit (IC) manufacture but also in the field, giving access to internal sub-systems of the IC, or for failure analysis and debugging. Because the JTAG needs to be left intact and operational for use, it inevitably provides a "backdoor" that can be exploited to undermine the security of the chip. Potential attackers can then use the JTAG to dump critical data or reverse engineer IP cores, for example. Since an attacker will use the JTAG differently from a legitimate user, it is possible to detect the difference using machine-learning algorithms. A hardware implementation of one of these algorithms is presented. An FPGA was used to mimic the JTAG system of the OpenSPARC T2 microprocessor. Methods are presented for implementation on a development board that allows a physical test of JTAG security.

IMPROVEMENTS TO COMPOSITE SUSPENSION DESIGN AND LOAD DATA ANALYSIS

STUDENTS Joshua Kubiak *Materials Science Engineering* | Christi Martin *Electrical & Computer Engineering*
ADVISOR Robert Heard *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

High levels of pollution and limited energy supplies are increasing the need for more efficient vehicles. By reducing the weight of automotive components without compromising their structural integrity, lighter and more energy efficient cars can be created. The goal of this project is to improve the design of lightweight, composite suspension components for the Carnegie Mellon Racing (CMR) vehicle and to implement a system for the collection of suspension loading data on the car. Computational analysis including FEA will be used to develop stronger suspension components which will be built and tested under tensile loads. In addition, strain gauges will be placed onto cars from past-years in order to obtain more accurate information on the loads experienced by the suspension links and aid in design.

INTEGRATION OF CONDUCTIVE MATERIAL DEPOSITION WITH EXISTING FDM TECHNOLOGY

STUDENTS Shepard Emerson *Electrical & Computer Engineering* | Ruban Kopli *Mechanical Engineering*
ADVISOR David Bourne *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Current advancements in the field of additive manufacturing have enabled low-cost residential printing of various thermoplastics (RepRap, Makerbot) and more recently of circuit boards (EX1). Currently, however, no solutions exist that combine these technologies into a single platform. This project aims to consolidate these two existing solutions in a single prototype platform that will be able to manufacture anything from simple electromechanical components to multi-layer printed circuit boards.

MODULAR WHEEL BASED ELECTRONIC ENCLOSURE

STUDENTS Edwin Cho *Electrical & Computer Engineering* | Jaime Chu *Electrical & Computer Engineering* | Preston Ohta *Mechanical Engineering*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

In lunar exploration and commercialization, success is highly dependent on the development of systems that reduce weight, improve stability, and reduce costs. Our goal is to demonstrate an integrated electronics system embedded within a lunar rover wheel, which will result in an increase in stability by lowering the center of gravity. This system would reduce the need for a heavy chassis, provide enhanced mobility capabilities in rough terrain, and provide a modular mobility and electrical payload solution for extraterrestrial exploration which could consequently lower the cost of rover development.

MULTISENSE

STUDENT Can Yang *Electrical & Computer Engineering*
ADVISOR Louis-Philippe Morency *Language Technologies Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

MultiSense project aims to build the computational foundations that enable computers to understand and participate in social interactions by analyzing and recognizing subtle human communicative behaviors in social interactions. This project will integrate existing technologies to acquire and analyze various information sources in real-time.

NEUROSTIMULATION USING IMPROVED FOCUSING OF ULTRASOUND

STUDENT Ana Cruz *Electrical & Computer Engineering*
ADVISOR Pulkit Grover *Electrical & Computer Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Ultrasound signals have been experimentally known to be able to modulate neuronal activity. The current work is motivated by improving ultrasound focusing so that a larger stimulating signal can be applied only at the desired location, without causing "side-effects" due to high signal amplitudes at other locations. This can used, for instance, for stimulating the neurons in the retina at nearly cellular resolution (e.g. for retinal prostheses), and for modulating neurons in the central nervous system (CNS)1.

Current implementations of focused ultrasound for stimulation largely use the technique of phased-arrays for beamforming signals to a particular point. The strategy has evolved from use of curved-surface ultrasound transducers that tend to focus signals by adjusting phase of ultrasound signals a the transducers, much like a how lens is able to focus waves that are traveling parallel to each other. As a result, the power at the point at which the signal is focused can be boosted relative to power at other points in the interference pattern only by increase in the number of transducers. We call the ratio of these two powers the focusing ratio.

In this paper, we are interested in investigating whether the focusing ratio can be increased keeping the location and the number of the transducers, but changing the signaling strategy. We explore the potential advantage of using "coded" modulattion of a sinusoidal signal in order to increase the focusing ratio. Using appropriate coding, the focusing ratio can be dramatically improved. In fact, this multiplicative improvement diverges to infinity as the number of transducers increases.

Maximizing the focusing ratio is an important issue in ultrasonic neurostimulation. A high focusing ratio means high spatial resolution, which is essential for visual prostheses applications. Improved focusing also reduces the chances of having unwanted high temperatures in the retina during stimulation.

OPTIMIZATION OF A BATTERY POWERED CAR WITH MANOMETER STOPPING MECHANISM

STUDENTS Anna Bandecca *Chemical Engineering* | Jonathan Berman *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Jaewoo Kim *Materials Science Engineering* | Joshua Kubiak *Materials Science Engineering* | Johnathan Roppo *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer 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 and optimize a vehicle that is powered and stopped with the use of chemical reactions, which will require many interdisciplinary skills and techniques. The car will compete in the 2015 American Institute of Chemical Engineers (AIChE) National Chem- E-Car Competition. At the competition, the car will be given a set distance it needs to move as well as a given weight it must bear. A lab-made battery will power the car, and a manometer system will stop the car. Mechanical, electrical, and chemical engineering must be combined with programming, circuitry, and modeling in order to successfully run and stop the car.

The 2015 AIChE National Chem-E-Car Competition is an annual competition in which college students design and build small, shoebox-sized cars that are powered by a chemical energy source and will carry a specified load over a given target distance. For the national competition, we hope to further ensure the stability, reliability, and success of the car.

OPTIMIZATION OF AERODYNAMIC DIRIGIBLE DESIGNS FOR SELF-DETERMINISTIC DELIVERY DRONES

STUDENTS Theodore Lee *Electrical & Computer Engineering* | Victor Yan *Mechanical Engineering* | Sam Zeng *Mechanical Engineering*

ADVISOR Satbir Singh *Mechanical Engineering*

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

In the past few years, there has been significant increase of interest in dirigible (airship) technology. Many companies including Boeing and Northrop Grumman have invested in dirigible research. A few like Raytheon have successfully sold their products which are now being implemented in our nation's defence. Dirigibles are unique in aerospace engineering; they are one of the first means of controlled flight and unlike any other means of flight, they can stay airborne for days. While they are currently used for advertising, tourism, research and military applications, others have begun to look at dirigibles as a means of large cargo transportation. They believe that dirigibles can be used to reach areas that are hard to reach or transport large delicate cargo which would be otherwise difficult to accomplish through conventional means.

Our project aims to discover how a dirigible compares to other other UAVs (unmanned aerial vehicles) currently being developed, namely quadrotors. We believe that dirigibles could be a cheaper, simpler alternative to quadrotors. In addition, we will experiment with the shape of the dirigible to see how a biologically inspired body could aid in its physical properties. Our findings will advance the field by helping to determine the abilities of dirigibles and exploring the possible alternatives to popular research.

OPTIMIZING A BLEACH-BASED CLOCK REACTION USING MATHEMATICAL MODELING

STUDENTS Alexandra Cerny *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Neil Jassal *Electrical & Computer Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Mechanical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Johnathan Roppo *Chemical Engineering*
ADVISOR Aditya Khair *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

The Chem-E-Car competition is a program for collegiate members of the American Institute of Chemical Engineers (AIChE) that revolves around the design and creation of a small chemically powered car. The judging of these cars is based on how accurately and effectively the car can reach a certain distance and stop on the mark within a two-minute time period. The Chem-E-Car Data Acquisition, Transfer, and Analysis, and Bleach Clock subgroups of the Chem-E-Car team are collectively applying for a SURG grant in order to optimize the car to succeed at the National Competition in November 2015.

The team spent the last semester designing and implementing a more modular testing interface for the movement mechanisms for multiple cars, building a new array of sensors, and beginning automation of chemical injection. Faster testing procedures were also initially developed by integration of wireless Bluetooth data transfer to the Arduino microcontrollers. The team also developed a system for computer-automated chemical injection, or "autoinjection," to increase accuracy of the run during competition.

The team has decided to use a new stopping mechanism consisting of bleach and a disodium salt after complications arose last semester with each component of the store-bought dye reacting at different stages. After a successful semester of testing the bleach-food dye stopping mechanism, the team will continue to improve upon this process to create an accurate data curve that can be utilized for the competition. The measurements from the resulting time trials of this reaction have been recorded and are currently being used in the process of modeling the data. The goals for this semester will be to observe the effects of stirring speed on the kinetics of the bleach reaction to limit its impact on the times of our reaction.

ORIGAMI LED SCREEN

STUDENT Leanna Pancoast *Electrical & Computer Engineering*
ADVISOR James Bain *Electrical & Computer Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:45 am

I will explore the possibility of a foldable computer screen by experimenting with smaller LED screen modules and hinges to make a collapsible LED screen. I wish to implement a crease pattern called a Miura-ori fold to develop a LED screen that is able to open and close with a simple motion. Over the summer I will experiment with different hinge designs and electrical connections to make the screen possible.

PROVIDING NEW BUSINESS ANALYTICS THROUGH GEOTAGGED SOCIAL MEDIA DATA

STUDENT Dong Hyun Choi *Electrical & Computer Engineering*
ADVISOR Jason Hong *Human Computer Interaction Inst.*
ROOM/TIME Rangos 3 / 12-2:30 pm

People have increasingly been creating geotagged social media data through platforms such as Twitter, Foursquare, and Flickr. This project shows how geotagged social media data can provide new ways for performing business analysis. Based on a specific store location, we could find where visitors tended to stop by before or after visiting the store, what the average revisiting rate for the store was, which neighborhood was most popular with the site, and at which time the store was most crowded. The project concludes by showing how these data sets can potentially help small-sized businesses who could not afford traditional business analytics tools.

PUNITIVE DAMAGES AND DETERRENT EFFECT OF FINANCIAL REGULATIONS

STUDENT Arushi Chawla *Electrical & Computer Engineering*
ADVISOR Joachim Groeger *Economics*
ROOM/TIME Wright / 1:20 pm

Post the financial crisis of 2008, Wall Street has become the subject of intense scrutiny at the hands of regulators and government agencies. While on one hand, the main reasons behind the crash were attributed to the "Too Big To Fail" thought-process of global banks as well as insufficient supervision by agencies, the aftermath of the crisis has seen some important legislations, particularly the Dodd Frank Act, come into play. These laws are a necessity for Washington, but an impediment for investment banks. Hence, it becomes imperative to address the question of "Over-regulation of Wall Street activities."

The said statement is broad and encompasses many provisions of the Dodd Frank Act. My thesis would focus specifically on the Volcker Rule, which restricts American banks from making certain speculative investments that do not benefit their clients. The act specifically prohibits a bank or an institution that owns a bank from engaging in proprietary trading that is not at the behest of its clients, and from owning or investing in a hedge fund or private equity fund, and also limits the liabilities that the largest banks can hold. Under discussion is the possibility of restrictions on the way market-making activities are compensated; traders would be paid on the basis of the spread of the transactions rather than any profit that the trader made for the client.

QUANTIZER DESIGN FOR CONTINUOUS-TIME SIGMA-DELTA ADC

STUDENT Andrew Mort *Electrical & Computer Engineering*
ADVISOR Jeyanandh Paramesh *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Wireless radios have become an integral part of the devices that we rely on everyday. From cell phones to laptop computers and even small sensor networks, more and more devices are being created with wireless capabilities. Unfortunately, these wireless radios, and the processing associated with them, contribute to a large portion of the power consumption in many modern devices. While there is a great push to reduce the power consumption in these systems, new wireless specifications are demanding higher bandwidths and better signal quality, both of which

typically require increased power consumption. My research is focused on the analog to digital converter (ADC), which is present right after the wireless radio in the signal chain. The ADC is responsible for converting the received wireless signal into the digital form that the rest of the system can use. Specifically, I am working on the design and implementation of a comparator and DAC cell for use in a continuous-time sigma-delta ADC. Many sigma-delta ADCs use a method called dynamic element matching (DEM), which is used to convert harmonics in the output, due to nonlinearity in the feedback DAC, to random noise. However, the DEM logic is in the critical path, between the comparator and the DAC, and can increase the delay of the feedback loop, potentially introducing several problems. My research is looking at creating a comparator and DAC cell that can be selected and placed at a different threshold value for each clock cycle. This will still provide the DEM to randomize the signal harmonics, but it will also remove it from the critical path, since the next thresholds can be generated while the current comparison is taking place.

ROBOMOUTH

STUDENT David Lu *Electrical & Computer Engineering*
ADVISOR Thomas Sullivan *Electrical & Computer Engineering*
ROOM/TIME McConomy Auditorium / 1:30-2 pm

The RoboMouth is a singing robotic mouth. It is a timbre-based robotic musical instrument, based on the human vocal tract. In this performance, I will demonstrate the instrument and use it to perform several pieces inspired by throat singing and electronic dance music.

ROBUST PHYSIOLOGICALLY-BASED SPEECH RECOGNITION

STUDENT Michael Kellman *Electrical & Computer Engineering*
ADVISOR Richard Stern *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Models for robust speech recognition over the years have considered several approaches which are based on physiological models to improve upon speech recognition accuracy. Improvements in speech recognition are quantified as increases in speech recognition accuracy in the presence of increasing background noise, decreasing signal quality, and under the presence of reverberation in the source environment. A common physiologically-motivated model for the auditory cortex is commonly represented as a bank of linear filters with varying characteristic frequency and bandwidths. A more novel physiological model is to represent cycle-by-cycle synchrony in the response of low-frequency auditory-nerve fibers. These measures of cycle-by-cycle timing have been shown to provide more robust features than the more common features given by Mel frequency cepstrum coefficients. This synchrony technique in addition to techniques of mean rate analysis on a set of higher frequencies will give a set of features similar to cepstra.

SIGNAL PROCESSING IN MICROSCOPE CONSTRUCTION

STUDENT John Wen-Hao Lee *Electrical & Computer Engineering*
ADVISOR Aswin Sankaranarayanan *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

One of the aims of this project is to build a simple digital microscope that can take high quality images while using cheap optics. While traditional microscopes make use of multiple lenses to correct for artifacts that are present in the image, one of the goals of this project is to replicate the quality of such complex lens assemblies with simpler optics and image processing algorithms to correct for distortions and aberrations.

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*
ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

THE STAND ALONE BRAILLE TUTOR

STUDENT Vivek Nair *Electrical & Computer Engineering*
ADVISOR Mary Bernardine Dias *Robotics Institute*
ROOM/TIME Rangos 3 / 12-2:30 pm

The Stand Alone Braille Tutor (SABT) is a battery-powered device that students can use to learn how to write in braille through automated exercises and educational games. The device provides user instructions through headphones or speakers and can be used with 3 interchangeable user boards depending on the user's level of proficiency. The SABT has been co-developed and user-tested in partnership with teachers and students at Mathru School for the Blind, Bengaluru, India where it has been integrated into the curriculum.

TORQUE VECOTRING FOR AN RWD INDEPENDENT WHEEL DRIVE ELECTRIC VEHICLE

STUDENTS Shepard Emerson *Electrical & Computer Engineering* | Noah Simms-Levy *Mechanical Engineering* | Omar Skalli *Electrical & Computer Engineering*

ADVISOR Koushil Sreenath *Mechanical Engineering*

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

Most recent road vehicles automatically control the brakes to improve traction and handling. This includes a number of systems such as anti-lock brakes, traction control, and brake-based differentials. While effective, the brake system can only control the vehicle so much without using the drivetrain. Most cars do not have an engine or differential capable of actively modulating torque and power to different wheels, and thus do not have full control capability. However, as electric vehicles with multiple motors and electronic differentials start to permeate the market, a new set of possibilities for controls opens up. The Carnegie Mellon Racing (CMR) electric vehicle provides an opportunity to develop control systems for the dual motor drivetrain that will allow for enhanced traction, safety, and fast-reacting handling in a way that a conventional car cannot match. While some automotive companies are starting to release products that use these systems, they are still rare. This research will help to advance a system that can be used to improve vehicle handling and stability for racecars and everyday vehicles.

UTILIZING ELECTRON BEAM MELTING TO BUILD MASS-OPTIMIZED, HIGH STRENGTH PARTS FOR HIGH PERFORMANCE ELECTRIC VEHICLES UTILIZING ADDITIVE MANUFACTURING SPECIFIC MASS REDUCTION TECHNIQUES

STUDENTS Sascha Demetris *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Theodore Lee *Electrical & Computer Engineering* | Eric Reeder *Mechanical Engineering*

ADVISORS Philip LeDuc *Mechanical Engineering*

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

With the advent of high efficiency hybrids as well as mature electric vehicles, saving weight is more critical than ever for increasing range and reducing energy consumption in the hyper-efficient vehicles of the future. Lightweight vehicles improve efficiency and allow for better vehicle dynamics and handling. To this end, this project will investigate the use of an Arcam S12 Electron Beam Melting (EBM) machine to additively manufacture multiple small, structural parts out of Titanium. The control afforded by EBM manufacture allows the creation of hollow and lattice structures that cannot be created by traditional machining. These structures are lighter than traditional, solid aluminum parts but still provide adequate strength and stiffness. Several parts will be manufactured by EBM and tested for Carnegie Mellon Racing's 2014-2015 Electric Vehicle.

ENGINEERING AND PUBLIC POLICY

MEASURES OF SPECTRUM HOLDINGS THAT REFLECT MARKET SHARE AND CONCENTRATION AMONG CELLULAR CARRIERS

STUDENT Nicholas Tan *Engineering and Public Policy*
ADVISOR Jon Peha *Engineering and Public Policy*
ROOM/TIME Rangos 3 / 12-2:30 pm

Regulators in most countries limit the amount of spectrum that a carrier is allowed to obtain as a way of reducing the risk that rival cellular carriers will be unable to obtain the spectrum they need to compete effectively. Spectrum holdings of a carrier in a given market are typically measured simply by considering the total bandwidth. However, it is not clear that total bandwidth of a carrier is the most useful measure, as the relationship is indirect between a carrier's total bandwidth and the capacity that the carrier can offer at a given infrastructure cost.

First, a measure of total bandwidth does not consider the frequencies of the spectrum held, although frequency affects the cost of building out infrastructure in that spectrum. Second, there are reasons to believe that a carrier's capacity is not linear with respect to the total bandwidth of its spectrum holdings.

My project empirically investigates whether these effects are apparent in cellular markets all across the U.S. by examining the relationship between concentration of market share, which should be closely tied to number of customers served and therefore capacity, and the concentration of spectrum holdings using a variety of different measures to quantify spectrum holdings.

MATERIALS SCIENCE ENGINEERING

CARNEGIE MELLON'S GLOBAL MEDICAL BRIGADES GOES TO NICARAGUA

STUDENTS Neil Carleton *Chemical Engineering* | Nadia Florman *Mechanical Engineering* | Tiffany Fu *Materials Science Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Megan Pudlo *Biomedical Engineering* | Anna Zhang *Chemical Engineering*
ADVISOR Jason D'Antonio *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This year, Global Medical Brigades engineering students received a CIT travel grant to visit rural Nicaragua over Spring Break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and explores sanitation and environmental engineering applications that are vital to developing countries.

CHARACTERIZATION OF ELECTRICAL CONTACTS TO WS2

STUDENTS Jenifer Hajzus *Materials Science Engineering* | Rekha Schnepf *Materials Science Engineering*
ADVISOR Lisa Porter *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Atomically thin films, commonly referred to as 2D materials, have recently become of interest to materials researchers due to their unique electrical, optical, chemical, and mechanical properties. 2D materials have the potential to be used for a range of applications, such as high speed computing. One such material is tungsten disulfide (WS2), which is a semiconducting material with a thickness-dependent bandgap, and a layered structure that can be easily exfoliated. However, some challenges with respect to these materials are the inability to produce low-resistance electrical contacts and the difficulty in creating large area films of them. In this project we characterized and compared Ti, Ni, and Mo metals as low-resistance ohmic contacts to WS2 bulk crystals. Estimates of contact resistances for each metal will be reported, as will our results on deposited WS2 films.

DESIGNING AND IMPLEMENTING AN ENZYMATIC FUEL CELL CAR

STUDENTS Joetsaroop Bagga *Chemical Engineering* | Isaiah Edmonds *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Joshua Kubiak *Materials Science Engineering* | Rinko Maeshima *Chemical Engineering* | Johnathan Roppo *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 the current energy crisis, alternative fuel is an active area of research worldwide. In an attempt to learn more about and potentially implement a greener approach to this issue, our group has been actively testing and improving upon the design of an enzymatic fuel cell. The purpose of our ongoing project is to construct a fuel cell powered by the oxidation of maltodextrin by glucose oxidase coupled with the reduction of potassium permanganate. Our goal is to optimize the power generated by multiple fuel cells in series to produce output capable of powering a VEX motor for national ChemE Car competitions.* These competitions require the motor to produce at least 1.1 Watts of power. Our research attempts to determine whether enzymatic reactions are a viable source of power given increasing energy demands in the 21st century.

Over the last year and a half, we have researched and refined possible approaches and constraints to this project, making immense progress in the Spring 2015 semester by constructing and testing a prototype fuel cell (see Figure 1). We measured and compiled data via Arduino to construct power curves (see Figure 2). Our design successfully generated consistent voltage outputs with magnitudes comparable to those of other enzymatic fuel cells in present-day research. These results have encouraged us to continue testing and optimizing the concentrations of the reactants in the cell and thus optimize the generated power. Over the semester we also plan to develop a correlation between glucose concentration and power output through experimentation. Finally, we plan to establish conclusions on the feasibility of our design with respect to our required power needs.

DEVELOPMENT OF A LOW-COST SPINAL ORTHOTIC FOR SCOLIOSIS

STUDENTS Seth Cordts *Mechanical Engineering* | Olivia Dippo *Materials Science Engineering* | Lucas Friedman *Materials Science Engineering* | Cherry Park *Chemical Engineering* | Juan Portela *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

Bracing has been proven to prevent the progression of scoliosis. This can prevent the need for surgery and improve the quality of life of the patient inflicted by scoliosis. However, because of the shape of the torso and types of scoliosis vary from person to person, current braces are made custom to each individual and are very expensive to purchase. We aim to create a brace for scoliosis that can be adjusted for multiple users and could eventually be manufactured in large quantities to reduce the cost. This device will consist of rigid components as well as a strapping system to apply the required three point loads to adjust the scoliosis. We will design the brace to be as effective as current braces while being more comfortable and cost effective. This will make it easier for humanitarian organizations to buy this brace and supply it to developing countries that lack the funds and resources to purchase their own brace.

ELECTROCHEMICAL CARBON DIOXIDE REDUCTION USING NANOCARBONS

STUDENT Manali Banerjee *Materials Science Engineering*

ADVISOR Tomasz Kowalewski *Chemistry*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:00 am

Carbon dioxide (CO2) emission from fuel combustion has had increasing harmful impacts on the environment leading to the focus of electrochemical research on CO2 reduction into renewable fuels. While this has been conducted using a platinum/pyridine co-catalyzed system, the use of an inexpensive yet efficient carbon-based material is considered a potentially attractive alternative. The long term goal of this field is to find a practical way to reduce CO2 while creating a viable fuel such as methanol and formate. The presentation will describe the attempt to catalyze CO2 reduction using copolymer templated nitrogen enriched nanocarbons (CTNCs).

These materials, previously synthesized in the Kowalewski lab, have shown success in replacing platinum in other catalytic reactions, such as oxygen reduction reactions (ORR), and show promise as a viable pathway for CO2 reduction. The research involves pyrolyzing these CTNCs, applying them to electrochemical CO2 reduction, and optimizing reaction conditions such that atmospheric CO2 can be converted to a usable fuel.

ENGINEERS WITHOUT BORDERS - PLASTIC THATCH

STUDENTS Emmett Horton *Civil and Environmental Engineering* | Aakash Parekh *Chemical Engineering* | Deepak Ravi *Mechanical Engineering* | David Sparks *Materials Science Engineering* | Stephanie Tjan *Civil and Environmental Engineering* | Julia Tucker *Mechanical Engineering* | Meghana Valluri *Self-defined* | Angela Wu *Civil and Environmental Engineering* | Alexander Yu *Electrical & Computer Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

The primary goal and focus of the PET Thatch project is to design a semi-automated system that will convert waste plastic bottles into reusable plastic pieces for construction material and roofing structures. PET Thatch is divided into 4 main groups: cutting, decontouring, fusing, and roof design. The specific goals of this semester were to create an efficient method for removing the contours from the waste plastic bottles, to build a sample roof for testing purposes, and continue looking for ways to integrate the four groups.

EXPLORING LOW ENERGY METHODS OF DECONTOURING WASTE PLASTIC BOTTLES TO CREATE UNIFORM PLASTIC RIBBON MATERIAL

STUDENTS Kenneth Chin *Materials Science Engineering* | David Sparks *Materials Science Engineering*
ADVISORS Robert Heard *Materials Science Engineering* | Bryan Webler *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

In the context of reusing plastic bottles, the research question is: What is the most efficient and effective way to decontour PET plastic bottles? The goal of decontouring is to eliminate the curvature of plastic bottles so that they are flat plastic sheets ready for reuse. The method in which this will be accomplished is by heating the plastic and then passing it through a set of rollers. The research will be conducted by an iterative design method informed by consultation with my sponsoring professors and my reading of the literature on PET plastic. We will systematically test different set ups of rollers by varying their material and quantity, and then by varying the conditions applied to the plastic, such as the temperature, tension, and pressure. By analyzing this data, we can find which combination of factors yields a decontouring method that is both cost effective and energy efficient.

GALLIUM ARSENIDE BAND STRUCTURE CALCULATIONS USING DENSITY FUNCTIONAL THEORY METHODS

STUDENT Julia Yang *Materials Science Engineering*
ADVISOR Elias Towe *Electrical & Computer Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:00 am

Gallium arsenide (GaAs) is a III-V compound semiconductor with high electron mobility and low heat conductivity compared to that in silicon. Its wide, direct band gap is useful in optical devices such as solar cells and laser diodes because of its ability to efficiently absorb and emit light. While GaAs is not as popular as silicon as a semiconductor material due to high manufacturing costs, it is critical in applications that require ultra-high frequency transmission and fast switching. In this work, we use density functional theory to calculate the band structure for one-dimensional bulk silicon and two-dimensional GaAs in order to fundamentally understand their differences in electronic and optical properties. Comparison to previous work shows good agreement and provides a basis for future investigation in other two-dimensional materials.

HIGH TEMPERATURE LEAD-FREE SOLDER MAGNETIC REFLOW

STUDENT Alex Chen *Materials Science Engineering*
ADVISOR Michael McHenry *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

It has been shown previously that lead free solders used in electronic packaging are promising alternatives to the traditional Pb-Sn solders. This is accomplished by applying an AC field through solder + magnetic nanoparticle composites for localized heating. Previous work done in Professor McHenry's research group has involved applications in high temperature MNP and Sn-Ag-Cu solder composites, with support from SRC and Intel. Wright Patterson Air Force Base has expressed interest in the development of high entropy alloys for lead-free solder reflow processes. Collaborating with them, we are working to develop a new high temperature solder composite based on Zn-Al-Cu. So far, it has been shown that zinc loss is prevalent due to the low vaporization temperature,

while strategies on casting a sample that is compositionally accurate are underway. Once an alloying technique is developed, further investigation on MNP interactions with the solder will be determined.

IMPROVEMENTS TO COMPOSITE SUSPENSION DESIGN AND LOAD DATA ANALYSIS

STUDENTS Joshua Kubiak *Materials Science Engineering* | Christi Martin *Electrical & Computer Engineering*
ADVISOR Robert Heard *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

High levels of pollution and limited energy supplies are increasing the need for more efficient vehicles. By reducing the weight of automotive components without compromising their structural integrity, lighter and more energy efficient cars can be created. The goal of this project is to improve the design of lightweight, composite suspension components for the Carnegie Mellon Racing (CMR) vehicle and to implement a system for the collection of suspension loading data on the car. Computational analysis including FEA will be used to develop stronger suspension components which will be built and tested under tensile loads. In addition, strain gauges will be placed onto cars from past-years in order to obtain more accurate information on the loads experienced by the suspension links and aid in design.

InGaN MATERIALS FOR UNDERWATER PHOTOVOLTAIC CONVERSION

STUDENTS Luis Hernandez Cazares *Mechanical Engineering* | Allison Perna *Materials Science Engineering*
ADVISOR Robert Davis *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 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).

INVESTIGATION OF PHASE SEPARATION IN MULTICOMPONENT PARTICLE BRUSH THIN FILMS FOR QUANTUM DOT PROCESSING APPLICATIONS

STUDENT Joshua Kubiak *Materials Science Engineering*
ADVISOR Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The battery life of mobile devices and the efficiency of general consumer electronics can be improved by developing more efficient screens. A promising method for increasing efficiency is the incorporation of quantum dot (QD) layers into backlights or primary-screens which can be electrically or photonically excited and provide more precise

control over color than existing methods (i.e. phosphors). The application of QD to screens is currently limited by processing as there is no facile method for the microscale arrangement of QDs into laterally defined regions of different wavelengths. Having control over QD arrangement is necessary to produce uniform, white light for backlights and to produce small pixels for primary-screens. The goal of this project it to investigate the possibility of extending the phase separation behavior exhibited in polymer blends to QD applications. Recent progress in controlled radical polymerization (CRP) techniques allows particle surfaces to be modified by grafting polymer chains from the surface. CRP can be utilized to graft chemically dissimilar polymer chains from QDs of different colors to potentially impart characteristic polymer phase separation behavior to create microdomains of suitable character for screen and backlighting applications. The aim of the present study is to analyze phase separation in model polymer grafted silica nanoparticle systems using homopolymer thin films as a control. Variations in annealing conditions and particle blend composition will be explored to create a versatile method for controlling domain formation. If positive results are obtained, this project will be extended to QDs.

MODIFIED INHALER ADAPTER

STUDENTS Morgan Fritz *Design* | Conor McGuire *Materials Science Engineering* | Jessica Uphoff *Design* | Thomas Vandenberg *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

My team is working with Dr. Philip Zapanta on project M.I.A. There are over a million patients diagnosed with a neuromuscular disease and over 500 million people over the age of 65 around the world. Many of these patients have difficulty using a standard inhale due to its design where one must apply all the force on a very small contact area. These individual usually require assistance to operate these inhalers.

M.I.A. or Modified Inhaler Adapter solves this problem by designing and ergonomic and easy to use inhaler that can be attached to the modern medication canisters for inhalers. Our design incorporates a two side wedge system where patients can use their whole hand to active the inhaler instead of just one finger. M.I.A. will help millions of people get the medication they need.

NANOPERM CRYSTALLIZATION IN SINGLE GRAIN SIZED NANOPARTICLES

STUDENT Eli Zoghlin *Materials Science Engineering*

ADVISOR Michael McHenry *Materials Science 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 overwhelming core losses is being driven by a push for more efficient electrical motors and power grid technologies (e.g power converters and transformers). NANOPERMTM and other amorphous nanocomposites, which consist of a metallic glassy matrix rich in glass forming elements surrounding nano-scale crystalline particles, are emerging to fill this niche. In this work crystallization of amorphous NANOPERMTM powders with nanometer-sized grains only slightly larger than the nanocomposite's crystallites was carried out. The powders were attained by cryogenic milling melt spun cast ribbon to avoid crystallization and maintain the amorphous state, and a differential scanning calorimeter (DSC) was used to induce and measure crystallization in the powder. Crystallization in this system is controlled by the diffusion of the glass forming elements so nanocrystallites and their immediately surrounding matrix tend to form

a core-shell structure, with the ratio of core to shell size of the particles having a large impact on electrical resistivity and magnetic induction, both important materials properties. Because of this crystallization mechanism, the nano-scale powder limits nucleation site density to ~1 crystalline particle per powder grain, thus diminishing the effects of soft-impingement from particles' overlapping diffusion fields and offering a unique perspective of this crystallization process. Results are considered in light of existing chemical partitioning models, chemical analysis, and a sequence of mass balances for the system.

OPTIMIZATION OF A BATTERY POWERED CAR WITH MANOMETER STOPPING MECHANISM

STUDENTS Anna Bandecca *Chemical Engineering* | Jonathan Berman *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Jaewoo Kim *Materials Science Engineering* | Joshua Kubiak *Materials Science Engineering* | Johnathan Roppo *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer 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 and optimize a vehicle that is powered and stopped with the use of chemical reactions, which will require many interdisciplinary skills and techniques. The car will compete in the 2015 American Institute of Chemical Engineers (AIChE) National Chem- E-Car Competition. At the competition, the car will be given a set distance it needs to move as well as a given weight it must bear. A lab-made battery will power the car, and a manometer system will stop the car. Mechanical, electrical, and chemical engineering must be combined with programming, circuitry, and modeling in order to successfully run and stop the car.

The 2015 AIChE National Chem-E-Car Competition is an annual competition in which college students design and build small, shoebox-sized cars that are powered by a chemical energy source and will carry a specified load over a given target distance. For the national competition, we hope to further ensure the stability, reliability, and success of the car.

OPTIMIZING A BLEACH-BASED CLOCK REACTION USING MATHEMATICAL MODELING

STUDENTS Alexandra Cerny *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Neil Jassal *Electrical & Computer Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Mechanical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

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

The Chem-E-Car competition is a program for collegiate members of the American Institute of Chemical Engineers (AIChE) that revolves around the design and creation of a small chemically powered car. The judging of these cars is based on how accurately and effectively the car can reach a certain distance and stop on the mark within a two-minute time period. The Chem-E-Car Data Acquisition, Transfer, and Analysis, and Bleach Clock subgroups of the Chem-E-Car team are collectively applying for a SURG grant in order to optimize the car to succeed at the National Competition in November 2015.

The team spent the last semester designing and implementing a more modular testing interface for the movement mechanisms for multiple cars, building a new array of sensors, and beginning automation of chemical injection.

Faster testing procedures were also initially developed by integration of wireless Bluetooth data transfer to the Arduino microcontrollers. The team also developed a system for computer-automated chemical injection, or "autoinjection," to increase accuracy of the run during competition.

The team has decided to use a new stopping mechanism consisting of bleach and a disodium salt after complications arose last semester with each component of the store-bought dye reacting at different stages. After a successful semester of testing the bleach-food dye stopping mechanism, the team will continue to improve upon this process to create an accurate data curve that can be utilized for the competition. The measurements from the resulting time trials of this reaction have been recorded and are currently being used in the process of modeling the data. The goals for this semester will be to observe the effects of stirring speed on the kinetics of the bleach reaction to limit its impact on the times of our reaction.

PERFORMANCE OF NANOCOMPOSITE SOFT MAGNETIC MATERIALS IN ELECTRIC MOTORS

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

This project addresses the potential for a newly developed Co-based nanocomposite material HTX005C™ to be used in the rotor and stator of an electric induction motor. Previous studies have shown that using this new material would allow significant size and rare earth reduction in hybrid electric motors, allowing motors to be more efficient and less expensive. Finite element analysis has also shown that this material would be able to withstand the stresses in a motor and is capable of producing lower losses than Si steel. In this project, a RC plane motor with a silicon steel stator is compared to a prototype of the same motor, but with a stator made of a HTX005C. Performance based on constant speed, constant power input, and maximum power input are compared between the 2 motors to show benefits of using this new material over conventional Si steel.

RENEWABLE RESOURCE POLYMER NANOCOMPOSITE MATERIALS

STUDENT Blair Graham *Materials Science Engineering*
ADVISORS Chetali Gupta *Materials Science Engineering* | Newell Washburn *Chemistry*
ROOM/TIME Rangos 3 / 12-2:30 pm

Lignin is a natural polymer that is responsible for strengthening tree trunks and is a byproduct of bleached paper manufacturing. Lignin, a renewable resource, has been embedded in amorphous Poly-L-Lactide to improve the mechanical properties. A consistent preparation process of this nanocomposite has been developed and mechanical testing has been performed to investigate its effect on tensile strength, toughness, and elasticity. In the future, its effect on conductive properties will be examined.

SIMULATION OF STRESS CONCENTRATION WITH A FAST FOURIER TRANSFORM MODEL

STUDENT Shiqi Fu *Materials Science Engineering*
ADVISOR Anthony Rollett *Materials Science Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Computational models have been widely used in research and development. Once a model is successfully constructed and proven accurate, it can greatly reduce the cost of research compared to conventional experiments. At the same time, with the drastic increase in computational power every year, computer simulations can conduct experiments on a magnitude that is infeasible to traditional methods. The goal for this project is to model the mechanics of the stress concentration at a crack tip in different loading modes and compare to the theoretical calculations (Hertzberg). Our approach to the problem is to use an existing FFT (Fast Fourier Transform) model first originated from Moulinec and Suquet and further developed by Lebensohn. By introducing elliptical cracks to the simulation with different sizes and curvatures, the mechanical behaviors of the material are analyzed in both anisotropic and isotropic settings. The simulations with isotropy under the elastic regime have shown high resemblance in terms of the shape of the stress contour plots. The minimized error between the simulation and the theory has been found to be approximately 20% for a particular set of parameters that characterizes the elliptical crack. The source of the error has been primarily attributed to the periodic nature of the model, in which the model assumes infinite dimensions with periodicity whereas the theory only assumes infinite dimensions. Future research may involve the optimization of the model and understanding of the stress concentration under the plastic and elastic-plastic regimes so that the characterization of the plastic zone and crack propagation can be possible.

STRUCTURE PROPERTY RELATIONSHIPS IN PRUSSIAN BLUE TYPE MATERIALS FOR GRID SCALE ENERGY STORAGE

STUDENT Catherine Groschner *Materials Science Engineering*
ADVISOR Jay Whitacre *Materials Science Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

One of the critical needs in making clean energy sources competitive with current non-renewable sources is the ability to cheaply provide a base-load power supply. The problem faced by most renewables is that their power output is necessarily intermittent by nature. As the use of intermittent power sources, such as wind and solar, grows, having methods of storing excess energy during peak production periods and providing energy during off-production periods will be critical. This problem emphasizes the need for cost-efficient grid-scale energy storage solutions. Prussian Blue analogue materials are a promising solution. Prussian Blue analogue materials have the benefit of having an open framework crystal structure and large interstitial sites which allows for little strain on the lattice and fast intercalation. Copper hexacyanoferrate is a Prussian Blue analogue, intercalation material with a cubic open framework structure formed by hexacyanometallate (R(CN)6) and transition metal cations having 6 fold coordination with nitrogen. Here we present a systematic study on how synthesis conditions affect the efficiency and capacity of copper hexacyanoferrate. Since the material relies on the ability to insert sodium ion species into the interstitial sites, increasing the crystallinity should enhance capacity and minimize energy barriers to intercalation.

THE EFFECT OF ANNEALING TEMPERATURE ON PHASE SEPARATION IN TWO-COMPONENT POLYMER-GRAFTED NANOPARTICLE FILMS

STUDENT Kimberly Justl *Materials Science Engineering*
ADVISOR Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Grafting particle chains from nanoparticles allows for control over their surface properties. Interparticle interactions in these particles have been shown to be largely controlled by the polymer chains. Mixtures of chemically distinct polymer chains usually phase separate into distinct regions. We are interested in seeing if the same phenomenon occurs with polymer-grafted nanoparticles. This effect would be very useful for applications that would require different nanoparticles to be "sorted" into discrete regions, such as the creation of quantum dot-based displays. The goal of this project is to determine the effect of annealing temperature on the phase behavior of these particles. This study uses nanoparticles with a diameter of 15nm that have been grafted with either poly(methyl methacrylate) (PMMA) or poly(styrene)(PS). Films containing a 50/50 mixture of the two types of particle are spin-coated and then annealed for 24h at varying temperatures ranging from 120-200C. The films will then be imaged using atomic force microscopy and compared to homopolymer PMMA/PS films in order to determine the effect that the nanoparticles have on domain formation. This work will help us to understand how to tailor the domains produced for a particular application.

UNDERSTANDING EFFECTS OF MANUFACTURING ON MATERIAL PROPERTIES IN BLOOD PLASMA-BASED BIOMATERIALS

STUDENT Irini Sotiri *Materials Science Engineering*
ADVISOR Phil Campbell *ICES*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Physicians in orthopedic and sports medicine are always looking for better ways to heal musculoskeletal injuries. A new controversial therapy uses injected autologous concentrated platelet-rich plasma (PRP) to accelerate natural healing by harnessing the native regenerative factors within blood plasma and platelets to direct tissue repair. However, PRP injections have had variable clinical outcomes, and are not simple, offtheshelf solutions. They discard large quantities of useful plasma, and are too readily adsorbed into the body.

Carmell Therapeutics Corp. has developed solid, biologically active materials called plasmabased biomaterials (PBMs) that are blood plasmabased bioplastics made from pooled allogenic plateletrich blood plasma. They address many of the issues with PRP injections, and can act as localized drug delivery systems that provide effective longterm dosing, while enhancing the body's ability to heal naturally.

However, questions remain about the behavior of PBM components during processing. It is possible that proteins within the PBM can be manipulated during PBM formation to affect the biomaterial properties (strength, swelling, growth factor release, etc.). This project explores the behavior of three fluorescently labeled abundant plasma proteins (BSA, IgG, and Fbn) during compression molding at 50, 60, and 70°C. Protein and salt localization within the PBMs was evaluated via fluorescence imaging and SEM, respectively, and material properties (tensile strength and swelling) in protein-rich and -poor regions were compared. This examination is a necessary step in understanding how the properties of the biomaterial might be tailored for specific regenerative applications in the future.

UTILIZING ELECTRON BEAM MELTING TO BUILD MASS-OPTIMIZED, HIGH STRENGTH PARTS FOR HIGH PERFORMANCE ELECTRIC VEHICLES UTILIZING ADDITIVE MANUFACTURING SPECIFIC MASS REDUCTION TECHNIQUES

STUDENTS Sascha Demetris *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Theodore Lee *Electrical & Computer Engineering* | Eric Reeder *Mechanical Engineering*

ADVISOR Philip LeDuc *Mechanical Engineering*

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

With the advent of high efficiency hybrids as well as mature electric vehicles, saving weight is more critical than ever for increasing range and reducing energy consumption in the hyper-efficient vehicles of the future. Lightweight vehicles improve efficiency and allow for better vehicle dynamics and handling. To this end, this project will investigate the use of an Arcam S12 Electron Beam Melting (EBM) machine to additively manufacture multiple small, structural parts out of Titanium. The control afforded by EBM manufacture allows the creation of hollow and lattice structures that cannot be created by traditional machining. These structures are lighter than traditional, solid aluminum parts but still provide adequate strength and stiffness. Several parts will be manufactured by EBM and tested for Carnegie Mellon Racing's 2014-2015 Electric Vehicle.

MECHANICAL ENGINEERING

A MULTIDISCIPLINARY STUDY INVOLVING THE EFFECT OF ELECTROSTATIC FORCES ON SEMICONDUCTOR POLISHING

STUDENT Graham Sides *Mechanical Engineering*

ADVISOR Cecil Higgs *Mechanical Engineering*

ROOM/TIME Pake / 12:20 pm

Testing the effect of electrostatic forces on material removal rate in Chemical Mechanical Planarization (CMP) will yield conclusive results that will streamline the CMP process. CMP is a hybrid of chemical and mechanical processes in which a surface is polished in order to generate a flat profile and discover appropriate connecting points for further layers. CMP is an extremely important step implemented many times during the making of a single chip. Material removal rate is a key factor in the cost of processing. By changing the adsorbing power of various abrasive particles to a wafer, the electrostatic forces are varied in the process of material removal once the wafer is inserted into the CMP device. By comparing weights before and after polishing, the improvement of material removal rate can be derived. Over the course of the summer, I plan to learn and master the technique of running a CMP process and collect data to sharply improve the process.

AN INVESTIGATION OF THE WEAR OF POLYCRYSTALLINE DIAMOND COMPACT CUTTERS AND HARD ROCK SURFACES

STUDENT Jeffrey Cole *Mechanical Engineering*
ADVISOR Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

With more than $320 billion in revenue in the United States alone, the oil drilling and gas extraction industry is an enormous piece of the global economy. Polycrystalline Diamond Compact (PDC) cutters revolutionized the industry upon their first production in 1976 and have grown steadily in popularity ever since. These PDC bits range from $8,000-$45,000 in cost, and generally require replacement every few hours of drilling, due to high levels of wear after long periods of frictional heating. As a result, these PDC drill bits are largely the most expensive operational cost for an oil or gas rig. This study closely follows existing work in the field by investigating the interaction between single PDC cutters and actual rock samples in the presence of industrial drilling muds. Tests were conducted on Nugget Sandstone, Mancos Shale, and Carthage Marble samples using a Bruker CETR UMT-32 Universal Tribometer and a single PDC cutter. Three industrial drilling muds were incorporated into testing for comparison with to data from earlier tests involving both dry and water lubricated cutting conditions.The results of this research include an analysis of the effect of drilling muds on the rate-of-penetration, frictional force, and debris formation in the interface between the rock and the cutter.

CARNEGIE MELLON'S GLOBAL MEDICAL BRIGADES GOES TO NICARAGUA

STUDENTS Neil Carleton *Chemical Engineering* | Nadia Florman *Mechanical Engineering* | Tiffany Fu *Materials Science Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Megan Pudlo *Biomedical Engineering* | Anna Zhang *Chemical Engineering*
ADVISOR Jason D'Antonio *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This year, Global Medical Brigades engineering students received a CIT travel grant to visit rural Nicaragua over Spring Break to investigate engineering solutions in the developing world. This report compiles the findings from their trip and explores sanitation and environmental engineering applications that are vital to developing countries.

CROWDSOURCING IN COMPLEX ENGINEERING DESIGN

STUDENT Wing Tung Wong *Mechanical Engineering*
ADVISORS Jonathan Cagan *Mechanical Engineering* | Mark Whiting *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:45 am

Consumers are playing a crucial role in modern product development, but this process is often time consuming and can lead to nuanced products with an emphasis on user-customization. Crowdsourcing, dividing a task into many small tasks and distributing them to a crowd of workers, can be used to involve the general public into the engineering design process with the benefits of user preference alignment, creativity, and efficiency. Many studies demonstrate successful crowdsourcing within a confined scope of design problem, but very few of them have explored using crowdsourcing for complex engineering design tasks, or the potential of utilizing crowdsourcing in the entire engineering design process, due to the seemingly heavy dependence on expertise, or the need of multi-

level data integration. Uncovering the possibility and developing a system for crowdsourcing in engineering design can drastically improve effectiveness in design, and transform the ways products are created.

This research explores the possibility of effective crowdsourcing in each step of the engineering design process based on task analysis with supporting literature, and empirically evaluates using Amazon Mechanical Turk to crowdsource product architecture, a particularly difficult and abstract stage of engineering design. Participants are asked to develop a product architecture for a new baby stroller through a number of subtasks, iteration, and between subject rating. Through review of supporting literature, proposed theories and a representative experimentation, we aim to demonstrate the potential and power of crowdsourcing for complex engineering tasks.

DESIGN AND FABRICATION OF CRAWLING ROBOT USING DIELECTRIC ELASTOMER ACTUATOR

STUDENT Yichu Jin *Mechanical Engineering*
ADVISOR Carmel Majidi *Mechanical Engineering*
ROOM/TIME Wright / 12:40 pm

Inspired from biological systems, soft robots contain soft, elastic structures which are capable of complex movement as well as adaptation to complicated environments. Soft robot delivers vital applications for a variety of purposes, including search and rescue in emergency situations, mine detection, surgery, and more. The goal of this project is to use shape memory alloy to develop and fabricate a soft crawling robot for rescuing assignments. Rapid prototyping with laser cutter and 3D printer will be utilized to develop this project. In addition, microcontroller and power supply will also be installed to make this robot untethered.

DEVELOPMENT AND VALIDATION OF NUMERICAL MODEL FOR ELECTRIC VEHICLE COOLING APPLICATIONS

STUDENTS Miles Smith *Mechanical Engineering* | Michael Spinelli *Mechanical Engineering*
ADVISOR Jonathan Malen *Mechanical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Electric vehicles are becoming an increasing presence in the automotive industry today, with motor and motor controller integration technology remaining a limiting factor in their continued development. However little research data is currently available for public review as to the optimal methods for properly sizing cooling components with electric powertrains. The goal of this project will be to develop a cooling system sizing algorithm for use in electric vehicle and typical automotive applications, then to research and evaluate the numerical model's performance through rigorous data collection. The project will also serve as a well-documented design and basis for future EV cooling design iterations, complete with detailed post construction analysis. Applications of this research include use for at-home builders of electric vehicles, automotive racing teams, and the vehicle industry in general will greatly benefit from this knowledge, and use it to continue pushing the trend towards electric vehicles forward.

DEVELOPMENT OF A LOW-COST SPINAL ORTHOTIC FOR SCOLIOSIS

STUDENTS Seth Cordts *Mechanical Engineering* | Olivia Dippo *Materials Science Engineering* | Lucas Friedman *Materials Science Engineering* | Cherry Park *Chemical Engineering* | Juan Portela *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

Bracing has been proven to prevent the progression of scoliosis. This can prevent the need for surgery and improve the quality of life of the patient inflicted by scoliosis. However, because of the shape of the torso and types of scoliosis vary from person to person, current braces are made custom to each individual and are very expensive to purchase. We aim to create a brace for scoliosis that can be adjusted for multiple users and could eventually be manufactured in large quantities to reduce the cost. This device will consist of rigid components as well as a strapping system to apply the required three point loads to adjust the scoliosis. We will design the brace to be as effective as current braces while being more comfortable and cost effective. This will make it easier for humanitarian organizations to buy this brace and supply it to developing countries that lack the funds and resources to purchase their own brace.

ENGINEERS WITHOUT BORDERS - PLASTIC THATCH

STUDENTS Emmett Horton *Civil and Environmental Engineering* | Aakash Parekh *Chemical Engineering* | Deepak Ravi *Mechanical Engineering* | David Sparks *Materials Science Engineering* | Stephanie Tjan *Civil and Environmental Engineering* | Julia Tucker *Mechanical Engineering* | Meghana Valluri *Self-defined* | Angela Wu *Civil and Environmental Engineering* | Alexander Yu *Electrical & Computer Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

The primary goal and focus of the PET Thatch project is to design a semi-automated system that will convert waste plastic bottles into reusable plastic pieces for construction material and roofing structures. PET Thatch is divided into 4 main groups: cutting, decontouring, fusing, and roof design. The specific goals of this semester were to create an efficient method for removing the contours from the waste plastic bottles, to build a sample roof for testing purposes, and continue looking for ways to integrate the four groups.

ETCHY: CNC LASER ETCHER

STUDENTS Korey Haug *Mechanical Engineering* | Taylor Hughes *Mechanical Engineering* | Matthew Lee *Electrical & Computer Engineering* | Ryan Oh *Electrical & Computer Engineering*

ADVISOR Bonita Olson *Mechanical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:30 am

Etchy is a CNC Laser Etcher that can take any image and etch it into common materials: balsa, acrylic, etc. This project was originally created as a Build 18 project in one week.

EVALUATION OF TURBULENCE MODELS FOR HIGH-SPEED INTERNAL COMBUSTION ENGINES

STUDENT Roberto Jaime Garza *Mechanical Engineering*
ADVISOR Satbir Singh *Mechanical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This project will evaluate mathematical models for turbulence applied to high-speed internal combustion engines. Internal combustion engine cylinder flow is designed to be turbulent to induce the maximum amount of mixing of fuel with air for better combustion. There are multiple methods for simulating turbulence. By comparing and analyzing mean flow trends and turbulence characteristics, different Large Eddy Simulation (LES) turbulence models will be evaluated in an effort to specify their accuracy and computational expenditure.

EXPLORATION OF ALGAL GROWTH SYSTEMS

STUDENTS Anchal Bhargava *Mechanical Engineering* | Nia Christian *Mechanical Engineering* | Shannon Horgan *Mechanical Engineering*
ADVISORS Cecil Higgs *Mechanical Engineering* | Philip LeDuc *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Renewable sources of energy such as wind and solar are becoming more important in society today. Last year's research began exploring ways to substitute gasoline in cars with biodiesel extracted from algae, however, this year, the focus has been on the chemistry and techniques behind growing algae, which is the first step in this much larger project. Not only is it possible to extract diesel from algae, but also algae can be used in Omega 3 fatty acids, fertilizers and reducing CO2 in the atmosphere. This project explores the effect of container size on algae growth rates and densities and the effect of growing algae in a room on its CO2 concentration. Four different setups will be used to grow algae (bioreactors, fish tank, flasks and pond) to establish growth curves for each geometry. This work was done under Dr. Fred Higgs, Dr. Phil LeDuc, and Dr. Jeremiah Mpagazehe.

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

STUDENT Eric Parigoris *Mechanical Engineering*
ADVISOR Philip LeDuc *Mechanical Engineering*
ROOM/TIME Dowd / 12:20 pm

Malnourishment results in a cycle that degrades the ability to effectively absorb nutrients even after adequate food has been consumed due to a disruption of gut homeostasis. 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 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 looked

at 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.

EXTERNAL UNIT FOR RETINAL PROSTHESIS

STUDENTS Shahana Ganesharajah *Mechanical Engineering* | Adriana Garcia *Design* | Stowe Hammarberg *Design* | Meghan Kaffine *Electrical & Computer Engineering*

ADVISOR Shawn Kelly *ICES*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:30 am

Our team is working with Professor Shawn Kelly, Ph.D. from Carnegie Mellon University to develop a retinal prosthesis that can compete with the Argus II on the US market. Our prosthesis will consist of 2 main units, the implant and the external device. The implant will consist of a thin film of electrodes, a copper coil, and a microprocessing chip. It will be placed on the eye through a small incision in the conjunctiva, and implanted on the back of the retina. There, it will use electrical impulses to stimulate the healthy nerve cells of the retina, and deliver 256 pixel vision to patients with severe Age-Related Macular Degeneration and Retinitis Pigmentosa. Though this is a limited number, it is a large step from the Argus II. The external component, which our group is directly responsible for, will consist of a headpiece which will contain a corresponding copper coil and micro camera, a wearable housing unit for the telemetry circuits, processing unit and batteries, a small remote for switching between distant and zoomed in modes, and a charger for the entire prosthesis. The external component will provide power and video feed for the implanted components.

Our prosthesis will differ and improve on the Argus II's concept, by using induction for delivering data and power to the implant, instead of radio frequency, will feature a more attractive and subtle design for everyday wear, and increased pixel resolution.

EZ-ECMO: NOVEL EXPANDABLE CATHETER FOR EXTRACORPOREAL MEMBRANE OXYGENATION

STUDENTS Erica Green *Chemical Engineering* | Palak Pujara *Chemical Engineering* | Christian Schultz *Mechanical Engineering* | Darwin Yang *Chemical Engineering* | Ariana Zito-Wolf *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:15 am

Extracorporeal membrane oxygenation (ECMO) is a last resort treatment for patients with cardiopulmonary failure. ECMO is a form of respiratory dialysis where blood is removed from the body, oxygenated, and returned via catheters. Catheter insertion is a time consuming process that requires the use of dilators to stretch the blood vessels to the required size. The dilations can be dangerous and complicated, which is why our team is collaborating with Dr. Rittenberger and Dr. Guyette from UPMC Emergency Medicine to design a catheter that can be inserted at a small diameter and expanded to the desired size once in the femoral artery. By eliminating the need for serial dilation, the EZ-ECMO catheter will decrease the risks associated with this procedure and, as a result, increase the survival rate.

HYBRID CONTROL OF A PARALLEL WIRE ROBOT

STUDENT Adam Costanza *Mechanical Engineering*
ADVISOR Cameron Riviere *Robotics Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

A parallel wire robot has been developed for minimally invasive epicardial interventions. In order to quantify the accuracy of hybrid control systems a planar robot was constructed with camera tracking. Utilizing both position and force control, results show that hybrid control is superior to position only control.

InGaN MATERIALS FOR UNDERWATER PHOTOVOLTAIC CONVERSION

STUDENTS Luis Hernandez Cazares *Mechanical Engineering* | Allison Perna *Materials Science Engineering*
ADVISOR Robert Davis *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 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).

INTEGRATION OF CONDUCTIVE MATERIAL DEPOSITION WITH EXISTING FDM TECHNOLOGY

STUDENTS Shepard Emerson *Electrical & Computer Engineering* | Ruban Kopli *Mechanical Engineering*
ADVISOR David Bourne *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Current advancements in the field of additive manufacturing have enabled low-cost residential printing of various thermoplastics (RepRap, Makerbot) and more recently of circuit boards (EX1). Currently, however, no solutions exist that combine these technologies into a single platform. This project aims to consolidate these two existing solutions in a single prototype platform that will be able to manufacture anything from simple electromechanical components to multi-layer printed circuit boards.

MODIFIED INHALER ADAPTER

STUDENTS Morgan Fritz *Design* | Conor McGuire *Materials Science Engineering* | Jessica Uphoff *Design* | Thomas Vandenberg *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

My team is working with Dr. Philip Zapanta on project M.I.A. There are over a million patients diagnosed with a neuromuscular disease and over 500 million people over the age of 65 around the world. Many of these patients have difficulty using a standard inhale due to its design where one must apply all the force on a very small contact area. These individual usually require assistance to operate these inhalers. M.I.A. or Modified Inhaler Adapter solves this problem by designing and ergonomic and easy to use inhaler that can be attached to the modern medication canisters for inhalers. Our design incorporates a two side wedge system where patients can use their whole hand to active the inhaler instead of just one finger. M.I.A. will help millions of people get the medication they need.

MODULAR MANUFACTURING SNAKE ROBOT DEPLOYMENT SYSTEM

STUDENT Korey Haug *Mechanical Engineering*

ADVISOR Howie Choset *Robotics Institute*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:45 am

In recent years, large scale automation in manufacturing has lead to a variety of opportunities in modular robotics. Using only a few platforms, many attachment modules can be used for specialized applications. The Biorobotics Lab in Carnegie Mellon's Robotics Institute is pioneering modular manufacturing and is proving technology for commercial application. This project is a new module that merges two existing platforms into one system. Now a mobile base robot can carry and deploy a snake robot into tight enclosures for specific missions. Through iteration and prototyping, this component is designed and built for commercial manufacturing applications.

MODULAR WHEEL BASED ELECTRONIC ENCLOSURE

STUDENTS Edwin Cho *Electrical & Computer Engineering* | Jaime Chu *Electrical & Computer Engineering* | Preston Ohta *Mechanical Engineering*

ADVISOR William Whittaker *Robotics Institute*

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

In lunar exploration and commercialization, success is highly dependent on the development of systems that reduce weight, improve stability, and reduce costs. Our goal is to demonstrate an integrated electronics system embedded within a lunar rover wheel, which will result in an increase in stability by lowering the center of gravity. This system would reduce the need for a heavy chassis, provide enhanced mobility capabilities in rough terrain, and provide a modular mobility and electrical payload solution for extraterrestrial exploration which could consequently lower the cost of rover development.

OPTIMIZATION OF AERODYNAMIC DIRIGIBLE DESIGNS FOR SELF-DETERMINISTIC DELIVERY DRONES

STUDENTS Theodore Lee *Electrical & Computer Engineering* | Victor Yan *Mechanical Engineering* | Sam Zeng *Mechanical Engineering*

ADVISOR Satbir Singh *Mechanical Engineering*

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

In the past few years, there has been significant increase of interest in dirigible (airship) technology. Many companies including Boeing and Northrop Grumman have invested in dirigible research. A few like Raytheon have successfully sold their products which are now being implemented in our nation's defence. Dirigibles are unique in aerospace engineering; they are one of the first means of controlled flight and unlike any other means of flight, they can stay airborne for days. While they are currently used for advertising, tourism, research and military applications, others have begun to look at dirigibles as a means of large cargo transportation. They believe that dirigibles can be used to reach areas that are hard to reach or transport large delicate cargo which would be otherwise difficult to accomplish through conventional means.

Our project aims to discover how a dirigible compares to other other UAVs (unmanned aerial vehicles) currently being developed, namely quadrotors. We believe that dirigibles could be a cheaper, simpler alternative to quadrotors. In addition, we will experiment with the shape of the dirigible to see how a biologically inspired body could aid in its physical properties. Our findings will advance the field by helping to determine the abilities of dirigibles and exploring the possible alternatives to popular research.

OPTIMIZING A BLEACH-BASED CLOCK REACTION USING MATHEMATICAL MODELING

STUDENTS Alexandra Cerny *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Neil Jassal *Electrical & Computer Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Mechanical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Johnathan Roppo *Chemical Engineering*

ADVISOR Aditya Khair *Chemical Engineering*

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

The Chem-E-Car competition is a program for collegiate members of the American Institute of Chemical Engineers (AIChE) that revolves around the design and creation of a small chemically powered car. The judging of these cars is based on how accurately and effectively the car can reach a certain distance and stop on the mark within a two-minute time period. The Chem-E-Car Data Acquisition, Transfer, and Analysis, and Bleach Clock subgroups of the Chem-E-Car team are collectively applying for a SURG grant in order to optimize the car to succeed at the National Competition in November 2015.

The team spent the last semester designing and implementing a more modular testing interface for the movement mechanisms for multiple cars, building a new array of sensors, and beginning automation of chemical injection. Faster testing procedures were also initially developed by integration of wireless Bluetooth data transfer to the Arduino microcontrollers. The team also developed a system for computer-automated chemical injection, or "autoinjection," to increase accuracy of the run during competition.

The team has decided to use a new stopping mechanism consisting of bleach and a disodium salt after complications arose last semester with each component of the store-bought dye reacting at different stages. After

a successful semester of testing the bleach-food dye stopping mechanism, the team will continue to improve upon this process to create an accurate data curve that can be utilized for the competition. The measurements from the resulting time trials of this reaction have been recorded and are currently being used in the process of modeling the data. The goals for this semester will be to observe the effects of stirring speed on the kinetics of the bleach reaction to limit its impact on the times of our reaction.

REACTOR COOLANT PUMP SEAL PERFORMANCE: MULTIPHYSICS MODELING

STUDENT Peter Chiappa *Mechanical Engineering*
ADVISOR Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

The goal of this project is to characterize the behavior of a high-pressure rotating face seal as used in a Westinghouse Electric Company reactor coolant loop pump. Of particular concern is the static deformation of the seal components given expected steady-state operating conditions. This analysis will be accomplished primarily by use of ANSYS's APDL package, for finite element analysis of the system with both structural and thermal constraints. This work is part of an ongoing collaboration between CMU's Particle Flow and Tribology Lab and Westinghouse Electric Company.

RHEOLOGICAL CHARACTERIZATION OF POWDERS FOR USE IN SELECTIVE LASER AND ELECTRON BEAM ADDITIVE MANUFACTURING TECHNOLOGIES

STUDENT Eric Myers *Mechanical Engineering*
ADVISOR Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

In recent years, the use of Additive Manufacturing (AM) technologies in industrial applications has become increasingly prevalent. With the emergence of electron beam melting (EBM) and selective laser sintering (SLS) machines, it is now possible to directly fabricate complex metal components with the same physical and mechanical properties as those produced by traditional manufacturing methods. However, in order to make this technology viable in applications where quality and accuracy is paramount, improvements to repeatability and process consistency must be made. During the AM process, a layer that is often only the thickness of a single powder particle is spread from a collection of loose metal powder. One of the primary causes for part defects during the AM process stems from non-uniformity in these layers, as a result of the complexities involved in powder flow. Therefore, it is crucial that research be conducted in order to understand the rheological properties of the wide array of AM powders in terms of how they affect spreading mechanics of thin layers. It is the objective of this investigation to analyze the flow properties across several commercial powders, in order to better understand the parameters most relevant to the spreading process in an AM machine. Rheological characterization was conducted on a Freeman FT4 powder rheometer, under varying flow speeds, compressive and unconfined stress states, different levels of compaction and entrained air, as well as tests to ascertain the yield stress under shear. Preliminary results suggest that flow properties vary substantially, not only between different materials, but between different manufacturers.

SYMBOLIC COMPUTATION OF DYNAMICS ON MANIFOLDS

STUDENT Brian Bittner *Mechanical Engineering*
ADVISOR Koushil Sreenath *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:00 am

Computing the equations of motion for robotic systems that evolve on manifolds is hard. Current approaches use local parametrization of manifolds, resulting in equations that are not globally-valid and possess singularities. Coordinate-free methods that employ variations on manifolds result in compact, singularity-free and globally-valid equations of motion. However, this involves laborious and error-prone manual computations. Traditional symbolic tools are incapable of automating this computation, as they are predominantly based on scalar symbolic variables. We present a symbolic algorithm to compute the equations of motions for systems varying on manifolds. Our approach uses Scala to capture scalar, vector and matrix symbolic variables, as well as their properties, along with mathematical rules and identities. We present results of using our algorithm to efficiently compute the equations of motion for several systems whose dynamics evolve on several manifold types.

TORQUE VECOTRING FOR AN RWD INDEPENDENT WHEEL DRIVE ELECTRIC VEHICLE

STUDENTS Shepard Emerson *Electrical & Computer Engineering* | Noah Simms-Levy *Mechanical Engineering* | Omar Skalli *Electrical & Computer Engineering*
ADVISOR Koushil Sreenath *Mechanical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Most recent road vehicles automatically control the brakes to improve traction and handling. This includes a number of systems such as anti-lock brakes, traction control, and brake-based differentials. While effective, the brake system can only control the vehicle so much without using the drivetrain. Most cars do not have an engine or differential capable of actively modulating torque and power to different wheels, and thus do not have full control capability. However, as electric vehicles with multiple motors and electronic differentials start to permeate the market, a new set of possibilities for controls opens up. The Carnegie Mellon Racing (CMR) electric vehicle provides an opportunity to develop control systems for the dual motor drivetrain that will allow for enhanced traction, safety, and fast-reacting handling in a way that a conventional car cannot match. While some automotive companies are starting to release products that use these systems, they are still rare. This research will help to advance a system that can be used to improve vehicle handling and stability for racecars and everyday vehicles.

TRANSIENT HOT WIRE MEASUREMENT OF DIAMONDOID THERMAL CONDUCTIVITY

STUDENTS Esteban Pacheco *Mechanical Engineering* | Matt Powell-Palm *Mechanical Engineering*
ADVISOR Jonathan Malen *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:00 am

In our research we measure the unique thermal properties of the Diamondoid Adamantane using a transient hot-wire technique. This substance is relatively unstudied, and possesses an extremely low thermal conductivity alongside several other interesting pressure and temperature dependent characteristics. Employing a novel method and self-machined experimental equipment, we observe these characteristics at pressures as high as 80,000 psi and temperatures as low as 77 Kelvin. These extremes elicit a plastic-inelastic phase change in the Adamantane crystal structure, which alters both the bulk thermal conductivity and density of the solid. We are studying this phase change and the phonon dispersion mismatch present between the Carbon-Carbon bonds and the Vanderwaals attractions in the crystal, which would result in an ultra-low thermal conductivity. Solid materials of ultra-low thermal conductivity have essential applications in a wide variety of micro and nanoscale thermal systems, and have potential applications in thermoelectric energy generation.

UNDERSTANDING AERODYNAMIC PROPERTIES OF QUADROTORS NEAR SURFACES FOR THE OPTIMIZATION IN PERFORMANCE AND DESIGN

STUDENTS Gianfranco Colombi *Mechanical Engineering* | Chang-Hyun Mungai *Mechanical Engineering*
ADVISOR Koushil Sreenath *Mechanical Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

With the use of complex fluid analysis we hope to visualize the flow patterns of air traveling through a quadrotor (a flying robot) close to a surface in order to optimize and better control flight in constrained spaces such as tunnels. Through the use of Particle Image Velocimetry (PIV) we hope to capture and develop flow streamlines of these interesting little devices. Although multiple research through feedback control has been done to improve quadrotor stability, however they are based on a model built on an 'invisible' force acting on the quadrotor. With the implementation of a feasible PIV system we hope to find interesting information regarding the agility of quadrotor flight close to surfaces.

UNMANNED AERIAL VEHICLE RESCUE AND RELIEF

STUDENTS Stefan Dasbach *Information Systems* | Nathaniel Thompson *Mechanical Engineering*
ADVISOR Maxim Likhachev *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Robotic relief measures reduce risk for the rescuers and provide aid to victims in conditions otherwise impassable for humans. Currently, the leaders in robotics are developing innovative aerial and terrestrial disaster extraction solutions. Despite this, there is still a need for reliable aerial surveillance. Specifically, quadcopters are considered. Quadcopters are small, agile, and vertically maneuverable, imparting convincing suitability for rescue operations. By attaching a camera to enable first person view, remote piloting is gained, allowing succor when unattainable from human support. The proposed quadcopter with a camera accessory offers valuable and reliably scalable insight into the possibility of unmanned aerial vehicle rescue missions. Furthermore, the experiment prompts subsequent research into more practical applications including thermal vision, rescue communication, and heavier payloads.

UTILIZING ELECTRON BEAM MELTING TO BUILD MASS-OPTIMIZED, HIGH STRENGTH PARTS FOR HIGH PERFORMANCE ELECTRIC VEHICLES UTILIZING ADDITIVE MANUFACTURING SPECIFIC MASS REDUCTION TECHNIQUES

STUDENTS Sascha Demetris *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Theodore Lee *Electrical & Computer Engineering* | Eric Reeder *Mechanical Engineering*
ADVISOR Philip LeDuc *Mechanical Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

With the advent of high efficiency hybrids as well as mature electric vehicles, saving weight is more critical than ever for increasing range and reducing energy consumption in the hyper-efficient vehicles of the future. Lightweight vehicles improve efficiency and allow for better vehicle dynamics and handling. To this end, this project will investigate the use of an Arcam S12 Electron Beam Melting (EBM) machine to additively manufacture multiple small, structural parts out of Titanium. The control afforded by EBM manufacture allows the creation of hollow and lattice structures that cannot be created by traditional machining. These structures are lighter than traditional, solid aluminum parts but still provide adequate strength and stiffness. Several parts will be manufactured by EBM and tested for Carnegie Mellon Racing's 2014-2015 Electric Vehicle.

VTOL DRONE DEVELOPMENT

STUDENTS Andrew Hutner *Mechanical Engineering* | Luke Tsai *Mechanical Engineering*
ADVISOR Satbir Singh *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:15 am

Development of a Vertical Take-Off and Landing drone delivery system.

COLLEGE OF FINE ARTS

ARCHITECTURE

AGGREGATE: DIGITALLY ARTICULATED FORMWORK FOR TEXTURAL SURFACE TREATMENT IN CONCRETE CASTING

STUDENT Leah Wulfman *Architecture*
ADVISOR Joshua Bard *Architecture*
ROOM/TIME Connan / 12-2:30 pm

The project is a rethinking of process and product dichotomies and methodologies in concrete casting to create a final textural surface image which drives surface weathering processes and patterns. The project investigates and progresses concrete casting techniques using novel formwork materials and methodologies. With concrete casting, there is a transfer of the formwork surface properties to the concrete surface properties. The project dually investigates the concrete surface through both concrete formwork and aggregate.

ARCHITECTURE OF DARKNESS: THE HETEROTOPIA OF SIGHT

STUDENT Edwin Cho *Architecture*
ADVISOR Mary-Lou Arscott *Architecture*
ROOM/TIME Connan / 12-2:30 pm

Architecture of Darkness in on the Heterotopia of Sight and how we can change the way we perceive in the realm of space and architecture. This thesis thrives to achieve a new architectural discourse where architects and inhabitants begin to embrace occulareccentrism where sight: the way we physically see an object and its sign and vision: the symbolic associations with what we see (perception) can be restructured to shift the way we perceive space. Space is composed of more than what you initially see and though it is never waiting to be discovered or recognized purely as a space defined by its signs, it always constitutes the relationship between its reality and the way we perceive. When space and perception are altered to redefine our conventional spaces, a heterotopic nature of space is revealed. In order to engage in a new architectural discourse where the focus relies heavily on using perceptive manipulations to expose heterotopic spaces, I have developed a framework that is necessary to the process of design:

The Recognition of Space
The Decomposition of Space
The Manipulation of Space and its Compositional Elements The Experience: Dislocation
The Unintended

ART

ICECREAM BINGE

STUDENT Yen-Ting Wang *Art*
ADVISOR Patricia Bellan-Gillen *Art*
ROOM/TIME Miller Gallery / 12-2:30 pm

Food is a struggle. Body is a struggle.

Ice Cream Binge is a series based on personal and societal addictions to an idealized female body image and food pornography. Responding to intimate experience with bulimia, the works depict the sensuality of female body parts in combination with ice cream. They explore the mental struggle between women's lust for food and their fear of having their bodies judged. Going beyond the psychology of eating disorders and social preoccupations, the project celebrates the pure seduction of visual stimulation and allure through images that make body and food indistinguishable.

MIXING GENRES; THE NEW LANDSCAPE

STUDENT Veda Sun *Art*
ADVISOR Andrew Johnson *Art*
ROOM/TIME Pake / 2:00 pm

In our heavily media filled, fast paced world there is constant migration, displacement, mixing of histories, cultures, leading to instances where we question the authentic (cultural heritage vs. popular culture as a valid identifier), and instances of loss, the loss of a singular cultural identity, but in return we gain diversity and new ideas. This past summer, I investigated the present social and cultural landscape through the synthesis of Eastern and Western landscape painting.

THE PRINCESS PUPPET THEATER: FEAST

STUDENT Crystal Yip *Art*
ADVISOR Ali Momeni *Art*
ROOM/TIME Connan / 12-2:30 pm

This is a documentation of my senior thesis, titled The Princess Puppet Theater, which is on display in the Miller Gallery starting May 1st. These are creative offshoots that occurred while working on the project, organically growing into their own pieces here for presentation. While fairy tales are a storytelling medium with predominantly female origins, it has been adapted, rewritten and commercialized in a manner that these voices have been distanced and removed. This project features a loose 'michiyuki' (a journey/monologue) style narrative inspired by Japanese Bunraku theatre to abstract and reclaim the voices that have been stifled.

THE RETURN OF YOUR IDOL: AN ART FILM

STUDENT Reese Adams-Romagnoli *Art*
ADVISOR Joe Mannino *Art*
ROOM/TIME McKenna / 11:40 am

I have made a movie exploring my relationship with popular culture as a gay man. Combining hand-drawn and computer animation with live-action performance, my movie takes place in a dystopia where I play three characters: a teenage girl, her mother, and a pop star. This project has also spawned screen-prints and works on paper, which will be displayed along with the film at CMU's Miller Gallery this May. By embodying my non-normative, queer fantasies I hope for my vulnerability to expose the oppression of cultural norms, and by employing live-action film and animation simultaneously I hope to conflate our sense of identification with art and popular culture.

DESIGN

COLLAGED NARRATIVE

STUDENT Julia Larrabee *Design*
ADVISOR Dylan Vitone *Design*
ROOM/TIME McKenna / 1:40 pm

Consider the black and white photograph found in your grandmother's attic. The face of the man climbing into the car, gazing hopefully at the camera, projects a certain mystique. Where is he going? Why is he smiling? Does he live happily-ever-after?

The photograph's image is faded: the man's story is left untold. Until now.

Sometimes disfigured with age, sometimes faded from misuse, almost always forgotten, we will use these lives as triggers to form our own narrative. I worked alongside a creative writer with discarded photographs that I discovered in antique stores over the past two years to create original, albeit speculative, narratives – art derived from found objects. We provided the text behind each face and string them together into one full narrative. The story was captured in book forms, referencing the physicality of a photo album. The viewer explores the pages to discover the narrative.

This collaged narrative of image, language, design, and experience pushes its viewers to remember the past, connect across generations, and contemplate the human condition. The project itself pushes the Carnegie Mellon audience to find value in the creative process, cross-disciplinary collaboration, and the imagination.

EXTERNAL UNIT FOR RETINAL PROSTHESIS

STUDENTS Shahana Ganesharajah *Mechanical Engineering* | Adriana Garcia *Design* | Stowe Hammarberg *Design* | Meghan Kaffine *Electrical & Computer Engineering*

ADVISOR Shawn Kelly *ICES*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:30 am

Our team is working with Professor Shawn Kelly, Ph.D. from Carnegie Mellon University to develop a retinal prosthesis that can compete with the Argus II on the US market. Our prosthesis will consist of 2 main units, the implant and the external device. The implant will consist of a thin film of electrodes, a copper coil, and a microprocessing chip. It will be placed on the eye through a small incision in the conjunctiva, and implanted on the back of the retina. There, it will use electrical impulses to stimulate the healthy nerve cells of the retina, and deliver 256 pixel vision to patients with severe Age-Related Macular Degeneration and Retinitis Pigmentosa. Though this is a limited number, it is a large step from the Argus II. The external component, which our group is directly responsible for, will consist of a headpiece which will contain a corresponding copper coil and micro camera, a wearable housing unit for the telemetry circuits, processing unit and batteries, a small remote for switching between distant and zoomed in modes, and a charger for the entire prosthesis. The external component will provide power and video feed for the implanted components.

Our prosthesis will differ and improve on the Argus II's concept, by using induction for delivering data and power to the implant, instead of radio frequency, will feature a more attractive and subtle design for everyday wear, and increased pixel resolution.

HOW QUICKLY DOES SILVER-NANOPARTICLE PAPER DECONTAMINATE WATER?

STUDENTS Uriel Eisen *Design* | Brandon Ortiz *Chemical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

Water-related illness kills more children than malaria, AIDS, and measles combined. One promising method to provide clean water is to use silver nanoparticle-embedded paper as an antibacterial filter. This recently developed technology is inexpensive and reduces e. coli over a million fold to EPA-safe levels [1]. Yet it remains unclear how quickly silver nanoparticles work, or how effective such a filter would be under non-ideal conditions. In this project, we attempt to find the minimal effective time for bactericidal efficacy under two models of accelerated filtering: high pressure before the filter, and vacuum filtration. We will measure deactivation of e. coli in two ways: counting colonies plated on agar from the filtrate, and IDEXX Colilert Quanti-tray, an EPA-approved semiautomated quantification method for potable water testing. We hope to determine the effect of flow rate on filter efficacy, better understand the properties of nanomaterials, and gain insight into how this technology could best be deployed to prevent waterborne disease in the developing world.

MODIFIED INHALER ADAPTER

STUDENTS Morgan Fritz *Design* | Conor McGuire *Materials Science Engineering* | Jessica Uphoff *Design* | Thomas Vandenberg *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

My team is working with Dr. Philip Zapanta on project M.I.A. There are over a million patients diagnosed with a neuromuscular disease and over 500 million people over the age of 65 around the world. Many of these patients have difficulty using a standard inhale due to its design where one must apply all the force on a very small contact area. These individuals usually require assistance to operate these inhalers.

M.I.A. or Modified Inhaler Adapter solves this problem by designing and ergonomic and easy to use inhaler that can be attached to the modern medication canisters for inhalers. Our design incorporates a two side wedge system where patients can use their whole hand to active the inhaler instead of just one finger. M.I.A. will help millions of people get the medication they need.

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*

ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

DRAMA

NATURAL RHYTHM

STUDENT Abigail Nover *Drama*
ADVISOR Kenneth Keeling *Music*
ROOM/TIME Wright / 4:00 pm

Natural Rhythm is a multi-media anthology of today's American folk music that follows the path of the Great Migration from New Orleans to Chicago.

POP UP BEATS: MAKING DIY MUSIC VENUES

STUDENTS Alex Tobey *Drama* | Samantha Ward *BHA*
ADVISOR John Pena *Art*
ROOM/TIME Connan / 12-2:30 pm

The Pop-Up Beats project is a series of Do-It-Yourself Pop-Up concerts that combine art and music in various parks in the Pittsburgh community using bubble:PGH as a venue. We will use the bubble to research how venues can be informally implemented in a community and how the public can easily create their own music events in public spaces. The project will culminate in a web-based blueprint explaining how future planners can create pop-up concerts in Pittsburgh. The bubble will roam through three parks in the East End of Pittsburgh, and feature small performances from Pittsburgh visual artists and musicians.

CROSS COLLEGE

BCSA

ALL IS FAIR: A GAME ABOUT RELATIONSHIPS

STUDENT MacKenzie Bates *BCSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

All is Fair is a game about relationships. It engages the player in experiencing how relationships differ, how they are similar, what behaviors, obstacles and challenges they face and how they overcome or fail to overcome them – to endure or collapse.

The game takes the form of what I like to call a Twin Stick Art Shooter. This 2D top down shooter has gameplay similar to Halo Spartan Assault, but is simplified and focused on the relationship between the player and their computer-controlled companions.

The game is set around the idea of the player exploring relationships in a photo/scrapbook. As such, each level reflects a different relationship between two partners. Players attempt to act in concert with their partners in ways that will help their relationships survive. The player and their companion are fighting "The Fear" which is the physical manifestation of things that can sabotage a relationship. It represents: tension, fights, confusion, jealousy. When aspects of The Fear are "destroyed", they shrink down to small "memories" that follow the player around. The issues of the relationship never really go away.

When a partner dies, this means they have given up on the relationship and the other partner continues on without them. If the player dies, they must watch their companion complete the level and along the way their companion may met someone new. If the companion dies, the player has to complete the level alone. The stakes of death are high.

At the end of a level the player is displayed in a photo/scrapbook page that shows the two characters and what their relationship is like following the play-through. If players make it to the next level with their partners and relationship intact, we see them closely together. If a separation occurs we see the partners alone or with new interests they have encountered.

Completing a level in Story mode unlocks the level in Rom-Com mode. In a romantic comedy, no matter what happens, the couple makes it out together. In this mode the player and their companion have unlimited lives, and timing and scoring are present. Also to play up the drama, the enemies become more difficult. This mode plays the most like Halo: Spartan Assault.

AUTOMATIC CARNATIC RAAGA CLASSIFIER

STUDENT Divya Mouli *BCSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 3:20 pm

With this project, I studied the ways in which machine learning techniques can be applied to the classification of Carnatic Raagas (musical modes of the South Indian Classical Music Style) from Audio Input, and also how a framework can be used to develop an interactive and growing database of Music Information. The culmination of my research is the development of a rudimentary application which accepts audio input data and returns a

classification of its musical mode, as determined by various statistical models as well as previous user input. With the creation and further development of such an application, I hope to provide a tool to those training in Carnatic Music to more easily learn and identify these Raagas in real-time situations and help contribute to an ever growing, and increasingly representative, database of automatically-identifiable Raagas in the Carnatic system.

CTRL+ART+CRITIQUE

STUDENTS Jolyn Sandford *BCSA* | Andrew Sweet *BCSA*
ADVISOR John Pena *Art*
ROOM/TIME Peter / 4:00 pm

In the recent past, the idea that one might consider video games as a form of art has risen to prominence among certain communities. However, this movement towards considering video games as art has met with resistance from both the art world and the gaming world. ctrl+art+critique is a series of videos featuring artists playing video games and critiquing them as art pieces. The goal of the series is to make critique of video games more accessible to the video game community, introduce artistic language to the where it is unfamiliar, and find common points of critique between all video games for a more cohesive way of giving constructive criticism to games.

HALLEY: AMBASSADOR ROBOT 001

STUDENT John Choi *BCSA*
ADVISOR Golan Levin *Art*
ROOM/TIME Connan / 3-5 pm

Ambassador Robot No. 001, also known as Halley, is a 2.6-foot humanoid automaton built for the sole purpose of exploring what it means to be human from a non-human perspective. The primary means of achieving this is through human-robot interaction, where the robot, Halley, emulates as many human functions as possible while interfacing with another person. In order to connect with the idea of being human, a humanoid shape of respectable size is deemed necessary, along with an array of face-to-face communication techniques. A speaker, camera, and microphone satisfies the need for basic sensory input and output. Gestures, such as raising hands to ask questions, are supported by Halley's movable arms and legs. Finally, and perhaps most importantly, the ability to express emotions will be achieved through the clever use of an Android phone as a face. The ultimate goal for this project is to have Halley take the place of a student in a classroom.

INTERACTIVE ALPHABET BLOCKS

STUDENT Jacob Klingensmith *BCSA*
ADVISORS H. Brown *Robotics Institute* | Alonzo Kelly *Robotics Institute*
ROOM/TIME Connan / 3-5 pm

PLAY WITH BLOCKS. LEARN LANGUAGE.

The Interactive Alphabet Blocks are objects whose physical properties, driven by electronics, encode a set of abstract language patterns. This encoding allows the user to internalize those language patterns during the process of interacting with the blocks. The blocks can act either as a toy, simply reacting deterministically to specific arrangements, or as a game, guiding the user toward certain arrangements and rewarding them with new interaction.

SIMULATING DISCRETE ELASTIC RODS

STUDENT Amanda Watson *BCSA*
ADVISOR James McCann *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

I implemented a model for discrete elastic rods, borrowing much of the implementation from Bergou et al, as well as some performance optimizations from Jonathan Kaldor and Columbia University. The goal of this project was to create a way to realistically simulator knit yarns as they moved through space.

THE CONSULTANTS

STUDENT Kevin Karol *BCSA*
ADVISOR Carrie Hagan *BHA*
ROOM/TIME McConomy Auditorium / 12-1 pm

The threat is imminent, and only you can stop it. The NSA has gained access to an encrypted device that contains the details of a terrorist plot, and you have been hired to break through the device's security measures and piece together the plan so that it can be stopped. In this new participatory theater piece you are at the center of the action as you use your cell phone to move your avatar, decrypt phone calls, text messages, and emails to gather information. But be warned, other agencies are also hard at work, and they will ruthlessly defend their turf in pursuit of a lucrative defense contract. A fusion of strategy, code breaking and technological prowess, every audience member will have a unique experience as they attempt to put the pieces together and save the day.

The Consultants utilizes a new theatrical paradigm, Server-Based Dynamic Narrative Delivery. Under this system theatrical events are constructed in stages, with each stage consisting of the collection of event parameters and the distribution of instructions to audience members through a server that has been set up to manage the event.

The Consultants was originally presented under the title Long Live the King at The Brick Theater Company in Brooklyn, NY as part of their Gameplay Festival. With the assistance of the Undergraduate Research Office it was featured at the National Conference of the Alliance for the Arts in Research Universities last November.

BHA

90s NOSTALGIA - DEVELOPING AN ORIGINAL TELEVISION ANIMATED SERIES

STUDENT Vanessa Branch *BHA*
ADVISORS Sharon Dilworth *English* | Kenya Dworkin y Mendez *Modern Languages*
ROOM/TIME Peter / 12:00 pm

My BXA Capstone project is a Show Bible for an original TV animated series aimed at a millennial, bilingual audience. In this Show Bible will be a pilot episode script and visual development including model sheets, storyboards, turn arounds, expressions, prop design, and environment design.

ASSEMBLY, ACTIVISM, AND ARCHITECTURE

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

When people utilize their rights to the first amendments, specifically the right to assembly, they are performing an act of guerrilla architecture by engaging the space around them to create a temporary partition which results in the alteration of circulation paths.

ASSERTING OWNERSHIP IN COMMUNAL SPACE: THE KOMMUNALKA IN ST. PETERSBURG

STUDENT Nicole Anderson *BHA*
ADVISOR Emanuela Grama *History*
ROOM/TIME Peter / 3:00 pm

The communal apartment became an ubiquitous housing model in St. Petersburg after the 1917 Russian Revolution. Suddenly sharing an apartment with dozens of strangers, Soviets were forced to renegotiate their ideas of home. Residents used material culture, their relationships with neighbors, and knowledge of apartment history to assert ownership over the shared space. This research uses fractal recursion to model the way lines of private and public were constantly redrawn within the shifting social environment of the kommunalka.

BeSPOKE

STUDENTS Daniel Campos Zamora *BHA* | Minnar Xie *BHA*
ADVISOR Susanne Slavik *Art*
ROOM/TIME McKenna / 1:00 pm

Throughout the semester we conducted participatory arts workshops with the Greater Pittsburgh Literacy Council's Advanced ESL class. While we intended to seek out stories of immigrating and adapting to life in Pittsburgh, instead, the reflections gathered made us critically reexamine the linguistic and cultural aspects of "Americanness." Through an experimental audio track, we distort pop music, recordings of the students, and phrases and idioms they identified as confusing in English, in order to reinterpret them.

BUGGY CRASH TEST SURG

STUDENTS Ryan Davis *Physics* | Rachael Schmitt *BHA*
ADVISOR Kathryn Palko *Student Affairs*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Crash testing in the Carnegie Mellon sport of buggy has to this date not been conducted. The only information we have on crashes are testimony and medical reports from drivers who experienced a crash. In the wake of two recent, very serious crashes and injuries, concern about safety in buggy is appropriately amplified, but our knowledge is very little. Our research project proposes to apply readily available science and engineering talent to the goal of improving driver safety. We will use a professional crash test dummy, a donated buggy, and robotic steering to perform crash tests. The expected result will be a comprehensive recommendation for a) procedural changes,

b) improvements in safety features, c) modifications to the racing cource, and d) safety performance criteria. We have full support from Sweepstakes, the Sweepstakes advisor, the Buggy Alumni Association, and Emergency Medical Services.

CASE STUDY OF THE IMPROVEMENTS IN COMMUNICATIONS SKILLS AND HAPPINESS THROUGH MUSIC THERAPY

STUDENT Hyo Seul Sohn *BHA*
ADVISOR Sharon Carver *Psychology*
ROOM/TIME Peter / 3:40 pm

As music therapy is becoming more prevalent in treating children with various physical and mental illnesses, this project focused on the impact that music therapy can have for a child diagnosed with CHARGE Syndrome (Coloboma of the eye, Heart defect, Atresia of the nasal choanae, Retardation of growth and/or development, Genital and/or urinary abnormalities, and Ear abnormalities and deafness). This case study project explored the effect of music therapy on improving happiness (the number of the times the child smiles during the session) and communication skills (the attempts to imitate the therapist's demonstration) for a 2 and 1/2 year old child diagnosed with CHARGE syndrome. Although research has demonstrated that music therapy can help to improve communication skills and attention deficits with respect to an autism spectrum diagnosis, the effect of music therapy on improving these same skills for those diagnosed with CHARGE syndrome has not been explored yet or formally documented. During weekly 60-minute music therapy sessions, the child's progress and special features of each session were recorded and evaluated. Through this project, I hope to shed light on ways to help individuals with CHARGE Syndrome by portraying the effects of music therapy on this one child.

'CAUSE NOW I'VE GOT THE PILL: COUNTRY MUSIC AND WOMEN'S LIBERATION

STUDENT Taylor Preston *BHA*
ADVISOR Carrie Hagan *BHA*
ROOM/TIME Connan / 12-2:30 pm

I am interested in women in country music leading up to, and during, the Women's Liberation Movement that began in the United States in the late 1960's. As a BHA student with concentrations in art and history, I will be able to dig deeper into the subject matter through the production of both a research paper and an artwork. I am specifically interested in the work of Dolly Parton, Loretta Lynn, and Tammy Wynette, and will be exploring their complicated relationship to the movement. Many issues central to women's lib – including sexuality, health, family and violence – were central to their music. Even then, they did not openly identify as feminists or take part in the movement. Regardless, they were still able to reach a demographic of women who often felt as though there was no place for them within it, while empowering themselves and others in the process. The history of feminism in the south is also an important part of my research.

Throughout the years, the south has upheld a strong patriarchal society. This made participating in the women's liberation movement especially difficult for southern women, as they could not easily criticize the patriarchy while so deeply embedded within it. Because it was already such a rich part of the culture, country music gave southern women a way to have their voices heard and stand in solidarity with other southern women. Through my research I

will show how Dolly, Loretta and Tammy shaped the identities female fans created for them selves, and contributed to the larger identity of southern women. My historical research, and the primary sources I uncover, provides the inspiration and foundation for the paintings I create. The questions I seek to answer in my research serve as the basis for their production. Through the production of an artwork, I will also address larger themes at play, including what it means to be a feminist and what is considered a feminist act. Art allows for more room for speculation, questioning and personal opinion, and I plan on taking advantage of this.

CMU STORIES

STUDENT Sejal Popat *BHA*
ADVISOR Donna Harsch *History*
ROOM/TIME Connan / 12-2:30 pm

The goal of CMU Stories is to create a holistic portrait of CMU's culture and community through a series of multimedia artwork. There are two components to this artwork. First, there is the audio component: A series of recorded interviews with members of the CMU community. Each interview revolves around the individual's current interests/work and perspective on the path they've taken to or from CMU. Second, there is the visual component: each of the interviews is accompanied by a portrait of the interviewee. The portraits are done in a combination of digital and traditional painting. Each of these paintings and their corresponding audio recordings will then be displayed on a website that any one interested in learning about CMU's culture as a whole, or the stories of its individual members can go to.

COEXISTENCE

STUDENT Rosalyn Denton *BHA*
ADVISOR Carrie Hagan *BHA*
ROOM/TIME McConomy Auditorium / 2-2:30 pm

My project was to hold a 10-minute live concert in Kresge Theatre with a piano, cello, and percussion. While the concert ran, a projection mapping was displayed over the venue and instruments to bring the audience into a constructed whimsical world and guide them through a story. The theme of the piece is the journey to the coexistence of the organic and mechanical rather than a tension between the two. I have been inspired after seeing some shows using projection mapping during my time abroad in Japan and I wanted to make a more complex story with elements from what I saw.

EXPERIMENTAL COMICS

STUDENT Elizabeth Imas *BHA*
ADVISOR John Pena *Art*
ROOM/TIME Connan / 3-5 pm

To tell a story, one must use convey meaning such that the same story is duplicated in the mind of another person. Linguistics is the study of how this is done, while comics are a visual way of attempting to tell these stories. Both comics and linguistics are about finding how we communicate to one another and achieve clarity, although comics are visual and linguistics is primarily about verbal communications. However, rarely are these fields ever considered

together. By studying how both these fields facilitate communication transferal of ideas between people, I can combine them and solve problems raised in one field (such as different languages having different reading orders for text and sequential image) that the other is adept at solving (such as creating an unambiguous universal reading order on a comic page). The end result is a set of comics that provides readers with new and unique, but still clearly understandable, reading experiences.

HELLO FROM HISTORY

STUDENT Jiyoon Kim *BHA*
ADVISOR Dylan Vitone *Design*
ROOM/TIME Connan / 12-2:30 pm

I have created three children's books to teach history to children in an illustrative and typographic manner titled, "Hello from History" a book about famous words and quotes from famous historical people, "Hiccups from History" a book about accidental inventions, and "Howl, Hooves, and Horns from History", a book about famous animals from around the world.

I'M NOT A REFUGEE ANYMORE: FAMILY RESPONSIBILITY, DESIRE, AND PERCEPTIONS OF SUCCESS IN PITTSBURGH'S RESETTLED BHUTANESE/NEPALI COMMUNITY

STUDENT Minnar Xie *BHA*
ADVISOR Judith Schachter *History*
ROOM/TIME McKenna / 12:20 pm

At what point does a resettled refugee stop being "a refugee"? Despite being home to one of the largest communities of Bhutanese/Nepali refugees outside of the refugee camps, Pittsburgh and the United States at-large have few ways of understanding their lives and decisions outside of the 'American Dream' framework. Drawing on a four year relationship with a Bhutanese/Nepali family and four months of fieldwork with the Bhutanese/Nepali community in the South Hills, this ethnographic study describes the perceptions youth have of success, and the necessity of balancing family with community responsibility. Observations on their choices for or against higher education, teenage marriage, and gender roles reveal that the process of resettling oneself as a young refugee goes beyond simply living in a new country.

LE THÉÂTRE DE LA TERANGA: THE EVOLUTION OF THEATRICAL PERFORMANCE IN MODERN SENEGAL

STUDENT Kaytie Nielsen *BHA*
ADVISOR Mame-Fatou Niang *Modern Languages*
ROOM/TIME McKenna / 4:40 pm

Through interviews with educators, government officials, university students, and aspiring theatre-makers, this documentary will explore the tradition of performative storytelling in Senegalese culture, theatre around the time of Independence, and the current state of live theatrical performance in Senegal today. Some of the interview material examines topics such as: the Senegalese caste system as it relates to entertainment, religion and entertainment,

Le Théâtre Sénégalais on the television, the Negritude movement, current public policy in the Ministère de la Culture, theatre in the education system, and a possible renaissance of live theatre in Senegal.

LEARNING TO TEACH: USING A STUDENT-LED COURSE AS PREPARATION FOR A TEACHING CAREER

STUDENT Laura Paik *BHA*
ADVISORS M. Stephanie Murray *BHA* | Kristina Straub *English*
ROOM/TIME Wright / 3:20 pm

This semester, I chose to teach a StuCo (Student-Led Course) on Gothic Literature and the Scary Story as part of my senior capstone project. My goal was to use the experience as a way to practice and improve at teaching, since I am interested in a career as a high school English teacher. While teaching, I took note of my strengths and weaknesses, tried out different ways of conducting classes, and asked my students to fill out several evaluations through the year. I gained some useful experience and insights that I can use going forward in my teaching career.

POP UP BEATS: MAKING DIY MUSIC VENUES

STUDENTS Alex Tobey *Drama* | Samantha Ward *BHA*
ADVISOR John Pena *Art*
ROOM/TIME Connan / 12-2:30 pm

The Pop-Up Beats project is a series of Do-It-Yourself Pop-Up concerts that combine art and music in various parks in the Pittsburgh community using bubble:PGH as a venue. We will use the bubble to research how venues can be informally implemented in a community and how the public can easily create their own music events in public spaces. The project will culminate in a web-based blueprint explaining how future planners can create pop-up concerts in Pittsburgh. The bubble will roam through three parks in the East End of Pittsburgh, and feature small performances from Pittsburgh visual artists and musicians.

PSYCHOLOGY THROUGH SHOES

STUDENT Anna Wettergreen *BHA*
ADVISORS Chante Cox-Boyd *Psychology* | Jamie Gruzska *Art*
ROOM/TIME Connan / 3-5 pm

As a student in the Bachelor of Humanities and Arts program at Carnegie Mellon, I concentrate in the fields of psychology and art, the integration of which inspires the creation of Psychology through Shoes. The project will be a series of photographs of shoes assembled in book form, conceptually driven by a visual representation of the social interactions described by certain principles of psychology. To do so, I will base each photo off the elements of human relations that fall under a specific psychological principle. I will arrange the shoes in specific layouts in entranceways and doorways. This work will help educate people about the concepts behind human interaction, through a visual and artistic medium and through familiar, static objects. Additionally, it will be a creative output fueled by a passion for psychology.

REINCARNATION AS DEPICTED AS A RITUAL IN SCIENCE FICTION

STUDENT Samuel Poulos *BHA*
ADVISOR Jeffrey Hinkelman *University Libraries*
ROOM/TIME Connan / 12-2:30 pm

I will make two cyanotypes that are exposed on sheets of plexiglass, rather than traditional paper or fabric. The first image will depict a still from Star Trek: The Motion Picture, specifically what I believe to be the exact moment when two of the main characters die, crossing over into another plane of consciousness. The second cyanotyped image will be a still of a video of my reciting the Nicene Creed underwater in a bathtub. This still will depict a more symbolic version of the same thing, imitating the ritual of baptism where the infant enters into a new life or a new spiritual consciousness.

The sheets of plexiglass would be mounted to screens that have The Motion Picture playing on one, and my own video-performance playing on the other. I would encourage the viewer to watch until the video matches perfectly with the cyanotyped image. At one inevitable point, the images will align visually, which is meant to symbolize a death of some life, and the birth of another. In this way, I mean to bring attention to the idea of reincarnation, and the existence of some form of living after experiencing some form of dying.

RESTORATION OF MOTOR AND COGNITIVE FUNCTION VIA LITHIUM TREATMENT IN RATS WITH EXPERIMENTAL TRAUMATIC BRAIN INJURY

STUDENT Monica Ly *BHA*
ADVISOR Daniel Brasier *Biological Sciences*
ROOM/TIME Wright / 4:20 pm

Traumatic brain injury (TBI) affects approximately 1.7 million people in the US every year and often causes significant disability in physical and cognitive function, especially memory. This project aims to test whether lithium, a drug commonly used for bipolar disorder, can also prove beneficial to recovery after TBI. Lithium has been shown to protect against cell death induced by other injuries, but its use for treating brain injury has yet to be extensively explored. The effects of chronic lithium treatment after experimental TBI were studied in rats. Physical function in the form of motor skills during the acute recovery stage was tested using beam balance and beam walking tasks. Cognitive function was measured 2 weeks after surgery with the Morris water maze task, which tested spatial learning and memory of a submerged platform within a large pool of water. By testing different dosages of lithium, an optimal therapeutic window can be determined, which will set the groundwork for further research into how lithium treatment can attenuate physical and cognitive deficits after brain injury.

ROLE OF SPATIAL FREQUENCY IN RAPID SCENE PROCESSING

STUDENT Charles Burlingham *BHA*
ADVISORS Elissa Aminoff *Psychology* | Marlene Behrmann *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:15 am

Rapid processing of scenes has been shown to be facilitated by the processing of low spatial frequency (LSF) components before that of high spatial frequency (HSF) components. It has been been proposed that magnocellular pathways carrying low spatial frequencies provide an initial 'gist' of a scene, which is filled in using higher spatial

frequencies along the the ventral stream. This study seeks to determine how performance on a six-way scene categorization task varies as a function of spatial frequency and image presentation duration. Across six categories of scenes, a low-high continuum of spatial frequencies, and a short 50ms presentation duration and longer 100ms one, we measured subjects reaction times and accuracies in categorizing scenes. Accuracy was equivalent for HSF-filtered scenes and LSF-filtered and this was true for the shorter and longer duration conditions. However, accuracy was significantly better for HSF-filtered images of forests at 100ms versus at 50ms presentation. Taken together, these results suggest that in addition to LSF information, HSF components of scenes may also facilitate rapid scene processing for some types of scenes.

STILL BURNING

STUDENT Abby Botnick *BHA*
ADVISOR Judith Conte *Drama*
ROOM/TIME McConomy Auditorium / 1-1:30 pm

Still Burning is an original dance performance movie that explores the themes of love, fear and human fragility. The movie follows the story of a nameless girl who steals the heart of a young boy named Ethan. They're flirting quickly turns into lust and slowly turns to love. But there is something wrong with the Girl. She questions her love for Ethan and her true nature is revealed.

Still Burning is presented through dance because it is the ultimate form of body language. Our bodies naturally tell people how we feel and our comfort level. We use our bodies to express our affection and love for one another. It is natural to tell a love story with the use of our body. The medium of Still Burning is film, as opposed to live theater performance, in order to reach people who wouldn't normally see a dance concert. Film will provide this population with a chance to experience the art form of dance in a familiar environment. Because movies reach larger audiences than live theater, the use of film for Still Burning will not only further the art form of dance, but also provide greater exposure. Furthermore, Still Burning will be unlike any current dance movie in the commercial market today. Current dance movies primarily focus on the spectacle and ticket sales. Still Burning will be a focus on the art of dance instead of the spectacle, while exploring difficult themes of human fragility and strength.

Abby Botnick has choreographed and directed the movie this summer.

SUSTAINABILITY IN ARCHITECTURE: "DEVELOPING" SOLUTIONS FOR THE DEVELOPED WORLD

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

Bringing western 'sustainable' ideas, businesses and technologies as solutions/aid for the Global South can be contested. Instead, can sustainability be redefined by different histories and cultures? Communities have been designed on modernist design principles and implemented largely by specialists, not by the people living in them, constructed on ideas of specialization, standardization, and mass production from the industrial age. With a focus on Latin America, those roles can be shifted: The project showcases specific architectural examples from Latin America -- like informal settlements and guerrilla solutions and propose, in an architecture manifesto, how they can inform sustainable solutions in the West.

THE ROLE OF SETTING IN AUTOBIOGRAPHICAL MEMORIES

STUDENT Rachel Asbel *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Dowd / 4:00 pm

The aim of this project is to explore how human cognition and memory are influenced by one's surroundings. Architects and architectural students make claims about sensory experiences or evocative spaces, however it is often conjectural or speculative. In this study, I addressed this idea from a psychological perspective, while respecting the qualitative understandings about architecture. I used a proven methodology to analyze memories prompted by six different setting descriptions. The settings were chosen to contrast places that are rich in multi-sensory elements against places that are lacking in multi-sensory elements. Participants recalled a memory for each setting, and then rated those memories for emotionality, vividness, evocativeness, and specificity. The findings of this study have the potential to inform us of how our perceptual experience in day-to-day life is shaped by the built environment.

VOCES PENINSULARES

STUDENT Bridget McCoy *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Wright / 1:40 pm

This project is a presentation of Spanish music portrayed through performance, written, and spoken word. The lecture-concert consists of pieces dating back to the Spanish Medieval period performed by a prepared choir and individual singers, along with an informative program and several minutes of speech about the subject matter. The research explores how the political and social climate of the era affected the music and how it has been incorporated into the modern day canon. The music is all sung in some form of the Spanish language.

WITH

STUDENT Katherine Lee *BHA*
ADVISOR Susanne Slavik *Art*
ROOM/TIME Peter / 11:40 am

"With" is a series of performances and visual artworks curated by Kathy Lee and Joseph Reilly to convey the sense of intimacy and solitude. "With" shows always involve the participation of hearing paired with one or more other senses. Sensory experience is the main mode of medium. This stems from the belief that nobody is capable of completely being 'with' another person, because each individual's lives cannot be intersected of overlapped. The beautiful tragedy of dying alone is presented using our senses which is the basis for how we, as humans, experience everything. (reference: http://www.kathyylee.com/withartduo/)

BIOLOGY AND PSYCHOLOGY

HEREDITARY SPASTIC PARAPLEGIA ATLASTIN 1 MUTATION EFFECTS ON CELLULAR SECRETORY PATHWAYS

STUDENT John Park *Biology and Psychology*
ADVISOR Christina Lee *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:30 am

The mechanism behind degeneration of long motor neurons in patients suffering from Hereditary Spastic Paraplegia (which leads to progressive loss of control in the legs) is currently unknown. One proposed hypothesis is that axon degeneration is caused by ER abnormalities, stemming from expression of mutant forms of atlastin, that in turn decrease the protein secretory capacity of the affected neurons. Utilizing a co-transfection of tsVSV-G and either the Y196C mutant or wild type atlastin and subsequent immuno fluorescence staining, the kinetics of secretion in cells expressing either mutant or wild type forms of atlastin can be determined and compared. The results will indicate the effect of mutant atlastin on the secretory pathway.

VOLUNTEERISM AND HEALTH IN OLDER ADULTS

STUDENT John Ra *Biology and Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The primary goals of this research study were to examine the relation between volunteerism and health in older adults, to expand upon the outcomes of volunteerism in previous research to include cognitive functioning, and to determine the mechanisms and moderators behind such relations. Forty-nine participants (aged 74 and older) from the Pittsburgh area were interviewed in-person for their recent volunteer history and health in the Spring of 2014 and then again about 5 months later in the Fall. The independent variables were the various aspects of recent volunteer history (i.e., volunteer hours in the past year or since the last session, total number of volunteer activities, and the percent of activities that were social), and the dependent health variables were mental health, physical health, and cognitive functioning. The effect of moderator variables, such as volunteer motives, on the relation between volunteering and health were also examined. Contrary to hypotheses, good health predicted a decline in volunteering rather than volunteering predicting improved health.

That is, those with better mental health and cognitive functioning at baseline volunteered less over time. Additionally, the volunteer motives of esteem enhancement and distraction from personal problems were most impactful in that those who volunteered more exhibited generally worse mental health and cognitive functioning if they reported high levels of these two motives. Taken collectively, results suggest that volunteer work may be a coping mechanism rather than an activity that benefits health.

BSA

A FLOOD IN THE SYNAPSE

STUDENT Theodore Teichman *BSA*
ADVISOR R. James Whipple *Music*
ROOM/TIME McConomy Auditorium / 11 am - 12 pm

The manner in which an individual interprets, forms representations of, and manipulates their environment is reliant on their individual perceptions. This collection of multimodal works probes and interacts with the the external and perceived world.There are elements of each person's bottom-up mechanisms that differ in how they construct a representation of the world. Even more significant, however, is the manner in which these individual differences and the unique experiences generate different cognitive schema and varying sensor, conceptual, and semantic prototypes, through which they shape their worldview via top-down mechanisms. Furthermore, these key factors can change in regards to their use and their makeup over the course of a person's life with changing experiences or with variations in setting, cast, and place (the people and physical elements the person is surrounded by and interacting with). Each of these pieces maintain variable elements in their performance that allow for an entirely different experience of each performance and therefore reflect the variation of the performers as individuals interacting with the world.

Performers: Hannah Criswell (Flute), Simone Sile (Horn), Valerie Senavsky (Horn), Shane Gillen (Bassoon), Brooke King (Oboe)

A GUIDE TO THE MUSIC BUSINESS

STUDENT Campbell Rogers *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 12:40 pm

I would like to create an interactive platform for musicians entering the industry who have no financial or business experience. As a college student studying music, there is no business class requirement, so many music students graduate without knowing how to create their own brand, organize their performance schedule, and manage their finances. Additionally, many musicians, especially classical singers, do not have one job for multiple years like many other people, but instead have to constantly search for opportunities and auditions around the world. In order to find out what makes a small company successful, I will research findings of past finance and business studies, as well as interview local musicians to see what has made them successful in the past, and what they feel they need to improve upon. In order to make this platform accessible to all musicians who are interested, I would like to present my guide as a website. The website would be designed in an easy-to-navigate fashion, and would simplify the information to make it accessible to anyone. The website will include both information and message boards for current artists to provide their own insight.

ARABIDOPSIS: A MODEL ORGANISM

STUDENT Rachel Willen *BSA*
ADVISOR Richard Pell *Art*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

My project deals with the changes evoked onto the natural world by the civilization of humans. This is the fast-growing field of biotechnology that has become a popular topic in the news due to the introduction of genetically modified organisms to the commercialized market. However, the applications of biotechnology extend far beyond the alteration of food, ranging from advances in material science to humanitarian causes.

The current and potential benefits of utilizing this technology are boundless, but the dangers can be devastating and moral and ethical codes can be called into question. As we advance our technological resources and applications of these tools, there are a growing number of participants in the conversation. This has resulted in miscommunication, misinterpretation, and fierce debate within the discourse, complicating the intentions and direction of the field. The goal of my project is to contribute to this conversation by informing and providing new perspective.

I am doing this through an exhibit for the Center for PostNatural History, a museum dedicated to providing information on genetically altered organisms. The exhibit will be a visual display of the physical changes of laboratory-induced mutations in Arabidopsis flowers. The goal is to extend the public's perspective on the field as a whole by showcasing the visual beauty and dynamic nature of genetic modification. The exhibit includes large-scale prints of microscope photos exhibiting various physical mutations of the Arabidopsis flower, a model organism of the plant world.

COLLECTING POLARIMETRY DATA FOR THE POLARIMETRIC DETECTION OF CHIRAL AU NANOPARTICLES

STUDENT Alexander Petti *BSA*
ADVISOR Nisha Shukla *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:15 am

The purpose of this talk is to explain how the polarimetric detection of enantioselective adsorption of chiral gold nanoparticles is affected by the temperature, wavelength of measurement, and nanoparticle size. This research is significant to the pharmaceutical community because some bioactive chiral enantiomers need to be completely separated from their chiral counterpart to work effectively. In this experiment, gold nanoparticles between 4nm and 80 nm in size were produced. Chiral ligands were attached to these solutions of gold nanoparticles and the solutions were then tested at wavelengths of 365, 436, and 546 nm and temperatures of 23, 30 and 40 °C. Measurements of the optical rotation of the solutions were taken after incrementally increasing the concentration of racemic propylene oxide (rac-PO) in the solution.

The results from the experiment are nine graphs of optical rotation over concentrations of rac-PO various wavelengths, temperatures, and nanoparticle sizes. It was found that when wavelength and nanoparticle size are decreased and temperature is increased, the sensitivity of the optical rotation of the chiral solutions increases.

DADDY ISSUES

STUDENT Laurel Michel-Schottman *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

I have created a web app where users can go and enter information about their relationship with their father. The project is meant to investigate the role of the modern father through the perspective of the child. Specifically of interest is how a father is able to go against gender norms to emotionally support their child, what amount of the care taking they are involved in and how the child fees about their relationship to their father.

With the entered information, the user will then be able to look at the image of the modern father. Traits and qualities of the father are displayed visually and then users can specify their search to look at a certain age group, locations or ethnicities of fathers.

DEATH AND REBIRTH IN THE STARS

STUDENT Stephanie Cheung *BSA*
ADVISOR Hy Trac *Physics*
ROOM/TIME Peter / 4:20 pm

Stars live in a perpetual cycle of death and rebirth, much like life on Earth. When clouds of gas from old and dying stars gravitationally collapse to ignite the process of nuclear fusion, a new star is born from the ashes of the old ones. While the celestial fire of the dying star disperses material for others to reignite, it also releases the building blocks for organic life (carbon, oxygen, nitrogen, hydrogen, etc) into space. Humans and all life on Earth are just a small part of this ancient atomic circle of life.

DIGITAR: DYNAMICALLY INTERACTIVE GUITAR IMPLEMENTING TONAL AUTOMATION ROBOTICS

STUDENT Sam Smith *BSA*
ADVISOR Roger Dannenberg *Computer Science*
ROOM/TIME Connan / 3-5 pm

I created a self-playing guitar that can be programmed and controlled by any user through electronic hardware. My design is unique in that most self-playing instruments have no user interface or interaction. My design will allow a non-expert to easily control and program the guitar.

GUTS: A NEW MUSICAL

STUDENT Alexander Petti *BSA*
ADVISOR Nancy Galbraith *Music*
ROOM/TIME Connan / 3-5 pm

Guts is the story of a group of survivors living in a military bunker 10 years after the zombie apocalypse. Their routines and their coping mechanisms are challenged and shattered when an outsider enters the bunker and makes them question what it means to be alive. Guts is a dramatic musical with book and lyrics by Bradley Plaxen and music by Alex Petti. The style of the musical is a fusion of alternative rock and musical theatre. At MotM, a video recording of the musical as well as songs from the soundtrack will be presented.

INTERACTIVE MUSEUM EXHIBIT

STUDENT Catherine Schwartz *BSA*
ADVISOR David Boevers *Drama*
ROOM/TIME Dowd / 12:40 pm

I want to design a fun, interactive museum exhibit aimed at children to teach them basic physics, and to hopefully get them interested in physics, and in science in general. I believe that even people who do not chose to go into STEM fields should have an understanding of and an appreciation for science, even if they don't understand the math behind the science. Science encourages questioning and wonder about the world around us.

MUSIC IN THE PEDIATRIC DENTAL OFFICE

STUDENT Alexa Goetz *BSA*
ADVISOR Sharon Carver *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Medical professionals encounter patient anxiety and fear when working with and treating patients. Studies have been conducted that used music in different capacities in order to help alleviate negative feelings experienced by patients, before and during procedures. However, in the field of dentistry, and pediatric dentistry specifically, the positive effects that music can elicit have not been studied in the same regard. Anxiety experienced by dental patients that deters them from routinely visiting the dentist is currently a problem that is faced by the field, and it can be traced back to childhood experiences in the dental office. This study investigates whether different types of music provided to children ages 5-15 while getting a dental procedure done are effective in helping them feel more at ease while in the dental chair. Two different types of music, stimulative and sedative, in addition to a no music control, were randomly given to children to listen to via an iPod with headphones. During the dental procedure, the child's behavior was assessed by an observer using Frankl's Behavior Rating Scale at timed intervals for the duration of the procedure. Also, parents of the children were asked to complete the Child Fear Survey Schedule-Dental Subscale (CFSS-DS) in order to evaluate prior anxiety levels of the child. Data analysis will take into consideration the results of the CFSS-DS and the child's behavioral observations in order to determine whether or not either type of music was effective in helping to reduce anxiety experienced by pediatric dental patients.

POLARIMETRIC DETECTION OF ENANTIOSELECTIVE ADSORPTION BY CHIRAL AU NANOPARTICLES - EFFECTS OF TEMPERATURE, WAVELENGTHS AND SIZE

STUDENT Alexander Petti *BSA*
ADVISOR Nisha Shukla *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:30 am

The purpose of this talk is to explain how the polarimetric detection of enantioselective adsorption of chiral gold nanoparticles is affected by the temperature, wavelength of measurement, and nanoparticle size. This research is significant to the pharmaceutical community because some bioactive chiral enantiomers need to be completely separated from their chiral counterpart to work effectively. In this experiment, gold nanoparticles between 4nm and 80 nm in size were produced. Chiral ligands were attached to these solutions of gold nanoparticles and the solutions were then tested at wavelengths of 365, 436, and 546 nm and temperatures of 23, 30 and 40 °C. Measurements of the optical rotation of the solutions were taken after incrementally increasing the concentration of racemic propylene oxide (rac-PO) in the solution.

The results from the experiment are nine graphs of optical rotation over concentrations of rac-PO various wavelengths, temperatures, and nanoparticle sizes. It was found that when wavelength and nanoparticle size are decreased and temperature is increased, the sensitivity of the optical rotation of the chiral solutions increases.

COMPUTATIONAL BIOLOGY

USING CONTEMPORARY IMAGING TECHNIQUES TO CHARACTERIZE BRAIN INJURY IN SEPSIS

STUDENT Victor Hsue *Computational Biology*
ADVISOR Natalia Hiller *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:15 am

The incidence of sepsis is expected to increase at a rate of 1.5% per year. As mortality caused by sepsis is on the decline, attention is being focused on organ damage that accompanies sepsis. The pathophysiology of sepsis-associated encephalopathy remains incompletely understood. Several hypotheses have been proposed and include neuro-inflammation, danger-associated molecular patterns (DAMPs) and cholinergic neurotransmitter pathway dysfunction. Last semester, I demonstrated that plasma HMGB1 and mtDNA are elevated in children with severe sepsis. We hypothesize that elevated DAMP concentrations provide a mechanistic link for the pathogenesis of brain damage in sepsis. Hence, as a first step, using a murine model of sepsis, I will use magnetic resonance imaging (MRI) to define the brain injury in sepsis. This research could lead us to a better understanding of sepsis-associated encephalopathy and its underlying mechanisms, thereby helping in designing therapeutic approaches.

WHAT'S IN A NAME? AN EXPANDED CLASSIFICATION OF XENOLOGS

STUDENT Charlotte Darby *Computational Biology*
ADVISOR Dannie Durand *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:00 am

Horizontal gene transfer (HGT) occurs when a species acquires a gene from a source other than its ancestor. The term "xenolog" is used to refer to genes related through HGT. However, this general term does not distinguish between the many different ways HGT can affect a gene family, depending on how many transfer events occurred, when they occurred, and which species were involved. We propose a formal framework for classifying xenologs into different subtypes, based on comparison of the gene family tree with the associated species tree. Our framework imparts structure and meaning to evolutionary relationships in any gene family history. It also provides the foundation required to develop a software package to automate the classification process. We also show how our conceptual framework can be applied to genes in the S. cerevisiae biotin synthesis pathway. This example demonstrates how our terminology facilitates interpretation of functional relationships between xenologs.

DIETRICH COLLEGE OF HUMANITIES & SOCIAL SCIENCES

ECONOMICS

AN ECONOMETRIC ESTIMATION OF DEADWEIGHT LOSS IN PENNSYLVANIA'S WATER MARKET

STUDENT Brent Heard *Economics*
ADVISOR Joachim Groeger *Economics*
ROOM/TIME Wright / 12:00 pm

Industrial water demand in the state of Pennsylvania is anticipated to increase in the near future due to the expansion of hydraulic fracturing of the Marcellus Shale. Pennsylvania's water markets are increasingly operated by investor-owned water monopolies, and have prices regulated by the Pennsylvania Utility Commission (PUC). The PUC's decisions on whether to approve or deny changes in the price of water can take up to nine months. This thesis estimates the quantity of deadweight loss attributable to regulatory lag in Pennsylvania's water markets in a scenario of increasing demand. In this work, the model for a natural monopoly facing a price ceiling is defined, followed by an estimation of the relevant cost and revenue curves for a representative Pennsylvania water monopoly, after which residential and commercial water demand were estimated, with deadweight losses then being calculated. The outcome shows that when water demand increases such that existing price ceilings in Pennsylvania water markets are binding, the approximated deadweight loss is notably larger than when they do not bind. This finding indicates that if maintaining market efficiency is a goal for the PUC, this commission should aim to respond as dynamically as possible to changing market conditions when regulating monopoly water pricing.

APPROACHES TO BLOCKING FOR SYRIAN WAR RECORDS

STUDENT Peter Sadosky *Economics*
ADVISOR Rebecca Steorts *Statistics*
ROOM/TIME McKenna / 12:40 pm

The estimation of casualties of war is an important pursuit in the field of human rights. In order to estimate the number of casualties during the course of war, we turn to record linkage, which is the process of merging multiple databases to remove duplicate entities. The process of merging databases, which is often done by comparing each death record to every other death record, is computationally intractable as the number of records grows. Thus, a central component of such an approach computationally is blocking, which partitions records into similar groups. We investigate multiple implementations of blocking, evaluating our methods on a set of Syrian Civil War databases and their subsets. First, we investigate variants of locality sensitive hashing (LSH), which place similar records into the same block based on hash functions. Second, we investigate conjunctions, which define context-specific rules for blocking records. Third, we propose combining a certain variant of LSH with a set of conjunctions.

CARNEGIE MELLON UNDERGRADUATE STUDENTS' ATTITUDES TOWARDS THE UNIVERSITY'S CURRENT ATHLETIC FACILITIES AND THEIR ANTICIPATION FOR THE NEW CUC GYM

STUDENTS Charlton Cheng *Economics* | Leeann Choi *Statistics* | Yifan Leng *Statistics* | Michelle Ong *Economics* | Danielle Peters *Science and Humanities Scholars*

ADVISOR Jared Murray *Statistics*

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

Our project topic is relevant to Carnegie Mellon University's plans to upgrade the current athletic facilities by expanding the Cohon University Center. In the midst of CMU's heavy workload and and stress culture, it is beneficial for each student to maintain a healthy lifestyle by taking advantage of the athletic facilities provided by the university. Therefore, implementing a survey of students' attitudes regarding the existing university athletic facilities' gym equipments, layouts and other services offered is relevant and timely. The athletic facilities consist of the Cohon University Center (CUC) Gym, Skibo Gym, and several gyms located in different campus dorms. Since the university has planned major improvements for its athletic facilities in the CUC, it will also be beneficial to understand students' attitudes on the upcoming improvements.

These responses will provide useful information to the university as it seeks to refine its athletic facilities to better cater to the student population. The university can also incorporate this information into future efforts to design and plan the new athletic facilities.

CMU COMMUNITY'S ATTITUDE TOWARD CROSS REGISTRATION AT PITTSBURGH AREA COLLEGES

STUDENTS Shaheen Essabhoy *Economics and Statistics* | Alexander Malerba *Statistics* | Matthew Reid *Economics* | Martin Smith *Economics* | Sasha Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

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

For our survey project, we have decided to study how much the Carnegie Mellon Community knows about cross-registration through the Pittsburgh Council on Higher Education (PCHE). This is interesting because it can give university administrators as well as the Student Senate a better idea of which resources are actively used and valued by the community. This will allow them to better target university policies that need improvement and prioritize based on student needs. The results of our study will determine whether the lack of cross-registration in CMU is based on lack of interest in the process or lack of knowledge about the availability of cross-registration. Our survey is best executed now because the issue of cross-registration at other PCHE institutions is currently debated by the student senate and the survey will help them make decisions and arrive at a more efficient solution.

EFFECT OF WEALTH TAX ON INVESTMENT

STUDENTS Terrell Bobb *Economics* | George Kurosawa *Economics*
ADVISORS Rebecca Lessem *Economics* | Ariel Zetlin-Jones *Economics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

This paper aims to study the effects of wealth taxes on investment, specifically to study whether wealth taxes increase or decrease investment levels in an economy. Our motivation behind studying the effects of wealth taxes is based on the fact that wealth taxes have increasingly entered the public discourse regarding ways to fight income and wealth inequality around the world. The rhetoric from policy makers around the world is increasingly tending towards greater taxation and also newer forms of taxation such as wealth taxes. Hence we want to study the effects of such a tax on investment as it could become prevalent in the near future. We first looked at data from a few countries such as Spain and France where wealth taxes have been implemented for at least a few decades. Through a preliminary data analysis where we studied the growth accounting figures for these countries, we conclude that wealth taxes as of today are being implemented at small scales and it is likely that we are not able to discern its macroeconomic effects as a result. Due to these limitations we build a two period representative agent model where we use corporate profit taxes as a proxy for wealth taxes. Our results from the model are as follows: The timing of taxes is more important than the overall level of taxes. In essence firms will try to optimize their investment level based on the marginal benefit of investing today versus tomorrow which is dependent on the current and future tax rates. Finally we ran an OLS regression on the log-log form of our model and found it to mostly affirm the predictions of the model.

EXAMINING APPLICATIONS OF FOURIER TRANSFORMS TO FINANCIAL DATA AND COVARIANCE ESTIMATION

STUDENT Stanley Krasner *Economics*
ADVISOR Yaroslav Kryukov *Economics*
ROOM/TIME Wright / 1:00 pm

Fourier transforms project functions and signals onto a space of orthogonal trigonometric functions. The transform preserves all the information contained in a function and gives insight into the spectral, or different frequency, components that make up the function. As a result, they have been useful in many fields of engineering, mathematics, statistics and finance. This paper will discuss some potential new uses of Fourier transforms in financial time series analysis. First, we show that traditional autoregressive models omit information that is captured by a Fourier transform. We then apply spectral decomposition to obtain better parameter estimates for a stochastic process. We conclude with a technique to obtain cleaner covariances for different assets using the Fourier transform.

EXAMINING THE RELATIONSHIP BETWEEN EDUCATION INEQUALITY AND INCOME INEQUALITY

STUDENTS Kelsey Choing *Economics* | Danielle McKinney *Economics*
ADVISOR Ariel Zetlin-Jones *Economics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

For our senior project, we are interested in understanding the relationship between income inequality and inequality in educational attainment, as well as understanding the relationship between inequality in educational attainment and GDP growth. Using data on educational attainment from 26 countries globally, we construct educational attainment Gini coefficients, which consider the dispersion of the percentage of years of attainment across shares of the population, as a measure of inequality in educational attainment levels across time and countries. Through this inequality measure, we find that educational attainment is becoming more equitable with time, as evidenced through decreasing values of our educational attainment Gini coefficients, and overall average levels of schooling are increasing globally as well as across developing, emerging, and developed economies.

Our analysis reveals an insignificant negative correlation between income inequality and inequality in educational attainment, such that, contrary to our hypothesis, higher levels of income inequality are correlated with lower levels of inequality in educational attainment on a global scale. This relationship becomes significant when restricted to analysis in developed countries. Additionally, contrary to our expectations, there is an insignificant positive correlation between educational attainment inequality and the ten-year average growth rate of GDP per capita globally. This positive relationship is strongest in developed countries. The correlation is negative for developing countries. Overall, our largely insignificant results suggest limited effectiveness of policies targeting these types of inequality and a need for further analysis to better understand what is driving these relationships.

FROM BURGER TO BURRITO: EXAMINING GROWTH AND DEVELOPMENT IN THE FRANCHISED RESTAURANT MARKET

STUDENTS Noah Cohon *Economics* | Alex Gerber *Economics* | Pablo Santiago *Economics*
ADVISORS Rebecca Lessem *Economics* | Ariel Zetlin-Jones *Economics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Everyone needs to eat to survive, and many choose to dine out at restaurants.The problem here is simply stated. What is the optimal time to open or close a restaurant in a particular location? Using data from Chipotle and Wendy's, examples of financially successful restaurant chains (the former relatively new and the latter relatively established), we test which macroeconomic variables affect the growth rates of Chipotle and Wendy's over time across all of the United States. We hypothesized that the number of university students in an area and the annual amount spent on dining out at restaurants would be most statistically significant in our set of regressed models, as well as poverty rate and the average income per capita. It appears that for Chipotle, number of university students had the most statistical significance whereas for Wendy's, population, consumption and a few other variables all displayed statistical significance. Chipotle's fiscal success and constant positive growth of restaurants in a turbulent economic period suggests that there may be more emphasis on non-economic factors affecting restaurant growth. We conclude that restaurant growth can, in fact, be roughly modeled with a few economic factors, but which factors those are may be dependent on the general economic volatility of the nation.ze general economic volatility of the nation.

IMPROVING PORTFOLIO PERFORMANCE USING MARKET TIMING: EXAMINING IF A PREDICTING VARIABLE CAN INCREASE PORTFOLIO PERFORMANCE

STUDENTS Matthew Greenberg *Economics* | Anton Razanav *Economics* | William Sanders *Economics*
ADVISOR Ariel Zetlin-Jones *Economics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This paper analyzes the theory that it is possible to increase a portfolio's risk adjusted returns over time by adjusting the allocation of capital within asset classes based on predictive variables. Namely, our study examines whether it is possible to predict the relative outperformance of Hi- Tech versus the S&P 500 in any given year, based on the real trailing 10-year average silicon price. This analysis revealed that as the real 10-year average silicon price declined, the excess returns to Hi-Tech were expected to increase. By backtesting our model and adjusting our allocation to Hi-Tech upwards and downwards based on the real 10-year average silicon price, we were able to achieve superior absolute, and risk adjusted returns, versus the set optimal allocation to Hi-Tech.

OPINIONS AND SATISFACTION WITH BLACKBOARD COURSE MANAGEMENT SOFTWARE AMONG UNDERGRADUATE STUDENTS

STUDENTS Jay Kapur *Social & Decision Sciences* | Stanley Krasner *Economics* | Matthew Limbu *Economics* | Hae Jin Park *Economics* | Quan Yuan *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The most recent Blackboard satisfaction survey was completed in 2007 though Blackboard has been updated and upgraded since then.

We conduct a survey of randomly selected Carnegie Mellon Undergraduates at the Pittsburgh campus to learn more about student perceptions about Blackboard use, commonly used features and overall satisfaction. This research was designed and conducted along side 36-303 Sampling, Surveys and Society.

SPECK: VISUALIZING AIR QUALITY IN U.S. CITIES

STUDENT Shouvik Mani *Economics*
ADVISOR Illah Nourbakhsh *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 11:00 am

The Speck Visualization is a CREATE Lab project that aims to inform citizens about the air quality in their region using real-time data from federal AirNow stations. Poor air quality takes a significant toll on human health and the environment. According to the American Lung Association, the Pittsburgh region ranks as the sixth worse in the nation for fine particle pollution levels, and more than a quarter million people in region suffer from asthma.

To address this issue, the Carnegie Mellon CREATE Lab has developed Speck, a low cost, indoor fine particulate monitor that empowers citizens to understand and take control of the air in their homes. In addition to monitoring the air quality in their homes, it is important that citizens understand the air quality in their region. The Speck Visualization solves this problem by aggregating real-time data from federal AirNow stations placed across the United States. The Javascript application identifies the user's current location using HTML5 geolocation and

pulls all the nearby AirNow feeds from a database. Then, it plots these feeds as markers on a map so that users can explore the pollution data in their area. The result resembles a weather map, but for air pollution. The goal of this project is to enable users to compare current air quality levels between different regions and understand the air quality in their region. Once users understand the problem, they can be empowered to take action and push for policy changes.

ECONOMICS AND STATISTICS

CMU COMMUNITY'S ATTITUDE TOWARD CROSS REGISTRATION AT PITTSBURGH AREA COLLEGES

STUDENTS Shaheen Essabhoy *Economics and Statistics* | Alexander Malerba *Statistics* | Matthew Reid *Economics* | Martin Smith *Economics* | Sasha Zhang *Statistics*

ADVISOR Jared Murray *Statistics*

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

For our survey project, we have decided to study how much the Carnegie Mellon Community knows about cross-registration through the Pittsburgh Council on Higher Education (PCHE). This is interesting because it can give university administrators as well as the Student Senate a better idea of which resources are actively used and valued by the community. This will allow them to better target university policies that need improvement and prioritize based on student needs. The results of our study will determine whether the lack of cross-registration in CMU is based on lack of interest in the process or lack of knowledge about the availability of cross-registration. Our survey is best executed now because the issue of cross-registration at other PCHE institutions is currently debated by the student senate and the survey will help them make decisions and arrive at a more efficient solution.

DETECTING CONNECTED PAIRS OF GALAXIES

STUDENT Yitian Feng *Economics and Statistics*

ADVISOR Peter Freeman *Statistics*

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

Galaxies interact and merge over time, though some galaxies are farther apart than others and not able to become pairs. What we want is an algorithm that can differentiate random pairs from connected pairs. One way to detect interaction is to detect streams of material that connect two galaxies. We apply an algorithm for detecting one-dimensional filamentary structures in image data. By observing the outputs of a large amount of close-pair galaxies, we try to estimate the relations between the distance and the possibility of connection.

FANTASY OR REALITY? EXPECTED SALARY PERCEPTIONS OF CARNEGIE MELLON UNIVERSITY UNDERGRADUATE STUDENTS

STUDENTS Dina Berdichevsky *Statistics* | Manuel Garber *Statistics* | Nicholas Lam *Economics and Statistics* | Yuka Moroishi *Statistics* | Angelina Tang *Statistics*

ADVISOR Jared Murray *Statistics*

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

This topic has an immediate bearing on students' choices of majors. When a student enters his or her first year of education, he or she puts down a payment of $60,000 every year in hopes of achieving a higher present value of future cash-flow. This survey must be done as soon as possible to educate students in the difference between their perceptions of their future and what is already statistically predicted for them. If we find a discrepancy between the two, then this indicates a lack of awareness and possible future issues for students who are deciding. The client of our survey is every university student who is picking a major or deciding to change majors that they believe will allot them a certain future opportunity.

HIGH FREQUENCY TRADING, INTERNATIONAL MARKETS, AND REGULATION

STUDENT Marko Hudak *Economics and Statistics*

ADVISOR Stephen Spear *Economics*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 10:45 am

In a recent interview with 60 Minutes, prominent author Michael Lewis explained, "the United States stock market, the most iconic market in global capitalism, is rigged." Millions of unregulated transactions occur in fractions of a second on a daily basis, avoiding documentation.

Several key players are paying hundreds of millions of dollars to gain unfair advantages at the expense of traditional game players. High frequency trading has been publicly scrutinized for its adverse effects to the domestic market place. Nowadays, it is not uncommon to find an article about an investigation due to high frequency traders colluding and sharing private information in a major news publication. This fascinating, evolutionary topic has gained mass attention, yet received limited regulation from authorities in charge of maintaining a fair market environment. With an ever-changing technological landscape, it is paramount to maintain the integrity upon which the stock exchanges and extended marketplaces were founded.

HISTORICAL META-ANALYSIS WITH A FOCUS ON PATTERNS OF TRANSPORTATION TO WORK

STUDENTS Anwesha Patnaik *Economics and Statistics* | Deahan Yu *Statistics*

ADVISORS Rebecca Nugent *Statistics* | Joel Tarr *History*

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

Walking to work as a mode of transportation has been decreased over the last century. Especially, from the early 1900's to the start of the Second World War, there must have been changes in patterns of work transportation due to expansion of place of employment such as downtown commercial areas. We have traffic study reports for Chicago (1916), Atlanta (1924), Baltimore (1925), Milwaukee (1928), Cleveland (1935), Allegheny County (1937), and Cuyahoga County (1940). Most of reports contain data such as mode of traveling to downtown

districts, pedestrian counts at certain streets on certain week and weekend day. From this analysis, we aim to find out changes in work transportation, patterns of people walking to work over time, and possible factors that contributed to the change in "Walking to work" patterns. Our method is meta-analysis with various data of different locations and times.

MODELING EBOLA TRANSMISSIONS

STUDENTS Adrian Botta *Economics and Statistics* | Andersen Chang *Statistics* | Abigail Smith *Mathematics*
ADVISORS William Eddy *Statistics* | Rebecca Nugent *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The most recent Ebola Hemorrhagic Fever (EHF) epidemic has grown to over twenty-five thousand cases, and over ten thousand deaths. Following the EHF outbreak in 2013-2014, a lot of research has been published in search for a model that could accurately simulate the spread of this disease. While existing research focuses on applying compartmental models to the data from each country and expanding the simpler SIR model into a more complicated SEIHFR model, we use compartmental models to simulate the spread of the EHF virus across the borders of the three countries most affected by the outbreak, Guinea, Liberia, and Sierra Leone. Using the EpiModel package in R, we optimize for the parameters of each model and assess a goodness of fit for each individual country. We then look at ways to combine cross-border movement data in Western Africa to model the spread of disease from one country to another.

SAMPLING GENOTOXICITY OF CHEMICAL STRUCTURES USING METROPOLIS-HASTINGS ALGORITHM

STUDENT Keon Woo Kim *Economics and Statistics*
ADVISOR Joseph Kadane *Statistics*
ROOM/TIME Dowd / 3:40 pm

Having toxicity data of chemicals, the question is how to find the genotoxicity data of chemical structures. While collecting data regarding chemicals through lab experiments is feasible, collecting data regarding chemical structures is relatively difficult by lab experiments. In order to bridge between chemicals and chemical structures, a Markov Chain Monte Carlo method is used. Metropolis-Hastings Algorithm, a type of random walk Markov Chain Monte Carlo, uses toxicity data of chemicals and generates sample of genotoxicity data for chemical structures. This application of Bayesian statistics strives to generate accurate sample distributions of the probability of toxicity of each of the chemical structures that are present in chemicals. Cross validated results suggest problems with the prediction power of the models hypothesized.

ENGLISH

COLLAGED NARRATIVE

STUDENT Jacqueline James *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME McKenna / 1:20 pm

Consider the black and white photograph found in your grandmother's attic. The face of the man climbing into the car, gazing hopefully at the camera, projects a certain mystique. Where is he going? Why is he smiling? Does he live happily-ever after? The photograph's image is faded: the man's story is left untold. Until now.

Sometimes disfigured with age, sometimes faded from misuse, almost always forgotten, we will use these lives as triggers to form our own narrative. We will work with discarded photographs that we have discovered in antique stores over the past year to create original, albeit speculative, narratives – art derived from found objects. We will provide the text behind each face and string them together into one full narrative. 50 photographs will each give rise to a short episode. These episodes will be posted on a shareable web-based archive and compiled into a bound book prototype. We hope to represent a cultural moment by reinventing the story of the photographs and push students' understanding of image and narrative. In our hyper-individualized time, our connection to the past is eroding faster than it ever has before. The work will not only expose our human connectivity, but also our generational solidarity; our unity most strongly represented in lost and anonymous black and white photographs.

DEVELOPING AND DECONSTRUCTING GENDER: NONBINARY INDIVIDUALS AND THEIR SEARCH FOR IDENTITY

STUDENT Jasmine Xie *English*
ADVISOR Kristina Straub *English*
ROOM/TIME McKenna / 3:40 pm

This paper examines the emergence of a new ways of discussing and naming gender identities that arose out of discourse generated by nonbinary-gender identified individuals on the social microblogging website, Tumblr. Nonbinary individuals - people whose gender falls outside the binary of male vs. female - experience a structural erasure of their identity due to the lack of existing, widespread terminology to describe their identity. To address this problem, as well as to challenge the role that gender plays in one's identity, nonbinary individuals are creating new terminology to describe their gender identity while changing how gender is discussed. This ultimately has the effect of destabilizing the notion of gender as fixed, inherent, and unambiguous. Through these new ways of discussing gender, nonbinary individuals are able to shape current gender discourse to better accommodate for and include their identities. To form a theory of how nonbinary users of Tumblr changed the common gender discourse to reflect their identities, this paper analyzes an extensive sampling of posts made on Tumblr by nonbinary individuals from 2013-present day, in which they discuss their gender identity, pronoun usage, and their conceptualizations of what gender is. By organizing these posts according to what aspect of gender is discussed, categories of difference can be established and further analyzed to discover the functional purpose of each type of post. Furthermore, my findings indicate that these new ways of discussing gender are unanticipated by previous theoretical works, and reflect an emergent view of gender that could become a new paradigm for conceptualizing gender.

HONORS PROJECT: A COLLECTION OF POEMS

STUDENT Von Wise *English*
ADVISOR Kevin Gonzalez *English*
ROOM/TIME Dowd / 1:00 pm

My project will be a collection of poems surrounding the life of Seth Croak, a fellow native of Lock Haven, Pennsylvania and close acquaintance. These poems will aim at capturing the life, goals, and pursuits of this truly interesting person whom I've come to respect since knowing. I hope to interview and potentially spend time living with him over the summer while he is away for his job cutting down trees, getting a sense of how he lives at work, and what his experiences are with his job and work mates. Ultimately, this project will capture in poetry the life of a working-class, rural Pennsylvanian, and how his life represents an often overlooked class of American citizen.

PICK YOUR POISON: A TEN MINUTE FILM

STUDENT Elana Goldberg *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME Pake / 1:40 pm

Miscommunication has served as a universal experience since the caveman days. Yet 200,000 years into humanity, and still, each day the failure to communicate launches a chain of unwanted reactions and repercussions. Miscommunication has changed the course of history. It has also laid the foundation of various keynote romantic comedies. As a screenwriter, I wrote and produced a ten-minute film based on the timeless miscommunication plot. I explore, not just the backlash, but also the accountability of the characters, focusing beyond how they miscommunicate, and into why they are incapable of communicating effectively. In a world filled with missed connections, how can one point blame on either the deliverer or the recipient, and perhaps more importantly, how does one choose which opportunity to reconnect?

SUMNER AND MURPHY, INCORPORATED

STUDENT Marisa Breitfeller *English*
ADVISOR James Daniels *English*
ROOM/TIME Pake / 3:40 pm

A senior honors thesis, this project is the first one hundred and fifty pages of a full fiction novel entitled "Sumner and Murphy, Incorporated". The novel follows a genderqueer protagonist's adventures at a unique detective agency, which uses the ability to enter and manipulate clients' dreams to solve odd-jobs cases. Using elements of Jungian psychology and Joseph Campbell's heroic archetypes, the story explores themes like the question of normality and how 'abnormal' individuals are marginalized by society, the distinction between true personal growth and change for change's sake, and the factors--external or self-inflicted--that we allow to influence our identities and presentation. A goal of the thesis was to create a primarily character- and theme-driven work that nonetheless has the pace and premise of a plot-centered genre fiction. The intended result is a work that appeals to both casual and dedicated readers, raising awareness of important issues without being necessarily "about" any one message.

THE CONTEXTUAL IMPLEMENTATION OF HEALTH TECHNOLOGIES IN OVERDOSE CONTROL AND HEPATITIS C PREVENTION

STUDENT Chloe Lula *English*
ADVISOR Caroline Acker *History*
ROOM/TIME Dowd / 4:40 pm

My senior honors thesis examines two public health issues - opiate overdose and hepatitis C - and explores the socioeconomic barriers barring patients from access to care, as well as the emerging forms of treatment that are making care increasingly accessible. In formulating my argument, I assert that traditional public health measures have failed to take the contextual factors of care into account for patients who come from limited-resource settings, and that there needs to be a greater emphasis on how to best implement health technologies to ensure their success in a real world environment.

THE PLAYERS, THE RULES, AND THE WORLD

STUDENT Michael Mingo *English*
ADVISOR Kevin Gonzalez *English*
ROOM/TIME Pake / 4:40 pm

"The Players, the Rules, and the World" is a short, full-length manuscript of poems that address political and historical topics. The goal of the collection is to encourage the reader to view the broad concept of politics from a variety of perspectives. The collection is divided into three sections. The first section, "The Players," consists of poems about or addressed to figures from different periods of history, from Tacitus to Bruce Springsteen. The second section, "The Rules," includes poems about process politics and political theories, as well as pieces mimicking the form of official documents. The final section, "The World," shifts focus to day-to-day experiences living in the political world: buying tickets at the airport, or driving down the interstate. By the end, the reader should have a better appreciation for the complexities of political life.

TRANSLUCENTLY, THE ORANGE SLEEPS AGAIN

STUDENTS Laura Berry *English*
ADVISOR Yasufumi Iwasaki *Modern Languages* | Anthony Stanton *Business Administration*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Japanese comics, or manga, have gradually made their way into the United States as early as the 1970s. Today the lively American manga market occupies its own section in any major bookstore, yet the medium itself has trouble overcoming its niche status. The publishers who put forth these books face a number of challenges in trying to create a high-quality product with broad appeal: a) they rarely have the opportunity to license high-concept or experimental works, as they pose too great a financial risk, b) they are not equipped to pursue projects with smaller print runs to avoid financial deficit, and c) the existing population of Japanese-English translators is largely accustomed to technical, not creative, translations, compromising the quality of the prose. My translation of Youichi Abe's "Translucently, the Orange Sleeps Again" aims to overcome these challenges. "Translucently" is a unique work in that it bridges the gap between high-concept artistry and the human literary themes that transcend cultural boundaries. Using the skills I have acquired in Japanese, creative writing, and print design classes here at CMU, I intend to translate, letter, and publish this comic to demonstrate the importance of creative media in fostering compassion across cultures of different people.

WHAT KEEPS US GOING: AN EXPLORATION OF EXPERIENCES AT THE EAST END COOPERATIVE MINISTRY

STUDENT Braden Kelner *English*
ADVISOR Jane McCafferty *English*
ROOM/TIME Pake / 11:40 am

As I volunteer at the East End Cooperative Ministry's food pantry in East Liberty, I explore my relationship with my grandfather, a man who lives in poverty and who I consider to be homeless. I relate my thoughts about him to my experiences with the people at the pantry. The people at the pantry tell stories and relate conditions that make me reconsider my previous thoughts about my grandfather. They help me to work out my frustrations with his conditions and accept how he lives.

WILD

STUDENT Jenna Bodnar *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME Wright / 12:20 pm

Wild is a collection of essays about the unseen side of the Pittsburgh Zoo & PPG Aquarium. The articles are compiled into an e-book that I designed to be visually compelling. Upon completion, the book will be distributed by the Pittsburgh Zoo & PPG Aquarium so that its visitors can read and learn about the animals at the zoo and the care they receive.

ETHICS, HISTORY & PUBLIC POLICY

HIGHER EDUCATION, INEQUALITY AND MENTORING: AN INQUIRY IN SOCIAL VALUES

STUDENT Marie Avilez *Ethics, History & Public Policy*
ADVISOR Nico Slate *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Throughout the world, the higher education system is riven with inequality. Higher education can be a fundamental stepping stone to upward mobility. Unfortunately with the cost of education increasing internationally, it is harder for students from marginalized groups or lower socioeconomic status to achieve an education that could provide them with financial stability. I argue that mentoring is a key aspect to fighting this inequality. There are several different types of mentoring. Often mentoring programs reflect what a society values. Some emphasize professional learning, whereas others focus on personal growth and development. While mentoring is vital in fighting inequality, it is important to remember that it must be done right to be effective. It is also important that

mentees have access to professional and personal growth opportunities in order to shift the higher education system from one that creates inequality to one that creates equality.

SHAKESPEARE AND ECONOMICS: CONNECTING THE LIFE AND DEATH OF KING JOHN TO CHANGES IN ENGLAND'S ECONOMY DURING SHAKESPEARE'S TIME

STUDENT Dhruva Krishna *Ethics, History & Public Policy*
ADVISOR Christopher Warren *English*
ROOM/TIME Pake / 3:20 pm

During the late 16th century and the 17th century, Europe was going through huge changes economically, socially, and politically. One of the most transformative changes was the change from feudalism to more globalized systems of trade involving mercantilist ideas. During these changes, William Shakespeare was writing his works. My presentation seeks to answer how Shakespeare's work, King John,comments on and shows the economic changes of his times.

SHOULD DIVISION 1 COLLEGIATE FOOTBALL AND BASKETBALL PLAYERS BE PAID? AN HISTORICAL, ECONOMIC, AND LEGAL ANALYSIS OF THE PAY-FOR-PLAY DEBATE IN COLLEGIATE ATHLETICS

STUDENT Colin Shaffer *Ethics, History & Public Policy*
ADVISOR Jay Aronson *History*
ROOM/TIME Wright / 4:40 pm

Division 1 men's college athletics has become a mainstay in American culture. On Saturdays in the fall, people come together to watch their alma mater or a regional football powerhouse play their rival for bragging rights, generating prime marketing opportunities for beer, car, and fast food companies and millions of dollars in advertising revenue for broadcasters. Every spring, the entire country is engulfed in "March Madness" as the NCAA basketball tournament unfolds. People root for their own teams and wait with anticipation to see which mid-major team upsets a major power to become the "Cinderella Story" of the tournament. While amateur athletics emerged as a way to "enhance the educational experience of students," over time it has become a significant profit-generating venture. Universities are making millions of dollars off of their football and basketball programs, yet the student-athletes do not receive any compensation aside from free tuition and other perks (for those lucky enough to receive scholarships). Should college athletes who generate millions of dollars for their universities, for large corporations, and broadcasters, be paid? In the past few years, many journalists, lawyers, labor specialists, and academics have begun to wrestle with this question. The goal of this thesis is to provide some historical context for this debate.

This topic will give an historical viewpoint on the "pay for play" debate that deals with the ethics of the NCAA as a governing body, the economics behind division 1 collegiate football and basketball, and the race relation issues within athletics. The economics behind collegiate athletics is the driving force behind the debate of "pay for play". This research will explore the history of television contracts with particular universities, conferences, and the NCAA as a whole. In addition, this research will examine how money has challenged the ethical structure of the NCAA which has caused the recent threat of unionization by college athletes. In terms of racial issues, this research will examine how the impact of money and ethics on college athletics has affected the general university's schema

for recruiting, accepting, and retaining particular groups of people. In particular, this research will delve into the growing importance of youth football and basketball as structure in the lives of young African American men and the possibility of athletics being a way out of poverty stricken communities.

Sports have always had a unifying factor from a local to a global level. This research deals with a topic that, with all the appropriate information provided, could change the landscape of college athletics. This information pertains to student-athletes, universities, the NCAA, major sports networks, and most importantly, future generations. It is important to understand how and why college athletics got to where it is today so we can be fully equipped to deal with the "pay for play" debate, and I intend to provide those answers.

It will examine the history of the NCAA and its relationship with member institutions as intercollegiate athletics became "big-business", the legal history for the NCAA and its member institutions with respect to labor law and unionization, and the economics of revenue generating Division 1 college athletics and the financial commitment between the NCAA, its member institutions, and outside stakeholders such as entertainment corporations. It will also undertake a historical and ethical analysis of the "pay for play" argument, culminating in a proposal for eventual adoption. Hopefully, this thesis will help to lay the foundation for a fair and just decision to be made on the "pay for play" argument in collegiate athletics.

HISTORY

#INSTACUBA: VIEWING CUBAN IDENTITY THROUGH THE TOURIST FILTER

STUDENT Natalie Giannangeli *History*
ADVISOR Therese Tardio *Modern Languages*
ROOM/TIME McKenna / 12:00 pm

Throughout history, Western tourists have fetishized the people and culture of their non-Western destinations. Tourists have traveled to Latin America imagining scenes of tropical beaches and "exotic-looking" women. Although tourism in Cuba has its specific history and complexities, it is a part of this broader narrative of tourism across Latin America. Prior to 1959, Cuba attracted more tourists than any other Caribbean island, as the Cuban government and travel agencies presented the island as an exotic paradise for tourists' self-indulgent pleasures. However, the Cuban Revolution in 1959 put an end to the gambling and prostitution that attracted many tourists. It was not until the fall of the Soviet bloc in the 1990s that the government turned to tourism as a way to generate capital and attract hard currency quickly. Realizing tourists' desires to see a romanticized ideal of the "last socialist country", the Cuban government promotes celebratory images of the Revolution alongside the capitalist excesses of sex from the 1950s and tropical paradise that once characterized the tourist attractions on the island. American cars and street murals of Che Guevara are common appearances in the images that tourists post on the social media platform, Instagram. While tourists post pictures of destinations throughout Latin America on social media, the case of tourist social media in Cuba is vastly different from other destinations. A lack of infrastructure and government restrictions makes consistent access to the Internet difficult for Cubans. On the island, tourist hotels have Internet service available for purchase, but the service is too costly for the majority of Cuban nationals. Most Cubans remain without the ability to use and contribute to new interactive web spaces, such as Instagram. Therefore, foreigners

control the Cuban presence on this social media platform. The images that tourists choose to share perpetuate the idea of Cuba as the last socialist paradise: a representation the Cuban state desires in order to continue to attract tourists and to preserve the image of the survival of socialist ideals, despite an increasingly capitalistic reality. Previous research examines social networks like Twitter and Facebook's impact on the tourist industry, but the role of Instagram in the industry has not had the same attention. This paper will explore the intricacies of the identity of Cuba and its people on Instagram.

COLLECTIVE SECURITY VS. APPEASEMENT: THE RESPONSE OF GREAT BRITAIN, THE UNITED STATES, AND THE SOVIET UNION TO THE RISE OF GERMAN FASCISM

STUDENT Julia Embody *History*
ADVISOR Wendy Goldman *History*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

In 1933, Adolf Hitler began seizing power over Germany and pursuing the occupation of European territory for the Reich. The period from 1934 to 1939 was marked by hesitation and a lack of international intervention that ultimately resulted in the loss of millions of lives. This thesis explores the response of three countries to the rise of German fascism and Hitler's expansionism by examining the press. It looks at the conflicting responses based in the collective security policy offered by the Soviet Union and the policy of appeasement promoted by Great Britain and the United States. Through close examination of the press, the aim of this research is to explore the different approaches of the three countries and as shaped by their geopolitical interactions, ideological orientation, and historical experience since World War I.

CORA OF NEW YORK: THE STORY OF A SLAVE SHIP

STUDENT Katherine Thomas *History*
ADVISOR Jane Bernstein *English*
ROOM/TIME McKenna / 3:00 pm

My project is an historical novel that explores the events of the 1860 capture of the slaver bark CORA, which was an American ship from New York illegally engaging in the West African slave trade. On September 25th, 1860, the flag ship of the US Navy's African Squadron, USS CONSTELLATION, intercepted her, rescuing the seven hundred Africans aboard, eventually transporting them to Monrovia, Liberia, where the fate of the recaptives remains largely unknown. My novel explores the backgrounds, prejudices, daily lives, and eventual destinies of the crews aboard both CORA and CONSTELLATION as well as those of the Africans trapped below.

DEVELOPMENT OF BROAD-SPECTRUM ANTIBIOTICS

STUDENTS Julia Atwood *Chemistry* | Emily Harwitz *Chemistry* | Cat Mao *History* | Adam Simpson *Chemical Engineering*

ADVISOR Danith Ly *Chemistry*

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

Bacterial infections are of rising concern in the world today. Antibiotics are of massive importance in controlling and eliminating potentially deadly infections, but due to widespread resistance are difficult to profitably research and produce. New classes of antibiotics, with different targets and mechanisms, must be sought and invested in to prevent a relapse to infection mortality of the pre-antibiotic era. The isolation and research of natural antimicrobial peptides offers intriguing drug leads. These molecules demonstrate potent antimicrobial activity in living systems and some have been shown to be immunomodulatory. Resistance to antimicrobial peptides so far has been slower to develop than in conventional drugs and may be combated further by synergistic effects when peptides and conventional drugs are used in combination. RTD-1 is a cyclic antimicrobial peptide in the theta defensin family isolated from rhesus macaque and baboons. It has been found to be effective against viruses, fungi and both gram-negative and gram-positive bacteria. Though effective by itself as an antimicrobial agent, the peptide is difficult to synthesize because of three disulfide cross-linkages that are necessary for the tertiary structure of the peptide. This obstacle was overcome by the incorporation of Peptide Nucleic Acid (PNA) monomers in a mimic of RTD-1, called RTD-1M. Previously, RTD-1M demonstrated similar antibiotic properties to native RTD-1 and low toxicity to human red blood cells.

We present the synthesis of a series of RTD-1M molecules with modifications to increase bactericidal potency and decrease production time and cost. These iterations will be tested via a combinatorial strategy and compared to currently available antibiotics and native RTD-1. Successful versions of RTD-1M could be developed into a novel oral therapeutic of a promising antibiotic class.

DO WE REALLY NEED THE MARINES? THE DISCOURSE OF OPPOSITION AND RECONCILIATION FROM THE 1770S TO THE 1970S

STUDENT Andrew Cobb *History*

ADVISOR Steven Schlossman *History*

ROOM/TIME McKenna / 4:00 pm

The United States Marine Corps is known for its heroic history. From the Revolutionary War to conflicts in Iraq and Afghanistan in the twenty-first century; from Chapultepec to Tripoli; and from

France to the islands of the Pacific, the Marines have established a legacy of operational prowess and dedication to duty. However, the pieces of Marine history that are often omitted in discussing "The Corps" are equally intriguing. As it turns out, the Marines have not always been considered an essential component of the American defense policy framework. In contrast, the definition and legitimization of a unique military mission for the Marine Corps has, historically, been bumpier than most Americans realize.

This study analyzes the discussions surrounding periodic attempts by members of various levels

of military and civilian leadership to disband, alter, or integrate the Marines into other branches of service. It also evaluates what the Marines did in response to successfully address these threats in their attempts to secure the future of the Marine Corps as an independent service.

In sum, the overarching narrative of this study shows that, regardless of the significance of Marines' contributions on battlefields, the security of their place within the national defense structure of the United States, even today, remains uncertain.

FIGURINES AND FINGER RINGS: LEVANTINE MATERIALISM, POLYTHEISM AND CULTURAL IDENTITY

STUDENT Noel Um *History*
ADVISOR Laurie Eisenberg *History*
ROOM/TIME McKenna / 4:20 pm

Archaeological discoveries regarding major Canaanite city-states during the late Bronze Age have shown the magnificent rise and fall of ancient cities including Hazor, Megiddo and Beit She'an. These cities were not only known as large Canaanite strongholds due to their prime locations for trade and commerce, but also as cross-cultural centers of urban development, as evidenced through the archaeological remains of the tel infrastructure. Along with advanced technology came a nuanced material culture that points toward the first signs of "higher culture" development. Centralized economies, formal burial systems, sewage systems and judicial systems burgeoned alongside development and evidence of intricate pottery, artwork, jewelry and amulet idols, all of which were shaped in some way by the polytheistic Canaanite religion. This research project will examine how the material culture of these Canaanite city-states points toward the development of higher culture and religious identity for the Levantine ancients.

LA LUTTE AGAINST HIV/AIDS AND STIGMATIZATION IN MOROCCO, 1986-2014

STUDENT Kristine Swarts *History*
ADVISOR Karen Faulk *History*
ROOM/TIME Pake / 12:40 pm

With its first identified case in 1981 in the United States of America, the human immunodeficiency virus infection and the acquired immune deficiency syndrome (HIV and AIDS) became an increasing problem throughout the world. In the 1980s, HIV/AIDS was a death sentence for any who had it. Today, it is a difficult, yet manageable, disease. But far more than just a medical problem, HIV/AIDS is a serious social epidemic resulting from the stigmatizations that arose with its discovery. While these stigmatizations still exist around the world, the Middle East and North African region (MENA) today is a leading area where HIV/AIDS are largely ignored. While these countries represent around 1% of the world cases (while consisting of 5% of the world's population), either through underreporting or lack of reporting, there has been an increase of HIV/AIDS cases in many of these countries because the governments have failed to acknowledge the issue.

Morocco, however, represents another path with HIV/AIDS when compared to other MENA countries. Starting in the early 1990s, the Moroccan government in conjunction with non-governmental organizations has worked to battle the stigmatizations around HIV/AIDS and improve the well-being of its citizens. Because of these major political, cultural, and economic changes, Morocco is a useful case study of HIV/AIDS in the MENA region where a Muslim country has been able to battle stigmatizations. This case study provides an example of a country in the MENA region that it has done well and has improved upon removing stigmatizations surrounding people with HIV/AIDS.

LIVING OUT THE WORDS

STUDENT Alexandria Hernandez *History*
ADVISOR Nico Slate *History*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The past century has been characterized by a massive worldwide educational expansion. Increasingly, complex economies demand a better-educated workforce. Moreover, in a globalizing world culture, nation-states – such as the United States and India – are expected to take over the duty of educating citizens. However, whether or not educational expansion is sufficient to reduce educational inequalities remains an issue facing many national governments. Research on educational stratification suggests that inequality in education based on ethnicity and caste continues and sometimes even widens in spite of educational growth. And yet, the literature on why these inequalities persist or even widen in spite of increases in overall educational levels remains poorly developed. To fill this void of information, I seek to investigate the social and cultural factors that perpetuate educational stratification in the United States and India. The United States and India's seemingly simultaneous civil rights movements, and efforts to expand equal access to education, provide a particularly compelling narrative framework for exploration. To gather information, I plan to conduct observational research in four urban high schools - two in Chennai, Tamil Nadu, India and two in Pittsburgh, Pennsylvania, USA. To supplement the data I collect through observation, I will conduct systematic interviews with the urban high school students, and school administration. Moreover, to understand the point at which the United States and India's social and cultural factors converge, I plan to facilitate and moderate a Skype discussion on ethnic and caste based inequality in education between the students in Chennai and Pittsburgh.

PEDDLING DISCRIMINATION: HOW AND WHY RECRUITERS CONVINCED AFRICAN AMERICANS TO JOIN A SEGREGATED NAVY

STUDENT Katherine Thomas *History*
ADVISOR Steven Schlossman *History*
ROOM/TIME McKenna / 3:20 pm

African Americans have a long history of serving in the United States Navy alongside their white compatriots. There were African American sailors in the Continental Navy, the Federal Navy of 1812, Lincoln's Navy, and many of those sailors served with distinction earning the Congressional Medal of Honor. This all changed as the Navy began to segregate at the beginning of the 20th century. In this paper, I briefly summarize the various reasons the Navy gave for segregating, especially the two most central: racial tension within crews and the desire to upgrade the Navy's public reputation. I also explore how the Navy hid its efforts at segregation from the public in order to encourage African Americans to continue enlisting. And lastly, I discuss why the Navy embarked on such an elaborate cover-up. I believe the answer lay rooted in 1) the unconstitutionality of full exclusion of African Americans from the Navy, 2) outside pressure from the African American press and civil rights groups like the NAACP, 3) persistent enlistment shortfalls, and 4) the threat of imminent war with Japan.

PLAYING THE WRONG GAME: THE FAILURE OF KRIEGSSPIEL IN GERMAN WAR PLANNING 1900-1914

STUDENT Thomas Vielott *History*
ADVISOR Laurie Eisenberg *History*
ROOM/TIME Pake / 3:00 pm

In 1914, something inexplicable happened. The German General Staff assented to, in fact encouraged, a diplomatic maneuver that would lead directly to a war that Germany could not win. Why? They thought that they held the keys to victory in their hands. In dozens of simulation games known as "Kriegsspiel" (literally "War Game"), the German Army had beaten its opponents with excellent strategies, ones that promised to end the war in the first two months. They did not deliver. Due to several incorrect assumptions, the results of their games were wrong in key places that killed the German Army's early offensives just short of their goals. Worse, the German Army's consistent success in the games deceived the Germans into the belief that they could fight the upcoming war from a position of strength, despite their industrial weakness. Germany pressed the diplomatic issue in 1914 because they believed that they could quickly win the ensuing war. They very nearly did, which only made the war worse. Kriegsspiel led the Germans to fight a kind of war which was not technologically possible at the time because it had worked in the idealized conditions of a game that was good, but not good enough.

SATISFACTION IN THE CMU STUDENT COLLEGE PROGRAM

STUDENTS Robert Citrone *Statistics* | Yeram Lee *Statistics* | Sean Richardson *Chemistry* | Thomas Vielott *History* | Qiutong Ye *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The Student College (StuCo) program allows CMU students to teach a small, 3 unit course for credit. Courses range in topic from Knitting to Minecraft, to Job Searching. Our goal in this survey is to measure two aspects of student participation in the StuCo program. The first is the satisfaction of StuCo students in both the specific classes they are taking now and the program in general. The second is the participation rate of students in the StuCo program. This mean absence rates, number of StuCo classes taken, willingness to take further StuCo classes and so on.

THE BUZZ ABOUT STARBUCKS: HOWARD SCHULTZ AND THE RISE OF THE WORLD'S COFFEE SHOP, 1971-1997

STUDENT Jessica Phoa *History*
ADVISOR Steven Schlossman *History*
ROOM/TIME Wright / 11:40 am

Starbucks Coffee Company operates over 21,800 stores in 66 countries across the globe and is considered to be a business phenomenon.

What many do not realize, however, is that Starbucks actually began as a modest joint venture between three coffee enthusiasts: Jerry Baldwin, Zev Siegl, and Gordon Bowker. The original Starbucks opened in 1971 near Seattle's Pike Place Market, a vendor of first-rate coffee beans; not a sit-down café. It continued to expand slowly

throughout Washington, eventually became one of the top roasters of the state. In reality, Starbucks' current Chairman and CEO, Howard Schultz, is the one responsible for the company's remarkable success. He did not join the company until 1982 when Baldwin hired Schultz as Starbucks' first director of retail operations and marketing. Five years later in 1987, Baldwin sold Starbucks and its assets to Schultz, a decision that led to the rise of the world's coffee shop.

THE CURRENT QUEBEC SEPARATIST DEBATE AND ITS INFLUENCE ON THE FIRST NATIONS OF QUEBEC

STUDENT Emily Etzel *History*
ADVISOR Karen Faulk *History*
ROOM/TIME Dowd / 4:20 pm

Quebec has a long history of political struggles for autonomy, stemming back to Britain's conquest of New France in 1759. Since then, tensions have increased between Anglophone and Francophone Canada. These tensions are manifested in the current separatist movements, which first gained substantial ground in the 1960's. The Parti Québécois, an influential political party in Quebec calling for sovereignty, has been the main driver for independence. The separatists want an independent Quebec, and often base their nationalism on a French-Québécois identity, including French as the primary language and a shared identity going back to the French settlers. However, as they define their own unique culture, and pit Quebec against the rest of Canada, separatists marginalize or ignore minority groups and the First Nations of the province. Despite this fact, the First Nations are crucial actors in the separatist debates, and their position sheds light on a seldom-seen dimension of Quebec separatism. The First Nations have a long history of inhabiting the region, and place great importance on the territory of their ancestors. However, the First Nations are by no means passive in the separatist debates, and through the use of international standards and local organizations, they vocally assert their position against separatism. Some of the main issues they see as pertinent in the separatist debates are issues of land rights, resource management, and their right to self-determination. For this reason, it becomes clear that separatism does not only concern French-Quebec and English-Canada, but that it concerns the First Nations as well. In this paper, I provide an overview of these debates, placing them in the context of the history of the First Nations, indigenous issues internationally, and current First Nations responses to separatism. I argue the Quebec separatist debates and the First Nations' responses expose the complexities of separatism and the long-standing tensions between the Canadian government and indigenous groups.

THE GLOBAL NORTH AND BRAZILIAN NGOS: A ONE-SIDED RELATIONSHIP?

STUDENT Juan Acosta *History*
ADVISOR Emanuela Grama *History*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Third sector organizations are everywhere you turn today. This is not only true in high-income countries, but is also true in upper middle income countries such as Brazil. Brazil is a unique country that experienced an explosion of third sector organizations after a period of continued authoritative rule in the mid-1980s onward. For countries like Brazil, scholars posit collaborations with Global North entities (World Bank, United Nations, International Monetary Fund, etc.) lead to non-governmental organizations (NGO) losing sight of the grassroots needs of the

people they serve. By analyzing the annual reports of two NGOs in Brazil who partner with Global North entities and two that do not, I observe the contrasts in their discourse and the scope of their impact. Ultimately, my research answers the question: What are the advantages and disadvantages establishing Global North partnerships for Brazilian NGOs and how does that impact the needs of those on the ground?

INFORMATION SYSTEMS

BROWSER TAB USAGE DURING INFORMATION FORAGING AND SENSEMAKING

STUDENT Lucy Havens *Information Systems*
ADVISOR Aniket Kittur *Human Computer Interaction Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Browser tabs' linear structure does not reflect the evolving mental models of their users during information foraging. The structures of users' mental models change in ways to which tabs can neither respond nor represent. In an effort to determine specific capabilities that browsers could add to better serve Internet users, a study of 16 participants' tab usage was conducted. Participants were interviewed about their Internet usage, were observed during a research task, and were interviewed once more about their actions during the research task. An analysis of the results shows that saving effort, orienting within an information space, and focusing were key concerns driving the majority of participants' actions. Across users, there were instances where the same concern yielded different actions, and different concerns yielded the same action. The results provide guidance to those developing information management tools with data supporting the need for flexibility with certain functionalities and the potential for automation in others.

EFFECTS OF MOBILE APPLICATIONS ON PUBLIC HEALTH IN HONDURAS

STUDENTS Omobolanie Ayo-Ani *Information Systems* | Wendy Chou *Psychology* | Jacqueline Pan *Self-defined* | Leslie Tay *Science and Humanities Scholars* | Emily Wells *Social & Decision Sciences* | Ming Y. Wu *Information Systems*
ADVISOR Jason Hong *Human Computer Interaction Institute*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Developing countries often lack the funding and resources necessary to educate communities on public health, leading to the spread of preventable diseases. Existing research has indicated that distance education through online and mobile settings have proven to be effective in public health education. In Honduras, a steady increase in the mobile phone penetration rate implies that mobile applications could be a viable low-cost solution to public health education that would allow for widespread dissemination of knowledge. Our mobile public health application will use interactive tutorials to educate users on sanitation and hygiene in order to reduce the spread of preventable diseases within local Honduran communities.

MAPPING ISRAEL'S VIRTUAL WATER TRADE

STUDENT Raphael Astrow *Information Systems*
ADVISOR Randy Weinberg *Information Systems*
ROOM/TIME Dowd / 3:00 pm

Where in the World is Israel's Virtual Water? is a mobile application that uses animated maps to visualize data about Israel's virtual water trade.

PET MATCH

STUDENT Sherry Chen *Information Systems*
ADVISOR Jeria Quesenberry *Information Systems*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The vision for Pet Match is to create an intuitive platform for interested individuals to find a pet for themselves or friends and family. The goal of this is to provide a place for potential users to go to, as opposed relying on generic search engine research.

To meet this target, the long-term goal of the final product will be a mobile application that begins with using existing data to create information cards for pets that users can easily go through on their phone. The application will also provide a hub for animal shelters' contact information, and make it easy to call, email, or message animal shelter representatives directly. Furthermore, there will be a social component to the process that allows for friends and families to share a pet's information card.

The objective of this semester's efforts is to design and implement two key features of the application: the search page, and the home page where users can swipe through pet's information cards. Additionally, extensive user testing was performed on these two features to further improve the design.

POCKETCHANGE

STUDENT Shaun Ford *Information Systems*
ADVISOR Larry Heimann *Information Systems*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Currently the only platform for buying and selling objects in the localized Carnegie Mellon area is a Facebook group called "For Sale @ CMU". For Sale @ CMU was started with the intention of providing a trusted market, internal to CMU, that would allow students to quickly and easily buy and sell necessities for their dorms, off-campus apartments, and even their classes. The PocketChange application is aimed at building a platform that takes the concept of For Sale @ CMU and expands and improves upon it. PocketChange already exceeds the capabilities of For Sale @ CMU by incorporating full category, item, and text search, filtering, and a personal dashboard for users. I intend for it to go even beyond those features, incorporating things that Facebook provides like messaging and notifications but also even more things like an ISBN scanner, and monetization through Venmo or Paypal.

UNMANNED AERIAL VEHICLE RESCUE AND RELIEF

STUDENT Stefan Dasbach *Information Systems* | Nathaniel Thompson *Mechanical Engineering*
ADVISOR Maxim Likhachev *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Robotic relief measures reduce risk for the rescuers and provide aid to victims in conditions otherwise impassable for humans. Currently, the leaders in robotics are developing innovative aerial and terrestrial disaster extraction solutions. Despite this, there is still a need for reliable aerial surveillance. Specifically, quadcopters are considered. Quadcopters are small, agile, and vertically maneuverable, imparting convincing suitability for rescue operations. By attaching a camera to enable first person view, remote piloting is gained, allowing succor when unattainable from human support. The proposed quadcopter with a camera accessory offers valuable and reliably scalable insight into the possibility of unmanned aerial vehicle rescue missions. Furthermore, the experiment prompts subsequent research into more practical applications including thermal vision, rescue communication, and heavier payloads.

LINGUISTICS

THE NATURE OF LOGOGRAPHY AND ITS IMPLICATIONS FOR SECOND-LANGUAGE LEARNERS OF WRITTEN JAPANESE

STUDENT Noah Hermalin *Linguistics*
ADVISOR Thomas Werner *Philosophy*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The goal of this research is to explore the inherent qualities of logographic writing systems, with a focus on how this knowledge can be applied to the study of Japanese kanji characters. Logographic writings systems are generally defined as ones in which each character has both semantic and phonetic value, though the degree to which a character binds to its two components varies by both language and definition of logography. This system contrasts with ideographic characters, which are said to only have semantic value, and phonetic/syllabic characters, which only map to sounds. By examining the link between Japanese kanji and their semantic and phonetic components, as well as the extent to which kanji should or shouldn't be considered logographic, this research hopes to identify which methods for teaching and learning kanji are most effective.

MODERN LANGUAGES

OTAKU: A DIGITAL MANGA

STUDENT Tyler Porten *Modern Languages*
ADVISOR Yasufumi Iwasaki *Modern Languages*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The project, Otaku: A Digital Manga, is an original Japanese short story, which incorporates elements of graphic novels, manga, and Japanese and western-style animation and video games. The story revolves around a protagonist whose images of both himself and Japan have been formed purely from his obsession with Japanese anime, manga, and games. Spending a year abroad in Japan for the first time brings his values into question, as reality clashes with his ideal vision of Japan. My objectives for the project are as follows: (1) to develop the genre of multi-media graphic novels by incorporating both new and traditional media, and Japanese and western artistic styles; (2) to examine how cultural stereotypes are formed and the role of media in their creation; (3) to produce a work that seamlessly integrates and advances the knowledge and techniques I have accumulated during my studies of Japanese and Electronic Time-Based (ETB) Art in the Bachelor of Humanities and Arts program; and (4) to produce a work that is entertaining, informative, and challenging to both Japanese and American audiences.

Two unique aspects of Otaku: A Digital Manga that are imperative for the realization of the project are the story and the media. The plot of my manga is about the experiences of a Japanese-American otaku who is traveling to Japan for the first time. "Otaku" is a discriminatory Japanese term used to describe a person who is obsessed with manga, anime, and game culture. The subplot of the novel concerns the formation of cultural stereotypes and the importance of first-hand experience in their eradication. Prior to visiting Japan, the protagonist's views of the country are shaped entirely by images from manga, anime, and games. Japanese, he finds, in turn have strong predetermined views of what foreigners should be, regardless of what they look like or how well they speak Japanese. Japanese and Americans alike have a distinct opinion about otaku ("he likes manga and anime, hence he must be weird"). Presented in a humorous and satirical fashion, my project will hopefully encourage viewers to reevaluate their beliefs about different cultures, and in the case of otaku, different interests. The medium of the digital manga I am pursuing with this project is a bridge between traditional graphic novels and animation. It is a flexible method in which still characters can be animated to emphasize important scenes. As a digital manga, the project will primarily use computer tools and software. The project will include hand-drawn digital illustration, text, hand- drawn and computer-generated animation, and audio in the form of voice acting, sound effects, and music. Although the final form will technically be an animation, I plan to use elements of the traditional graphic novel to produce the feel of a manga. Hence the viewer will see one panel of the comic at a time—with the camera panning to each successive panel as the story progresses— and will control when to proceed, like turning the pages of a book. Some animation companies and web artists have explored this technique for a portion of an animation or static comic, but I intend to expand it into a stand-alone medium. The proposed digital graphic novel will expand upon the "visual" novel found in some Japanese video games, but the latter lacks animation and does not read as a manga.

PSYCHOLOGY

A COMPUTATIONAL ACCOUNT OF THE N400

STUDENT Sam Cheyette *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:30 am

The N400 is a negativity seen in EEG components about 400 milliseconds after the presentation of a meaningful stimulus (e.g. a word). We present a computational account of the N400 that aims to explain some of its properties. Our model uses certain neourphysiologically plausible features, not present in standard neural networks, which we believe help explain the N400's shape and how its size varies depending on various factors.

ATTACHMENT STYLE DIFFERENCES IN THE AMOUNT OF AND EFFECTIVENESS OF RECEIVED SUPPORT

STUDENTS Mattie Hedgebeth *Psychology* | Lavender Yi *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

We are applying for a SURG grant in order to conduct a daily diary study in Dr. Brooke Feeney's Relationships Lab. Our study examines (1) whether individual differences in attachment style predicts the amount and quality of support received in a relationship, and (2) whether attachment style influences the effect of support on the recipients' well-being. Well-being is defined as the recipients' life satisfaction and psychological health. This is important with regard to establishing the effects that supportive (and unsupportive) relationships have on the overall health and happiness of individuals. Romantic couples will be recruited through the Pittsburgh community, and both couple members will receive compensation for their participation. Participants will complete a preliminary questionnaire recording demographics as well as a measure of attachment style. They will also complete online questionnaires for five consecutive days to report the amount of support they received each day as well their well-being. We hypothesize that attachment style will predict the amount of support received and also the effectiveness of the support regarding its influence on subjective well-being.

EFFECT OF INTERFACE DESIGN ON MATH TUTORING APPLICATION

STUDENT Wendy Chou *Psychology*
ADVISOR Noboru Matsuda *Human Computer Interaction Institute*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Previous studies have illustrated that students learn effectively through the learning by teaching method, in which students learn by teaching others (E.G. Cohen, 1994). The SimStudent teachable agent has demonstrated improved student learning by having students teach a synthetic peer to learn procedural algebra skills (Matsuda et. al., 2013). In this study, we will investigate how the current software interface should be modified in order for students to use the teachable peer learner application more effectively to maximize learning. Using human-computer interaction research methods, we will conduct evidence-based iterative redesign-engineering to the current interface to meet students' needs and overcome their challenges in using this technology.

EFFECTS OF COLLABORATIVE SPATIAL EXERCISES ON THE ACQUISITION OF MENTAL ROTATION ABILITY

STUDENT Ashley Taylor *Psychology*
ADVISOR Sharon Carver *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This study aims to determine whether commercially available games claiming to expand spatial awareness actually increase understanding of mental rotation and whether collaborative learning techniques are beneficial to the learning of mental rotation in this context. To test these questions, 40 children from the CMU Children's School were randomly assigned to work individually or collaboratively to complete either building block replication tasks or mental rotation block challenges. Four and five-year-old children participated in three training sessions, flanked by a pretest and posttest using the Children's Mental Transformation Task. Results showed a significant increase in mental rotation ability overall, but the difference between groups was not significant. This suggests that while the commercially-available mental rotation games do improve mental rotation ability, they are not significantly more effective than building replication tasks that pose less overt mental rotation demands.

EFFECTS OF MOBILE APPLICATIONS ON PUBLIC HEALTH IN HONDURAS

STUDENTS Omobolanie Ayo-Ani *Information Systems* | Wendy Chou *Psychology* | Jacqueline Pan *Self-defined* | Leslie Tay *Science and Humanities Scholars* | Emily Wells *Social & Decision Sciences* | Ming Y. Wu *Information Systems*
ADVISOR Jason Hong *Human Computer Interaction Institute*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Developing countries often lack the funding and resources necessary to educate communities on public health, leading to the spread of preventable diseases. Existing research has indicated that distance education through online and mobile settings have proven to be effective in public health education. In Honduras, a steady increase in the mobile phone penetration rate implies that mobile applications could be a viable low-cost solution to public health education that would allow for widespread dissemination of knowledge. Our mobile public health application will use interactive tutorials to educate users on sanitation and hygiene in order to reduce the spread of preventable diseases within local Honduran communities.

ELDERLY PRIMING EFFECT ON GRIP STRENGTH, REACTION TIME, AND DRIVING PROFICIENCY

STUDENT Zachary Anderson *Psychology*
ADVISOR John Creswell *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:45 am

Elderly priming is a topic within psychology currently under intense scrutiny. Generally defined, elderly priming is the idea that priming stimuli relating to the elderly stereotype make one more likely to subsequently behave in ways consistent with this stereotype (e.g., walking slower). The current paper tests this phenomenon with the prediction that elderly stereotype priming will reduce physical grip strength, reaction times, and driving performance on a simulator task. In this study, priming stimuli were presented supraliminally with old/young faces. A marginally significant increase in peak grip strength and overall grip strength following our elderly priming manipulation was

observed, compared to young or mixed faces control conditions. Additionally, participants exhibited significantly slower response time to pictures of elderly faces in the facial recognition task than in the young or mixed condition. Our hand grip results suggest the presence of an elderly priming effect, however, not the one we had originally hypothesized. I propose a model, which combines our physical resources mechanism (Klatzky & Creswell, 2014) with a motivation priming effect. This motivation prime arises, as a result of a participant's awareness of our dependent measure. Therefore, as elderly priming alters the perception of participants, causing him or her to feel relatively weak, each participant squeezes the hand grip apparatus more firmly to compensate for the perceived loss of grip strength.

EXAMINATION OF CULTURAL DIVERSITY AND PROGRESSION THROUGH PHOTOGRAPHS OF TAMIL NADU, INDIA

STUDENT Rubini Naidu *Psychology*
ADVISOR Charlee Brodsky *Design*
ROOM/TIME Connan / 12-2:30 pm

Each culture is built upon its own unique historical events and cultural experiences, which has led to the diverse array of beliefs, values, and traditions that are present all around the world. The historical credibility of each culture further suggests that no culture is inherently more or less superior than another. This project is an exploration of being open-minded to this cultural diversity and broadening one's own views by learning from other cultures. Additionally, this project examines how regions of the world can assist one another in helping their inhabitants obtain their basic needs and also improving the opportunities accessible to their inhabitants, while maintaining the unique beauty of their own culture.

This project was conducted through digital documentary photographs of Tamil Nadu, India that were taken during December, 2014. Interviews of the local individuals were conducted and artifacts from the region were collected to provide context and deeper understanding of the region. The photographs are presented in a handmade Japanese-bound artist book to reflect the organic nature of southern India. Supplemental text and commentary of each photograph is included to deepen exploration of this topic.

EXPLORING THE RELATIONSHIP BETWEEN OBESITY AND MOTOR SEQUENCE LEARNING

STUDENT Amira Millette *Psychology*
ADVISOR Timothy Verstynen *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:00 am

Mastering motor sequences is essential for many daily life activities. This form of learning relies on a group of subcortical nuclei known as the basal ganglia, particularly the striatal nuclei (Doyon, 2008; Doyon et al., 2009). Previous research has shown that obesity is associated with compromised striatal responsivity (Stice et al, 2008). Thus, the current study seeks to investigate the potential link between physical obesity and reduced learning in a sequential motor skill task. Using an indirectly-cued serial reaction time task (SRTT), long-term motor sequence learning was measured and assessed in a cohort of thirty participants, with body types ranging from lean, to overweight, to obese. Results reveal that individuals with a higher level of central adiposity, measured as central waist circumference, had slower learning across training days in the SRTT, particularly for response speed during

sequential blocks. Overall, we found an association between physical obesity and the efficiency of motor sequence learning, suggesting that obesity is a basal ganglia concern, not just in reward processing, but in motor skill acquisition.

HEMISPHERIC DIFFERENCES IN FACE DISCRIMINATION AFTER PRIMING

STUDENT Adam Dickter *Psychology*
ADVISOR Marlene Behrmann *Psychology*
ROOM/TIME Pake / 1:00 pm

Studies show that the accuracy of face recognition is correlated with the laterality of processing and is mediated by the right hemisphere. This study sought to determine whether one can bias the perceptual processing of faces by introducing information that enhances the global or local precedence of the right hemisphere prior to the onset of a face stimulus. Specifically, we 'primed' participants by presenting local or global information to the right or left hemisphere (using visual half-field paradigms) and then examined the effect of this information on face processing performance. Subsequent analysis revealed local priming enhancement of left hemisphere face discrimination and no performance facilitation for either hemisphere after global priming of facial features. Further exploration of laterality effects may improve the understanding of priming conditions that facilitate selectivity in facial recognition tasks.

HISTORICAL INSIGHT INTO THE LOS ANGELES JUVENILE COURT USE OF FORESTRY CAMPS AND OTHER INSTITUTIONS IN THE TREATMENT OF AFRICAN AMERICAN YOUTH

STUDENT Arielle Cohen *Psychology*
ADVISOR Steven Schlossman *History*
ROOM/TIME Wright / 3:40 pm

I am interested in the use of juvenile probation services and county- and state-operated correctional institutions for black delinquent youth in Los Angeles in the 1930s and 1940s. I am examining the Los Angeles Juvenile Court in the year 1940 via original, one-of-a-kind case files obtained from Dr. Steven Schlossman. My focus is mainly on understanding Louis S. Tenette, the first African American juvenile court probation officer in Los Angeles. Tenette managed the cases of many minority youth in this time period, and chose to place most of these youth on probation or to send them to forestry camps in the hopes of setting them on a better path. I am investigating the range of probation services offered and the structure and programs of the forestry in order to better understand Tenette's enthusiasm for both court dispositions, as well as to provide insight into the use of public resources on minority youth in this era. This research aims to illuminate largely unexplored scholarly terrain dealing with the relationships between African American youth, their families, and the public welfare and criminal justice systems in the first half of the 20th century.

HUMAN ECHOLOCATION

STUDENTS Spencer Barton *Electrical & Computer Engineering* | Rudina Morina *Electrical & Computer Engineering* | Brandon Perez *Electrical & Computer Engineering* | Arley Schenker *Psychology*

ADVISOR Laurie Heller Psychology

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:00 am

Echolocation is no longer just for the bats. Humans have the ability to learn this skill too, and for a number of blind people echolocation has already proven itself as a useful navigation tool. However in order for this ability to be useful to the blind community at large the training process needs to become more accessible. Our work begins with the creation of realistic artificial echoes which we used to build a curriculum. We encompass this curriculum in a mobile application.

IMPLICATIONS OF THE PATIENT-PHYSICIAN RELATIONSHIP FOR SATISFACTION AND ADHERENCE AMONG ADULTS WITH DIABETES

STUDENT Shaquille Charles *Psychology*

ADVISOR Vicki Helgeson *Psychology*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:15 am

The purpose of this study was to examine aspects of the patient-physician relationship as predictors of satisfaction with health care providers and regimen adherence among Black and White adults with diabetes. We asked 99 adults with type 1 (n = 18) or type 2 (n = 77) diabetes (mean age = 60.32, SD = 10.68) to complete a questionnaire that assessed patient satisfaction with physicians, regimen adherence, and the degree to which participants viewed their physicians as warm, cold, dominant, submissive, supportive, and collaborative. White participants displayed a greater level of blood glucose testing and medication adherence than Black participants (p's < .05), but there were no race differences in diet or exercise adherence or in any aspect of the patient-physician relationship. Physician warmth and dominance were related to greater patient-physician co! llaboration (p's< .001). In addition, physician warmth was linked to greater emotional and informational support from physicians (p's < .001), while physician cold-heartedness was marginally associated with less informational support (r = -.18, p = .07). Perception of physicians as warm and as dominant were both related to greater patient satisfaction (p's < .001), whereas perceptions of physicians as cold was marginally related to less satisfaction (r = -.19, p = .06). Collaboration was correlated with greater patient satisfaction (p < .001) but was only related to one domain of adherence: exercise (r = .26, p = .01). In summary, this study suggests that physicians may increase patient satisfaction and regimen adherence by engaging in collaborative health care, providing emotional and informational sup! port to their patients while projecting a dominant and warm personality. The extent to which these relations held for both black and white persons will be discussed.

INFANTS' UNDERSTANDING OF NEWTON'S THIRD LAW

STUDENT Siriana Abboud *Psychology*

ADVISOR David Rakison *Psychology*

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

Previous research has shown that infants as young as 3 months of age possess certain expectations of the physical world in which they live (Kellman & Spelke, 1983; Leslie & Keeble, 1987). More recent research has experimented

with infants' understanding of simple physics, such as concepts of gravity and momentum. Numerous studies have tested infants' expectations of object causality and the relationships between objects in motion and at rest (Kotovsky and Baillargeon, 2000). Past studies, however, have left certain gaps concerning infants' understanding of Newton's Three Laws of Motion. The proposed experiment will test how infants of 4, 8, and 12 months of age perceive Newton's Third Law of Motion. This novel study will concentrate on the behavior of angular movement and whether infants recognize the simple physics present in such motion. The results of this study will allow us to better comprehend the cognitive development of infants at such a critical stage of life.

INSTRUCTION-DRIVEN CHANGES IN KNOWLEDGE ORGANIZATION

STUDENT Rachel Walsh *Psychology*
ADVISORS Anna Fisher *Psychology* | Layla Unger *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Prior research indicates that semantic knowledge becomes increasingly differentiated and organized with age. For instance, with development, knowledge about living organisms becomes increasingly differentiated into taxonomic groups of biologically related organisms. To test whether these changes that have been observed developmentally can be induced in young children using direct instruction, we assessed organization of knowledge about living organisms that belong to three taxonomic categories in a group of preschool children over the course of approximately one month, and administered instruction sessions to half of the children during this time. During the instruction sessions, children were taught about biological features that are shared by organisms that belong to the same taxonomic category (e.g., mammals have fur and give birth to live babies). Our results did not reveal greater increases in the influence of taxonomic categories on semantic organization in children who received instruction versus children who received no instruction.

LEARNING ENVIRONMENTAL CONTEXT FOR INTELLIGENT ROBOTIC PLANNING SYSTEMS

STUDENT Myles Blodnick *Psychology*
ADVISOR Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:30 am

This proposal provides an overview of my goals in regards to engaging in research with HERB, a Home Exploring Robot Butler, at the Personal Robotics Lab. The research will entail the computational feasibility of unifying disjoint robotic software tools and models in an efficient way in order to input and process data about the environment and plan actions for HERB. This will be accomplished through the method of establishing a Mongo database that will interpret data for symbolic planning algorithms. In addition to developing the new framework, I will be using the current software tools to utilize a symbolic planner to design planners that account for environmental context in order to increase the versatility and improve the quality of HERB's capable actions.

MOUSE COLD AVERSION BEHAVIOR CHANGES WITH REPEATED EXPOSURE TO COOLING STIMULI

STUDENT Kathryn-Mary Wakim *Psychology*
ADVISOR Alison Barth *Biological Sciences*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Research shown that mice avoid cooler floor temperatures. Furthermore, recent imaging and lesion studies have shown that the insular cortex plays a role in non-noxious thermal perception. Although recent work has established that an intact primary somatosensory cortex (S1) is needed to form a sensory percept2, no research to date has explored whether intact insular cortex functioning is required for thermal aversion behavior.12, 2 To address this gap, we explore changes in cold aversion behavior before and after optogenetic inhibition of the insular cortex. In the first part of this study, we used a two-plate thermal preference assay to verify that mice prefer warm temperatures over cool (Figure 1). We found that mice who preferred warm temperatures on the second trial of the thermal preference task showed a robust and reliable preference for warm temperatures (>90%) upon a third exposure. In the second part of the study, we will ontogenetically stimulate the insular cortex of archaerhodpsin (Arch) transgenic mice to assess how inhibition of this region changes mouse thermal preference behavior.

OFFLINE ASSOCIATIVE LEARNING

STUDENTS Halley Bayer *Psychology*
ADVISORS John Creswell *Psychology*
ROOM/TIME Dowd / 3:20 pm

Offline processing is regarded as the continued thought of information that occurs without explicit attention and outside of one's conscious awareness, and it has been shown to be particularly advantageous in comparison to conscious thought and immediate testing in the realm of decision making. There is evidence for an underlying learning mechanism supported by offline processing, and recent work demonstrates advantages of offline processing in associative learning tasks. This study aims to address whether offline processing can be utilized as a practical technique in a real world learning task, and to investigate what specific types of distractor tasks best facilitate offline processing and learning. Participants encoded new real world information and were later tested on the material in either an immediate, same domain distractor, or different domain distractor condition in an online survey. Initial results indicate no advantage or disadvantage for either type of offline processing in comparison to immediate subsequent testing of newly encoded information. It is possible that this study presents evidence contrary to offline processing being a beneficial tool in real-world learning, however, as such a newly investigated topic, this study more likely provides useful information as to what may or may not work in order to utilize offline processing in real world learning contexts.

PROBLEM SOLVING AMONG DATING COUPLES

STUDENT Imaobong Essien *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The purpose of our study sought to investigate the link between communal coping and health. We manipulated

communal coping in the laboratory with an experimental design to see if it had the same relational and health benefits among couples without health problems. We sought to determine whether communal coping leads to better problem-solving outcomes, better relationship outcomes, and better health outcomes (operationalized by physiologic reactivity). The specific outcomes measured via questionnaires were personality traits, such as mitigated and unmitigated communion, relationship satisfaction, mood and thoughts about the upcoming task (giving a speech). Results to be provided.

RIFT

STUDENT Samantha Chiu *Psychology*
ADVISOR Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

Rift juxtaposes natural processes and synthetic materials by capturing chaotic geological phenomena in rigid plastic forms. The line is composed of 3 looks, each of which captures a still moment in nature but still appears to be moving and alive.

THE EFFECT OF AWE-RELATED STATES ON MEMORY RECALL

STUDENT Angelina Sung *Psychology*
ADVISOR John Creswell *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Recent research suggests that feelings of awe elongates a person's perception of time. Using this rationale, this study hypothesized that awe has the potential to increase our memory recall abilities. The nature of awe seemingly gives us the impression that we have more time to memorize items as well as expands the "space" of our minds to store more items. Thirty participants were shown either an awe-inducing video or a control video, and then performed a memory task immediately after. Although awe was successfully induced in the experimental group, results showed that there was no statistically significant differences in memory recall abilities between the experimental and control group. These findings suggests that awe may not be related to memory. However, further research should be done to explore the psychological effects of awe on our cognition.

THE ROLE OF POWER IN CONFLICT IN ADULT CLOSE RELATIONSHIPS

STUDENT Jaclyn Ross *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:45 am

Past research has shown that conflict occurs regularly in close relationships and has significant implications for relationship wellbeing. The purpose of this study was to investigate the role of perceived power in conflict resolution in romantic relationships. The study examined the power, relationship satisfaction, and conflict behaviors of 37 dating couples. Participants provided ratings of power and relationship satisfaction, and then participated in a 6-minute videotaped conflict discussion, which was systematically observed and coded for both positive and negative conflict behaviors. Results indicated that individuals with high power demonstrated less positive, more negative affect during conflict. Furthermore, results demonstrated that perceived power equality versus inequality

is associated with a number of behavioral tendencies during conflict, and gender is a significant predictor of these associations. Implications and directions for future research are discussed.

TOWARDS IMPROVING DIAGNOSIS OF ADHD: ASSESSING DIAGNOSTIC POTENTIAL OF A NEW CLINICAL TEST

STUDENT Anna Vande Velde *Psychology*
ADVISORS Anna Fisher *Psychology* | Erik Thiessen *Psychology*
ROOM/TIME Pake / 12:00 pm

The aim of this study was to examine the diagnostic capabilities of a tool designed by Dr. Craig Liden and The Being Well Center, a clinic dedicated to diagnosis and treatment of attention disorders. A mixed-design study was implemented to assess any differences in performance on the task between a clinical population and neurotypical controls. Two main effects were hypothesized: that groups would differ in both reaction time and accuracy. A significant difference in reaction time was found, while accuracy was less informative.

SELF-DEFINED

CMU FRESHMEN MEAL PLAN SATISFACTION

STUDENTS Elizabeth Chang *Statistics* | Izaia Haynes *Statistics* | Elissa Maercklein *Business Administration* | Henry Neale *Self-defined* | Tias Sen *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

On November 13, 2014, the State Assembly in New Jersey passed legislation (with a 53-17 vote) banning both public and private universities, with the exception of Princeton, from requiring their students to purchase a meal plan. The bill also requires schools to offer meal plans in the form of pre-paid debit cards, with a refundable balance at the end of the term.

Meal plans on college campuses are widely criticized, notorious for being overpriced and lack necessary nutrients. A study published in the Journal of Nutrition Education and Behavior stated that many college students are not even eating one serving of fruits and vegetables per day. This is surprisingly lower than the average government recommendation of 4.5-5 servings of each per day. NBC published an investigative report last year on the meal plan at Ohio State University, focusing on how overpriced on-campus dining is. One student admitted to paying $35 (seven blocks on their $5/block system) for a case of Powerade - the same size case that is sold at Sam's Club for

$12.48. The article published by NBC also discusses how students are often forced to purchase such a high number of these nonrefundable blocks, causing "people go into panic mode" to use up their balance of blocks at the end of the semester. This recent attention to the issues surrounding college campus meal plans made us question the merits of the meal plan system here at Carnegie Mellon.

Earlier in January, Carnegie Mellon announced they would be raising the price of the required meal plan for first-year students to an exorbitant $5,310 (an increase from $5,120 in the 2014-2015 school year, which was already an

increase from $4,920 the previous year). Consequently, we would like to conduct a survey to gauge the sentiment of the Carnegie Mellon community towards the meal plan, specifically focusing on the "block" system. Our study will address the primary issue associated with campus meal plans: cost. We would like to look into the average amount of money that is wasted on unused blocks biweekly, as they do not roll-over into the subsequent period for first year meal plans. We would answer the following questions in conducting this study: What is the true monetary value of a block and how does this compare to how much students not on the meal plan are spending? Would students be more satisfied with the meal plan if their blocks would roll-over per biweekly period?

This survey would be extremely beneficial to both CulinArt and the Carnegie Mellon administration, allowing them to identify specific issues within the current meal plan system and adjust accordingly. The meal plan is something that affects everyone who attends CMU, so our findings will be significant and informative for those who attend CMU. There is often major discontent expressed about the forced meal plan for first-year students and conducting this survey would provide the statistics to support that dissent, making the issue more apparent. The results of our survey will also allow us to make an informed recommendation on how to improve the meal plan.

EFFECTS OF MOBILE APPLICATIONS ON PUBLIC HEALTH IN HONDURAS

STUDENTS Omobolanie Ayo-Ani *Information Systems* | Wendy Chou *Psychology* | Jacqueline Pan *Self-defined* | Leslie Tay *Science and Humanities Scholars* | Emily Wells *Social & Decision Sciences* | Ming Y. Wu *Information Systems*

ADVISOR Jason Hong Human *Computer Interaction Institute*

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

Developing countries often lack the funding and resources necessary to educate communities on public health, leading to the spread of preventable diseases. Existing research has indicated that distance education through online and mobile settings have proven to be effective in public health education. In Honduras, a steady increase in the mobile phone penetration rate implies that mobile applications could be a viable low-cost solution to public health education that would allow for widespread dissemination of knowledge. Our mobile public health application will use interactive tutorials to educate users on sanitation and hygiene in order to reduce the spread of preventable diseases within local Honduran communities.

ENGINEERS WITHOUT BORDERS - PLASTIC THATCH

STUDENTS Emmett Horton *Civil and Environmental Engineering* | Aakash Parekh *Chemical Engineering* | Deepak Ravi *Mechanical Engineering* | David Sparks *Materials Science Engineering* | Stephanie Tjan *Civil and Environmental Engineering* | Julia Tucker *Mechanical Engineering* | Meghana Valluri *Self-defined* | Angela Wu *Civil and Environmental Engineering* | Alexander Yu *Electrical & Computer Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

The primary goal and focus of the PET Thatch project is to design a semi-automated system that will convert waste plastic bottles into reusable plastic pieces for construction material and roofing structures. PET Thatch is divided into 4 main groups: cutting, decontouring, fusing, and roof design. The specific goals of this semester were to create an efficient method for removing the contours from the waste plastic bottles, to build a sample roof for testing purposes, and continue looking for ways to integrate the four groups.

SOCIAL & DECISION SCIENCES

EFFECTS OF MOBILE APPLICATIONS ON PUBLIC HEALTH IN HONDURAS

STUDENTS Omobolanie Ayo-Ani *Information Systems* | Wendy Chou *Psychology* | Jacqueline Pan *Self-defined* | Leslie Tay *Science and Humanities Scholars* | Emily Wells *Social & Decision Sciences* | Ming Y. Wu *Information Systems*

ADVISOR Jason Hong *Human Computer Interaction Institute*

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

Developing countries often lack the funding and resources necessary to educate communities on public health, leading to the spread of preventable diseases. Existing research has indicated that distance education through online and mobile settings have proven to be effective in public health education. In Honduras, a steady increase in the mobile phone penetration rate implies that mobile applications could be a viable low-cost solution to public health education that would allow for widespread dissemination of knowledge. Our mobile public health application will use interactive tutorials to educate users on sanitation and hygiene in order to reduce the spread of preventable diseases within local Honduran communities.

EVOLUTION OF NAVAL SPECIAL WARFARE: WHAT MAKES A MISSION SUCCESSFUL

STUDENT William Misitano *Social & Decision Sciences*

ADVISOR Martha Dunigan *Social & Decision Sciences*

ROOM/TIME Dowd / 12:00 pm

This thesis will look at the importance of Naval Special Warfare, and how they have changed over the years to develop their capabilities to complete their mission. By looking at four case studies from different operations involving Naval Special Warfare I hope to show the evolution of their tactics. The individual cases will then be analyzed on whether they were successful in fulfilling their objectives, and whether the training, preparation, and technology, of the operators played a large role in the outcome of the operation. This will provide insight as to whether the training, preparation, or the technology used contributed to their success.

ILLEGAL SCHENGEN MIGRATION: A GAME THEORETICAL ANALYSIS

STUDENT Christopher Skaggs *Social & Decision Sciences*

ADVISOR Geoffrey McGovern *Social & Decision Sciences*

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

The European Union and members of the Schengen Agreement are experiencing massive migration waves from North Africa and the Middle East. Hundreds of thousands of refugees and migrants seek to enter the EU via Southern Europe and Greece every year. Many of these migrants die in the Mediterranean or arrive in cash strapped Southern European countries only to languish in migrant detention centers in deplorable conditions. Using illegal immigration as a case this paper seeks to explore what game theory can reveal about features of this social sciences problem. This paper addresses the current events, the relevant law and policy to the migration problem. And

then using game theory explores features of the case and evaluates policy proposed by members of the academic community. The hope is that game theory will yield insights that can enable meaningful policy change through reframing this crisis in terms of a collective action problem.

OPINIONS AND SATISFACTION WITH BLACKBOARD COURSE MANAGEMENT SOFTWARE AMONG UNDERGRADUATE STUDENTS

STUDENTS Jay Kapur *Social & Decision Sciences* | Stanley Krasner *Economics* | Matthew Limbu *Economics* | Hae Jin Park *Economics* | Quan Yuan *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The most recent Blackboard satisfaction survey was completed in 2007 though Blackboard has been updated and upgraded since then. We conduct a survey of randomly selected Carnegie Mellon Undergraduates at the Pittsburgh campus to learn more about student perceptions about Blackboard use, commonly used features and overall satisfaction. This research was designed and conducted along side 36-303 Sampling, Surveys and Society.

PREDICTING UNDERGRADUATE PASSIONS: AN ANALYSIS OF MAJOR MIGRATION AT CARNEGIE MELLON

STUDENT Kelsey Dietz *Social & Decision Sciences*
ADVISORS Baruch Fischhoff *Social & Decision Sciences* | Russell Golman *Social & Decision Sciences*
ROOM/TIME Dowd / 11:40 am

With six undergraduate colleges, Carnegie Mellon University creates an environment that both assists and hinders each student's ability to change his or her course of study over the undergraduate career. There are opportunities to hold majors across multiple departments, but the process of switching primary major can be challenging for students whose interests change. This paper discusses the potential reasons behind major migration at CMU, and whether or not we are able to predict the likelihood that a given student will switch their major before graduation. By looking at the Class of 2015 cohort over twelve semesters, we can run linear discriminant analysis and logistic regression on a representative sample of 1136 students. Through these methods, we determine that predicting student migration yields high error rates when working with a small subset of binary demographic variables, yet there is potential for a stronger prediction algorithm with more data and more robust variables such as cumulative QPA and socio-economic status. My research also focuses on the predictive capability of Dietrich College first-year survey data, and whether initial major interest is correlated with graduating major.

THE UNITED STATES COURTS OF APPEALS AND THE RIGHT TO BEAR ARMS: ARE JUDGES DECIDING SECOND AMENDMENT CASES USING LEGAL PRECEDENT, FACTS, OR IDEOLOGY?

STUDENT Catherine Ciriello *Social & Decision Sciences*
ADVISOR Geoffrey McGovern *Social & Decision Sciences*
ROOM/TIME Wright / 2:00 pm

This research analyzes the decision making of judges at the United States Courts of Appeals level. Specifically, this paper will discuss the application of three models: fact, legal, and attitudinal, to a comprehensive data set of Second Amendment cases decided by these courts. Each of these models has been shown to be salient at the Supreme Court level with civil rights cases. With the rising number of cases being denied certiorari, how judges decide cases at this level becomes especially salient. This research found that judges are largely falling in line with precedent set forth by the Supreme Court. Additionally, unlike the Justices on the Supreme Court, this research found no statistical significance of ideology influencing the outcome of a case. Facts do largely matter when deciding a Second Amendment case. Overall, circuit judges for the United States Courts of Appeals, are deciding cases on point.

STATISTICS

CARNEGIE MELLON UNDERGRADUATE STUDENTS' ATTITUDES TOWARDS THE UNIVERSITY'S CURRENT ATHLETIC FACILITIES AND THEIR ANTICIPATION FOR THE NEW CUC GYM.

STUDENTS Charlton Cheng *Economics* | Leeann Choi *Statistics* | Yifan Leng *Statistics* | Michelle Ong *Economics* | Danielle Peters *Science and Humanities Scholars*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Our project topic is relevant to Carnegie Mellon University's plans to upgrade the current athletic facilities by expanding the Cohon University Center. In the midst of CMU's heavy workload and and stress culture, it is beneficial for each student to maintain a healthy lifestyle by taking advantage of the athletic facilities provided by the university. Therefore, implementing a survey of students' attitudes regarding the existing university athletic facilities' gym equipments, layouts and other services offered is relevant and timely. The athletic facilities consist of the Cohon University Center (CUC) Gym, Skibo Gym, and several gyms located in different campus dorms. Since the university has planned major improvements for its athletic facilities in the CUC, it will also be beneficial to understand students' attitudes on the upcoming improvements.

These responses will provide useful information to the university as it seeks to refine its athletic facilities to better cater to the student population. The university can also incorporate this information into future efforts to design and plan the new athletic facilities.

CLASSIFYING KEPLER OBJECTS OF INTEREST

STUDENTS Eric Alpert *Mathematics* | Ronald Yurko *Statistics*
ADVISORS Peter Freeman *Statistics* | Rebecca Nugent *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

NASA's Kepler Mission surveys a region of the Milky Way galaxy to search for exoplanets. The goal of the Kepler Mission is to identify exoplanets with conditions similar to the Earth, as well as to expand the knowledge of stars and their potential orbiting exoplanets. Before the exoplanets can be studied however, they must be identified. The Kepler Telescope has identified 7348 objects of interest (KOI) in attempt to identify exoplanets. Of the KOI, 993 are classified as confirmed exoplanets with 3170 false positives while 3185 are still unlabeled candidates. Utilizing statistical methods this project explores the relationships between the KOI classification and numerous covariates. A random forest and other classification models are fit to the labeled KOI in order to predict whether the remaining 3185 candidates are confirmed exoplanets or false positives. Furthermore, unsupervised learning methods are also used to view the natural structure of the remaining candidates in comparison to the labeled KOI.

CMU COMMUNITY'S ATTITUDE TOWARD CROSS REGISTRATION AT PITTSBURGH AREA COLLEGES

STUDENTS Shaheen Essabhoy *Economics and Statistics* | Alexander Malerba *Statistics* | Matthew Reid *Economics* | Martin Smith *Economics* | Sasha Zhang *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

For our survey project, we have decided to study how much the Carnegie Mellon Community knows about cross-registration through the Pittsburgh Council on Higher Education (PCHE). This is interesting because it can give university administrators as well as the Student Senate a better idea of which resources are actively used and valued by the community. This will allow them to better target university policies that need improvement and prioritize based on student needs. The results of our study will determine whether the lack of cross-registration in CMU is based on lack of interest in the process or lack of knowledge about the availability of cross-registration. Our survey is best executed now because the issue of cross-registration at other PCHE institutions is currently debated by the student senate and the survey will help them make decisions and arrive at a more efficient solution.

CMU FRESHMEN MEAL PLAN SATISFACTION

STUDENTS Elizabeth Chang *Statistics* | Izaia Haynes *Statistics* | Elissa Maercklein *Business Administration* | Henry Neale *Self-defined* | Tias Sen *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

On November 13, 2014, the State Assembly in New Jersey passed legislation (with a 53-17 vote) banning both public and private universities, with the exception of Princeton, from requiring their students to purchase a meal plan. The bill also requires schools to offer meal plans in the form of pre-paid debit cards, with a refundable balance at the end of the term.

Meal plans on college campuses are widely criticized, notorious for being overpriced and lack necessary nutrients. A study published in the Journal of Nutrition Education and Behavior stated that many college students are not

even eating one serving of fruits and vegetables per day. This is surprisingly lower than the average government recommendation of 4.5-5 servings of each per day. NBC published an investigative report last year on the meal plan at Ohio State University, focusing on how overpriced on-campus dining is. One student admitted to paying $35 (seven blocks on their $5/block system) for a case of Powerade - the same size case that is sold at Sam's Club for

$12.48. The article published by NBC also discusses how students are often forced to purchase such a high number of these nonrefundable blocks, causing "people go into panic mode" to use up their balance of blocks at the end of the semester. This recent attention to the issues surrounding college campus meal plans made us question the merits of the meal plan system here at Carnegie Mellon.

Earlier in January, Carnegie Mellon announced they would be raising the price of the required meal plan for first-year students to an exorbitant $5,310 (an increase from $5,120 in the 2014-2015 school year, which was already an increase from $4,920 the previous year). Consequently, we would like to conduct a survey to gauge the sentiment of the Carnegie Mellon community towards the meal plan, specifically focusing on the "block" system. Our study will address the primary issue associated with campus meal plans: cost. We would like to look into the average amount of money that is wasted on unused blocks biweekly, as they do not roll-over into the subsequent period for first year meal plans. We would answer the following questions in conducting this study: What is the true monetary value of a block and how does this compare to how much students not on the meal plan are spending? Would students be more satisfied with the meal plan if their blocks would roll-over per biweekly period?

This survey would be extremely beneficial to both CulinArt and the Carnegie Mellon administration, allowing them to identify specific issues within the current meal plan system and adjust accordingly. The meal plan is something that affects everyone who attends CMU, so our findings will be significant and informative for those who attend CMU. There is often major discontent expressed about the forced meal plan for first-year students and conducting this survey would provide the statistics to support that dissent, making the issue more apparent. The results of our survey will also allow us to make an informed recommendation on how to improve the meal plan.

CUSTOMER SATISFACTION: STEEL CACTUS

STUDENTS Mary Behnke *Statistics* | Darun Kwak *Business Administration* | James Lee *Statistics* | Guillermo Marce-Santurio *Statistics* | Brooke Tsu *Statistics*

ADVISOR Jared Murray *Statistics*

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

Market research is vital for the success of any business. Whether planning to launch a new startup or expanding current operations, businesses need market data that highlights its opportunities and marks its challenges. Every business can benefit from the contributions and marketing strategies suggested in this proposal.

We aim to work with a small, local business. We'd like to help them promote business through better understanding how they attract customers. This survey/research project could help a local business grow and succeed.

We believe that we can contribute to the local economy by helping a local business better strategize its operations. We will choose a local business with high numbers of Carnegie Mellon student clientele. We will analyze purchasing patterns made by clients, measure customer satisfaction, and survey about product quality. We hope that understanding Walnut Street's economic activity and studying the purchasing behavior of clients will help us learn how to better promote local business.

The results of this survey may be helpful not only to the local business we examine, but to other businesses around Walnut Street and the Carnegie Mellon campus.

FANTASY OR REALITY? EXPECTED SALARY PERCEPTIONS OF CARNEGIE MELLON UNIVERSITY UNDERGRADUATE STUDENTS

STUDENTS Dina Berdichevsky *Statistics* | Manuel Garber *Statistics* | Nicholas Lam *Economics and Statistics* | Yuka Moroishi *Statistics* | Angelina Tang *Statistics*

ADVISOR Jared Murray *Statistics*

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

This topic has an immediate bearing on students' choices of majors. When a student enters his or her first year of education, he or she puts down a payment of $60,000 every year in hopes of achieving a higher present value of future cash-flow. This survey must be done as soon as possible to educate students in the difference between their perceptions of their future and what is already statistically predicted for them. If we find a discrepancy between the two, then this indicates a lack of awareness and possible future issues for students who are deciding. The client of our survey is every university student who is picking a major or deciding to change majors that they believe will allot them a certain future opportunity.

HISTORICAL META-ANALYSIS WITH A FOCUS ON PATTERNS OF TRANSPORTATION TO WORK

STUDENTS Anwesha Patnaik *Economics and Statistics* | Deahan Yu *Statistics*

ADVISORS Rebecca Nugent *Statistics* | Joel Tarr *History*

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

Walking to work as a mode of transportation has been decreased over the last century. Especially, from the early 1900's to the start of the Second World War, there must have been changes in patterns of work transportation due to expansion of place of employment such as downtown commercial areas. We have traffic study reports for Chicago (1916), Atlanta (1924), Baltimore (1925), Milwaukee (1928), Cleveland (1935), Allegheny County (1937), and Cuyahoga County (1940). Most of reports contain data such as mode of traveling to downtown districts, pedestrian counts at certain streets on certain week and weekend day. From this analysis, we aim to find out changes in work transportation, patterns of people walking to work over time, and possible factors that contributed to the change in "Walking to work" patterns. Our method is meta-analysis with various data of different locations and times.

HITTING THE WALL: MIXTURE MODELS OF LONG DISTANCE RUNNING TRAJECTORIES

STUDENT Joseph Pane *Statistics*

ADVISOR Rebecca Nugent *Statistics*

ROOM/TIME Dowd / 1:20 pm

The International Association of Ultrarunners 24 Hour World Championships holds a 24 hour race during which each entrant tries to run as many laps as they can. There are several different strategies to running a race, and these may be characteristic to the runner. Some runners may race at a consistent pace, dropout, take breaks and/or fluctuate their pace. Records containing how many laps a particular entrant runs over each hour in the race allow us the opportunity to model the different types of strategies and how successful they are. Building on previous work

by White and Murphy (2013), use mixture models, latent class analysis, and model based clustering for mixed data. We further plan to develop a longitudinal model-based clustering approach using Poisson processes to determine the type and number of clusters of runners. This approach will have a large scale impact on other applications outside the field of sports. The same type of model-based clustering can be used in various medical research questions, including clinical depression scores of patients over a period of time.

IDENTIFYING SCHIZOPHRENIA RISK GENES AND SUB-NETWORKS USING DAWN FRAMEWORK

STUDENT Julian Zhou *Statistics*
ADVISOR Kathryn Roeder *Statistics*
ROOM/TIME Dowd / 1:40 pm

Human genetics researchers in the post-genomics era are blessed with unprecedentedly powerful genomic technologies such as next-generation sequencing to uncover the mysteries of complex human diseases. On the other hand, nevertheless, geneticists also face many new analytical challenges, such as the need for more sophisticated statistical methods. In this project, we take advantage of large-scale genomic datasets made available by multi-institutional consortia and apply a new meta-analysis framework, Detecting Association With Network (DAWN), to identify risk genes and sub-networks for schizophrenia, a neuropsychiatric disease for which evidence of a strong genetic basis has been shown. In doing so, we also address a measurement issue that arises with the transition between microarray and RNA-seq technologies by proposing a transformation technique that simultaneously achieves sample size enrichment while attending to the issue.

LEARNING FRENCH ONLINE

STUDENTS Anusha Kukreja *Statistics* | Akhil Prakash *Mathematics*
ADVISOR Rebecca Nugent *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Given that more and more people are moving to online courses, it is important for teachers to understand how to tailor the course and how students are utilizing the online resources. Although research has been conducted in this area, it has been generally limited to Math or Science classes. We will be looking at data from the Online Learning Initiative (OLI) Spring 2014 French 1 class. The class is conducted across many universities and high schools, including: Carnegie Mellon University, San Jose City College, UC Boulder, etc. The data was collected from the DataShop web application offered through the Pittsburgh Science of Learning Center. The anonymized data is on a problem by problem basis, including timestamp, school, and actions such as clicking on a button. The main questions we wish to answer are where in the course students drop out, how students navigate through the course, which features of the course are used effectively, and where students struggle. For the initial phase of the project, we will focus on the CMU students only. We will visualize the transaction based data as a student path through the course with network models and the Spearman Correlation Coefficient. We will also use clustering to see if course performance correlated with specific actions or paths within the course. Once we have working visualizations and models for the CMU population, we will check our conclusions by comparing to an in-depth video study of 3 students, and then generalize across other university populations for the same course.

MODELING EBOLA TRANSMISSIONS

STUDENTS Adrian Botta *Economics and Statistics* | Andersen Chang *Statistics* | Abigail Smith *Mathematics*
ADVISORS William Eddy *Statistics* | Rebecca Nugent *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The most recent Ebola Hemorrhagic Fever (EHF) epidemic has grown to over twenty-five thousand cases, and over ten thousand deaths. Following the EHF outbreak in 2013-2014, a lot of research has been published in search for a model that could accurately simulate the spread of this disease. While existing research focuses on applying compartmental models to the data from each country and expanding the simpler SIR model into a more complicated SEIHFR model, we use compartmental models to simulate the spread of the EHF virus across the borders of the three countries most affected by the outbreak, Guinea, Liberia, and Sierra Leone. Using the EpiModel package in R, we optimize for the parameters of each model and assess a goodness of fit for each individual country. We then look at ways to combine cross-border movement data in Western Africa to model the spread of disease from one country to another.

NHL SHOT LOCATION ADJUSTMENT

STUDENT Andersen Chang *Statistics*
ADVISOR Andrew Thomas *Statistics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Since 1997, the National Hockey League (NHL) has used the Real Time Scoring System (RTSS) in order to keep track of and record the details of the events that occur in every game. The logging of all of the data in the RTSS is done manually while the game is in progress. We are interested the recorded shot locations in the data; as these locations are judged by human eye, we suspect that they might be inaccurate. We look at the distribution of recorded shot locations at each arena and compare it to the league-wide distribution, which we assume is the expected distribution of shot locations in each stadium, using kernel density estimation. We then try to develop methods to correct for the shot location bias in each arena using iterative regression and gradient adjustment. Ultimately, our goal is to find the best adjustment functions, unique to each NHL rink, to correct the RTSS shot locations.

OPINIONS AND SATISFACTION WITH BLACKBOARD COURSE MANAGEMENT SOFTWARE AMONG UNDERGRADUATE STUDENTS

STUDENTS Jay Kapur *Social & Decision Sciences* | Stanley Krasner *Economics* | Matthew Limbu *Economics* | Hae Jin Park *Economics* | Quan Yuan *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The most recent Blackboard satisfaction survey was completed in 2007 though Blackboard has been updated and upgraded since then. We conduct a survey of randomly selected Carnegie Mellon Undergraduates at the Pittsburgh campus to learn more about student perceptions about Blackboard use, commonly used features and overall satisfaction. This research was designed and conducted along side 36-303 Sampling, Surveys and Society.

PERCEPTION OF GREEK LIFE AT CMU

STUDENTS Andrew Fernandes *Statistics* | Theodore Peterson *Statistics* | Maxwell Ponte *Statistics* | Alice Ye *Business Administration*

ADVISOR Jared Murray *Statistics*

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

Greek organizations have been negatively depicted in the media as of late due to a perceived connection between partying and sexual assault. However, greek organizations undoubtedly have a positive impact on the beneficiaries of their community service projects. Greek life also seems to benefit the members by giving them a loyal group of friends and a stronger than normal social network. In our study, we aim to find out if CMU students perceive Greek life as having a positive community impact. We suspect that CMU has a generally negative opinion about Greek Life, perhaps due to media influence. Surveys like these could help the University decide if they should place further restrictions on Greek life or "give them some slack." Perhaps also national insurance providers that insure Greek organizations would be interested why?

PREDICTING GALAXY ELLIPTICITY FROM OTHER GALAXY PROPERTIES

STUDENT Brittany Chen *Statistics*

ADVISOR Peter Freeman *Statistics*

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

Due to weak lensing, our perception of galaxies is stretched and warped due to the bending of light traveling. However, we can statistically estimate the true shape of galaxies based on correlation among the ellipticities of galaxies. Using multiple covariates of a galaxy, I am building a model to predict the ellipticity of a galaxy. Some covariates include model flux, scale length of the galaxy, various colors of the galaxies. I am using exploratory data analysis to fit various models to the data, including linear regression, general additive models, regression trees, and various other types of models. Several forms of cross validation and bootstrap are used to evaluate the parameters of each type of model.

PREDICTING THE MASSES OF GALAXY CLUSTERS USING WEIGHTED LINEAR REGRESSION

STUDENT James Eby *Statistics*

ADVISOR Peter Freeman *Statistics*

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

Galaxy clusters are the largest gravitationally bound structures in the Universe. The distribution of their masses is directly related to the parameters that govern the Universe and its evolution, so if we can "weigh" clusters, we can constrain the values of these parameters. In this project, we analyze data from 2,500 simulated galaxy clusters, each observed along several lines of sight, to calibrate the relationship between the velocity dispersion of the individual cluster galaxies and the cluster masses. In our analysis, we apply weighted linear regression, and our results indicate that taking into account the correlation between galaxy velocities for different lines of sight leads to regression parameters that are significantly different from those found by the unweighted regression analysis of Ntampaka et al. (2014).

SATISFACTION IN THE CMU STUDENT COLLEGE PROGRAM

STUDENTS Robert Citrone *Statistics* | Yeram Lee *Statistics* | Sean Richardson *Chemistry* | Thomas Vielott *History* | Qiutong Ye *Statistics*

ADVISOR Jared Murray *Statistics*

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

The Student College (StuCo) program allows CMU students to teach a small, 3 unit course for credit. Courses range in topic from Knitting to Minecraft, to Job Searching. Our goal in this survey is to measure two aspects of student participation in the StuCo program. The first is the satisfaction of StuCo students in both the specific classes they are taking now and the program in general. The second is the participation rate of students in the StuCo program. This mean absence rates, number of StuCo classes taken, willingness to take further StuCo classes and so on.

SELF-ESTEEM, BRAND LOYALTY, AND CONSUMER WILLINGNESS TO PAY: AN EXAMINATION OF "AVERAGE WOMEN" CAMPAIGNING

STUDENT Stephanie Rifai *Statistics*

ADVISOR Saurabh Bhargava *Social & Decision Sciences*

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

A wealth of research has established the detrimental psychological effects of unattainable body images of women in the media (Chang et al, 2013; Selvic & Tiggemann, 2011; Harrison, 2008). As a response to the recent public attention around such unrepresentative media portrayals, some companies have began to advertise with more archetypal images of women. Companies using this tactic will sometimes point this out within the advertisement, likely with the intention of generating good will in exchange for socially responsible behavior. This study takes a closer look at the effects of "real women" advertisements on participants' self esteem, brand loyalty, willingness to pay, as well as advertisements effectiveness, and further examines whether explicitly drawing attention to this type of portrayal alters consumer perception. Do we observe differences in stated willingness to pay, various brand loyalty and advertisement effectiveness measures, and immediate self esteem between people who see an advertisement with a traditional thin ideal woman, an average representation of a woman, and an average representation of women with explicit pro-sociality messaging? A hypothetical choice survey distributed on amazon mechanical turk and taken by 450 U.S. adults, asked participants to view the advertisement in one of three conditions (Thin Image, Average Image, Average Image with Messaging), and answer a series of follow up questions. We find there to be a significant positive change in perceived positivity, advertisement quality, and likelihood to buy product for females, who saw average sized women as compared to their counterparts. We find neutral and negative effects for males in these categories. There is no difference with respect to willingness to buy and self esteem for all participants. These findings provide economic motivation for the use of such social elements in advertising.

MELLON COLLEGE OF SCIENCE

BIOLOGICAL SCIENCES

A LIGHT-BASED APPROACH FOR THE PREVENTION OF BIOFOULING AND BIOCORROSION

STUDENT Nicholas O'Hallaron *Biological Sciences*
ADVISOR Kelvin Gregory *Civil and Environmental Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Microbial biofilms and the corrosion that they cause are an enormous cost to a variety of industries, including oil and gas and water and wastewater treatment. Although a variety of control methods are available, none are cost-effective or certain. This particularly true with the oil and gas industry of Pennsylvania where prior work has revealed that the bacteria responsible for biocorrosion are present in high numbers and recalcitrant to the biocides that are employed in an attempt to control them. There is an urgent need for novel methods to control the sulfide producing bacteria that are responsible for industrial biocorrosion. one such approach may be the use of light to stimulate the growth of other bacteria at the expense of the detrimental ones. Light provides a more thermodynamically favorable growth regime for bacteria than does anaerobic sulfidogenesis. Therefore, we hypothesize that light will stimulate microbial populations that out-compete sulfidogenic bacteria and reduce rates of biocorrosion. We will evaluate this hypothesis in batch reactors and use molecular microbial ecology and analytical chemistry to verify the results from these experiments. This interdisciplinary research will be supervised by experienced graduate students in Professor Gregory's laboratory using methods that are well in hand. Results will be of broad interest to the CMU research community as well as industries such as oil and gas and water and wastewater.

ANALYSIS OF MOTHER-TO-CHILD HIV INFECTION RATES IN THE UNITED STATES AND SOUTH AFRICA.

STUDENT Jenine Nembhard *Biological Sciences*
ADVISOR Stephanie Wallach *History*
ROOM/TIME Peter / 1:40 pm

This research topic will present a review on the current health care systems in the United States and South Africa as it relates to the transmission of HIV from mother-to-child. This includes the basic health care systems in both countries and the various medical disparities that may cause different infection rates. The vast factors that may cause disparities in infection rates are expanded upon with the examination and analysis of statistical data. This project attempts to investigate the scope in which this issues is handled within the two healthcare systems and the resulting consequences.

ASSESSING DOPAMINE TRANSMISSION KINETICS IN STRIATAL REGIONS USING FAST-SCAN CYCLIC VOTAMMETRY

STUDENT Miranda Munoz *Biological Sciences*
ADVISOR Amy Wagner *University of Pittsburgh*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Fast-scan cyclic voltammetry (FSCV) is an electrochemical method that monitors in vivo dopamine (DA) concentration changes in real-time to study the kinetics of DA neurotransmission. Currently, FSCV data is widely interpreted using the Michaelis-Menten model and we improved this method by making realistic assumptions of known neurobiological principles of neurotransmission. This allows for more complete analysis of differently shaped DA responses in the dorsal and ventral striatum. To test the validity and usefulness of the new model, we have successfully applied it in cases of acute drug treatment and injury. Our model will make FSCV analysis much easier and more biologically accurate.

CORTICOCORTICAL FEEDBACK-MEDIATED FACILITATION IS CELL-TYPE SPECIFIC AND GATED BY NUCLEUS BASALIS ACTIVITY

STUDENT Mark Nicholas *Biological Sciences*
ADVISOR Sandra Kuhlman *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:45 am

Sensory circuits of the brain build an internal representation of the external world which is used to guide subsequent behavior and learning. Importantly, the internal representation is not a precise replicate of environmental statistics; rather it is filtered to facilitate appropriate behavior. Previous works demonstrate that both the internal state of the brain and the context in which stimuli are presented impact the functional response of sensory neurons in primary cortex. In other words, we see with our brains, not our eyes.

As visual perception is dictated by brain state, we look to study how the circuitry of the visual cortex functions based on nucleus basalis activity. We suggest that there is some feedback from the secondary visual cortex (LM) back to the primary visual cortex (V1), which will result in the regulations of the specific firing rates during visual stimulation. This experiment looks to further understand this network mechanism of top-down control of visual response and determine if this feedback from LM modulates the firing response of both V1 pyramidal cells and fast spiking neurons during visual stimulation. This experiment is performed using a mouse as an animal model and recording was done in both the presence and absence of cholinergic input from the nucleus basalis.

DEVELOPMENT OF A CLEANING ASSAY FOR REMOVAL OF VIRAL CONTAMINATION FROM ATOMIC FORCE MICROSCOPY PROBES: A GAME CHANGER FOR IMAGING RESOLUTION

STUDENT Kaitlin Hamilton *Biological Sciences*
ADVISORS Alex Evilevitch *Physics* | Krista Freeman *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:00 am

Atomic force microscopy (AFM) is a technique that utilizes the interaction between a surface and the tip of a probe to construct an image of that surface and measure the mechanical properties of the sample. It is an important tool

for biological experiments because it can image biological materials in physiologically-relevant solutions. AFM can also be used in a quantitative manner to measure, for instance, the DNA pressure inside a viral capsid or the force required to break a capsid. This type of analysis is performed in our group in order to understand how the mechanical stability of the virion correlates with the retention of the viral genome inside the virion. Mapping this correlation with AFM elucidates the ability of the virus to survive in harsh environments outside the host between infection events. The accuracy of this analysis is dependent upon the cleanliness of the AFM probe tip (cantilever). Tip contamination due to experimental use can lead to low resolution images that not only make it difficult to see the biological materials but also to perform the appropriate manipulations for quantitative measurements. Previous studies have described methods for cleaning AFM probe tips but have also found that the effectiveness of these methods is strongly dependent on the nature of the tip contamination.

The purpose of my project is to systematically investigate the effectiveness of three previously described methods at cleaning AFM nitride tips contaminated with herpes simplex virus 1 (HSV-1) material. To our knowledge, none of the previous studies of cleaning methods looked at this type of protein contamination. The three techniques that I will be testing include ethanol and ultraviolet light treatments, biaxially oriented polypropylene (BOPP) film insertion, and sonication in ethanol. We will assess the level of contamination of the tips before and after cleaning by imaging HSV-1 particles because they have a well-defined structure. We will also quantify tip characteristics to assess any damage to the tip as a result of the cleaning process. The results of these analyses will be used to suggest the best method of the three for removing HSV-1 contamination from an AFM probe.

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, Window side / 12-2:30 pm

Autoimmune diseases are caused by the immune system confusing self and foreign proteins, either due to genetic or environmental influences. The key players of the immune system in this process are antibodies; the antibodies target and bind specific self-proteins in order to attack the tissues of the body, thus causing inflammation. The target proteins are called auto-antigens. Rheumatoid Arthritis (RA) is one of the most prevalent autoimmune diseases, affecting 2% of our population. 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 discover the specific auto-antigens recognized by auto-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 specific target auto-antigens through their binding to RA or RA-ILD patient auto-antibodies. To discriminate between target proteins and patient antibodies, biotin-CDM will be used to tag target protein and not antibodies. Biotin-CDM is helpful in enhancing the identity of biomarkers because contamination from other general antibodies is minimized. We will use DIGE (difference gel electrophoresis) to track the progression of RA's progression into RA-ILD.

INVASION OF CANDIDA ALBICANS INTO POLYACRYLAMIDE HYDROGEL

STUDENT Tammy Ying *Biological Sciences*
ADVISOR Frederick Lanni *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:15 am

My research is aimed at understanding the invasion of hyphal cells (elongated filamentous cells) of the fungus Candida albicans into cross linked elastomer. The proposed theoretical model is that strains use turgor equal to the Young's modulus of the substrata to gain an invasive phenotype. This was tested experimentally using two approaches. Elastic substratum with varying elastic moduli was used to assess the depth of invasion of wild-type C. albicans. Wild-type and mutant strains deficient in glycerol were also assayed for intracellular osmolarity in order to further quantify and prove our hypothesis that C. albicans hyphae use osmotic pressure to drive invasion in solid substrata. My proposal is novel in that it studies the biophysical invasion of C. albicans hyphae into elastomer during biofilm formation. This project is actually part of a larger research question on the effects of the gene RHR2 on biofilm formation and invasion. RHR2 encodes the enzyme glycerol-3-phosphatase, which is responsible for producing glycerol, the suspected osmolyte. In a mutant strain where this gene is missing, the biofilm integrity is compromised along with defects in invasion into substrata. Thus, RHR2 is necessary for biofilm formation and invasion in C. albicans.

KINESIN BINDING UNDER PHYSIOLOGICAL pH AND SALT CONDITIONS

STUDENT Jamie Zhan *Biological Sciences*
ADVISOR David Hackney *Biological Sciences*
ROOM/TIME Wright / 3:00 pm

Progressive neurodegenerative diseases such as Parkinson's, Alzheimer's and Huntington's all share a similar characteristic in that they involve the inhibition of a type of cellular mechanism called Fast Axonal Transport (FAT). FAT is a neuron's way of transporting components such as proteins and organelles to and from its body. Kinesin, along with a handful of other motor proteins, are responsible for mediating this process. Although kinesin has been studied in depth before, the research done on it was often completed at a pH of 6.8, where kinesin shows optimal binding. This data may not be medically relevant as the body's pH is closer to 7.2. The goal of this project is to use Fluorescent Resonance Energy Transfer (FRET) assays to determine how effectively kinesin binds under relevant physiological conditions and how pH and salt levels can influence its efficiency.

MICRO-FLUIDIC SYSTEM WITH PARTITIONED SAMPLES

STUDENT Jacqueline Lee *Biological Sciences*
ADVISOR Alan Rosenbloom *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:30 am

In an age when increasingly sophisticated embedded systems are automating and controlling ever more complex tasks in devices from washing machines to satellites, there is no assistive technology for clinical research. The Rosenbloom laboratory is developing an autonomous sampling device that will continuously collect fresh urine samples, and bank them without cross-contamination, evaporation or spoilage. Fresh urine samples will allow researchers to access the samples to subsequently gain insight of acute kidney injury, AKI. The goal of this project

was to create a device that will enable researchers to discover biomarkers in the urine of critically ill patients who develop kidney failure. This will allow earlier intervention and more effective recognition of response to new therapies on a molecular level. This design included two pumps, one for urine extraction from the patient and the second for injecting fluorocarbon to partition the samples. Using a scaled down computer, such as Beaglebone, the pumps of the microfluidics system are controlled by border detection programming of the fluorocarbon partitions. Storage of urine samples was designed for the maximum volume of sample in a small enough container to fit unobtrusively on a patient's urinary collection bag. The bench-tested components were recast into a field ready prototype.

NEW INSIGHTS INTO LAMININ AS A STRUCTURAL CUE FOR MYOBLASTS USING MICROPATTERNED SURFACES

STUDENT Shaun Ranadé *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The goal is to understand how cells respond to different structural cues and to achieve broader goal of understanding their role in the field of tissue engineering and regenerative medicine related applications. Controlling the extracellular microenvironment and the surface geometry is one way to observe how cells grow and differentiate into tissues under different structural cues. It has been proven that topographical and chemical cues in different geometries regulate cell adhesion, morphology, cytoskeletal organization and cell-cell interactions. Fibronectin and laminin are well appreciated for their role in guiding the myoblasts in particular orientation to facilitate faster and well organized myotube differentiation. Micropatterned stamps are employed for creating such cues as a pattern on surfaces. Periodicity is an important factor as much as shape of the patterns. Here, we propose a study to compare effect of laminin micropatterns compared to fibronectin as well as effect of linear periodic patterns in comparison with bulge shaped linear patterns.

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*
ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new

area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

THE COMPARATIVE ANALYSIS OF THE CIRCUMSTANCES OF INTERNATIONALLY DISPLACED REFUGEES IN KENYA AND INTERNALLY DISPLACED PEOPLES IN HAITI, AND THE NET EFFECT OF NON-GOVERNMNETAL ORGANIZATIONS ON BOTH SCENARIOS

STUDENT Arsema Thomas *Biological Sciences*
ADVISOR Michael West *Modern Languages*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

There is a glaring difference between reality and fantasy, which has never been more true than in the case of the non-governmental organizations in countries that have undergone immense trauma, and their work that they carry-out at the community level. The premise of the research carried out was to compare the contrast between what was expected and needed, to what was actually supplied, using two case studies. The first being internationally displaced refugees at the Kakumah Refugee Camp at the border between Sudan and Kenya, run under the authorization of the United Nations Refugee Agency (UNHCR). The second case study is that of the Canaan Internally Displaced People's (IDP) Camp, funded by USAID in Port-Au-Prince, Haiti. With interviews with residents from both camps, there are specific disparities between the two scenarios, but there is also an overlying similarity, that is rooted in the idea that, these people are being denied the aid they so rightly deserve. This denial of basic essentials is under out the false illusion that their government alongside the help of various non-governmental organizations have provided the basic necessities, especially the medical and nutritional aspects.

THE EFFECTS OF CHRONIC MORPHINE ON THE RATE OF MU-OPIOID RECEPTOR (MOR) TRAFFICKING

STUDENT Preethy Sridharan *Biological Sciences*
ADVISOR Manojkumar Puthenveedu *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:15 am

Morphine addiction is characterized by the signaling and activity of the mu-opioid receptor (MOR), a GPCR protein found on the surface of human cells. The MOR is endogenously activated by endorphins and enkephalins that are naturally found in the human body. Due to their similar chemical structure, the MORs also bind and respond to morphine and other opiates, foreign to the body. As of yet, it is still unclear why the natural endorphins and enkephalins are harmless, while opiates cause addiction. One route to answering the question is to analyze the changes in the activity of the MOR when activated by natural substances as opposed to opiates. Specifically, it is of interest to monitor the changes in activity after cells have been exposed regularly to opiates over the course of several days, because these could emulate the changes cells undergo in the human body after many exposures to morphine.

THE EFFECTS OF INHIBITING WNT SIGNALING ON GENE EXPRESSION IN REGENERATING PATIRIA MINIATA

STUDENT Katherine Huang *Biological Sciences*
ADVISORS Gregory Cary *Biological Sciences* | Veronica Hinman *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:30 am

In many organisms, including the sea star Patiria miniata, Wnt signaling regulates axial patterning and stimulates cellular proliferation during early development. Specifically, Wnt is expressed in the posterior half of P. miniata embryos and larvae. Imaginably, the proliferation aspect of Wnt signaling is also implicated in cancer and stem cell growth, which is of particular interest in modern medicine. Because sea stars are phylogenetically close to humans, and because Wnt proteins are highly conserved across species, studying Wnt signaling in sea stars is conducive to understanding human cancer and stem cell phenomena. My work this semester investigates the effect of inhibiting Wnt signaling with the drug Wnt-C59 on the gene expressions of the transcription factors foxQ2 and brachyury, which are involved in anterior and oral development, respectively. I used whole mount in situ hybridization (WMISH) to first visualize foxQ2 and brachyury expression in P. miniata embryos that had been exposed to a range of Wnt-C59 concentrations. This tested the hypothesis that Wnt inhibition would lead to overdevelopment of anterior characteristics, which was found to be especially true in the brachyury samples. I then transversely bisected P. miniata larvae to create anterior and posterior regenerating halves. These bisected specimens will be treated with different concentrations of Wnt-C59, and WMISH will be used to detect the expression patterns of foxQ2 and frizzled5/8 (a gene known to have a similar expression to foxQ2, normally) in the anterior and posterior regenerating halves. Additionally, because Wnt signaling is known to be involved in cell proliferation during regeneration, I will perform a proliferation assay on regenerating larvae in both the presence and absence of Wnt-C59, in order to detect cell-growth patterns upon Wnt inhibition.

THE GUT-MICROBIOME-BRAIN CONNECTION

STUDENTS Jennifer Huang *Biological Sciences* | Taechawidd Nantawisarakul *Biological Sciences* | Emilio Rodriguez *Biological Sciences*
ADVISOR Brooke McCartney *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:00 am

New research is revealing the significance of the symbiotic relationship between humans and the bacteria and fungi that live in and on our bodies, collectively referred to as the microbiota. In one aspect, bacterial ecosystems have been found to influence learning, memory, anxiety, depression, and autism spectrum disorder behaviors. Using Drosophila melanogaster, the common fruit fly, as the model organism, we aimed to understand how the connection between the gut microbiome, the gut cells themselves, and the brain contributes to these cognitive and behavioral health conditions. Flies were raised with none to extremely limited bacterial exposure to have a "germ-free" microbiome. Behavioral tests (phototaxis, chemotaxis, learning and memory, and geotaxis) were then conducted comparing behavior of conventional and germ-free flies. Overcrowding and heat shock were other variables tested for their effect on behavior between conventional and germ-free flies. Overall, these experiments aim to better understand the relationship between the microbiota and the behavior of Drosophila.

THE ROLE OF ANTIBIOTICS IN MODULATING MACROPHAGE IMMUNE CELL FUNCTION

STUDENT Gordon Pherribo *Biological Sciences*
ADVISOR James Collins *Massachusettes Institute of Technology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:45 am

The current drug model for antimicrobials is rapidly shrinking. Drugs that once targeted important bacterial pathways involved in growth and reproduction are no longer effective as new antibiotic resistant strains arise. While researchers have a general idea of how antibiotics kill bacteria, little is known about how bacteria actually die, especially in the context of the host. Here, we investigate how antibiotics affect innate immune cell responses during bacterial infections. To better study this complex interaction, macrophage phagocytosis assays were performed to measure the degree of intracellular bacterial killing when treated with spent media from antibiotic-treated bacteria. We then performed the same experiments with macropinocytosis inhibitors to study the role of this process in mediating host- antibiotic interactions. Our results reveal that bacteria release factors involved in inhibiting macrophage function, and the treatment of bacteria with low doses of antibiotics restores the normal macrophage killing phenotype. In the presence of the macropinocytosis inhibitor, the addition of bacterial effector molecules and/or antibiotics had no effect on macrophage killing. Through this research we plan to gain insight into the direct and indirect interactions between antibiotics and professional phagocytes, with the hopes of improving our understanding of microbe-host responses for therapeutic treatment.

CHEMISTRY

AN INTEGRATED FRAMEWORK ADVANCING MEMBRANE PROTEIN MODELING AND DESIGN

STUDENT Rebecca Alford *Chemistry*
ADVISOR Jeffrey Gray *John Hopkins University*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Membrane proteins are critical functional molecules in the human body, constituting more than 30% of open reading frames in the human genome. Unfortunately, a myriad of difficulties in overexpression and reconstitution into membrane mimetics severely limit our ability to determine their structures. Computational tools are therefore instrumental to prediction of membrane protein structure, consequently increasing our understanding of membrane protein function and their role in disease. Here, we describe a general framework facilitating membrane protein modeling and design that combines the scientific principles for membrane protein modeling with the flexible software architecture of Rosetta3. This new framework, called RosettaMP, provides a general membrane representation that interfaces with scoring, conformational sampling, and mutation routines that can be easily combined to create new protocols. To demonstrate the capabilities of this implementation, we developed four proof-of-concept applications for (1) prediction of free energy changes upon mutation; (2) high-resolution structural refinement; (3) protein-protein docking; and (4) assembly of symmetric protein complexes, all in the membrane environment. Preliminary data show that these algorithms can produce meaningful scores and

structures. The data also suggest needed improvements to both sampling routines and score functions. Importantly, the applications collectively demonstrate the potential of combining the flexible nature of RosettaMP with the power of Rosetta algorithms to facilitate membrane protein modeling and design.

ATOMIC FORCE MICROSCOPY ANALYSIS OF SELF-HEALING MATERIALS

STUDENT Gabriella Cottiero *Chemistry*
ADVISOR Tomasz Kowalewski *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Over the past few years, the importance and prevalence of self-healing materials has increased dramatically. Such materials are able to repair themselves after experiencing damage and subsequently restore important physical properties such as hardness, stiffness, and conductivity. Unfortunately most of these materials are inefficient due to a dependence on temperature or pH to induce the healing. This has led to the development of a new system consisting of a blend of poly(2-dimethylaminoethyl methacrylate) (PDMAEMA) and poly(acrylic acid) (PAA) grafted to silica nanospheres, a system, which relies on the tendency of amines and carboxylic acids to form strong, non-covalent bonds through electrostatic interactions. The ability of these bonds to break and reform grant the system its self-healing properties, without the need for external stimulation. The polymer component makes the system soft and mobile enough to heal itself, while the silica nanospheres contribute the harder matrix to grant durability. This research was focused on analyzing this system using atomic force microscopy (AFM) to obtain information about important properties such as surface morphology and stiffness. The compositions of the two polymers were varied in order to acquire information about each of their effects on the self-healing properties.

CHARACTERIZATION AND ANALYSIS OF NONCOVALENT COMPLEXES FORMED BETWEEN FLUOROGENIC DYES AND FLUORESCENCE ACTIVATING PROTEIN (FAP)

STUDENT Sukjin Jang *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:15 am

The project involved characterization of noncovalent complexes formed between fluorogenic dyes and proteins. These binding interactions cause the fluorogenic dyes to “light up”, i.e. become fluorescent. Various combinations of the dyes and proteins give rise to the full range of visible colors. Some proteins are highly selective for binding to a particular dye, whereas others are more promiscuous, giving rise to the ability to generate several different fluorescence colors from the same protein. Experiments included were (a) determination of equilibrium dissociation constants (KD), which are a measure of the affinity between the dye and protein; (b) fluorescence quantum yield measurements, which relates to how efficiently the dye emits fluorescence relative to the absorbance of photons; and (c) photostability measurements, which indicate how many times a dye-protein complex can absorb and emit light before undergoing an irreversible chemical reaction that eliminates its ability to fluoresce. Several dyes and proteins in the Armitage lab, notably Malachite derivative dyes, were complexed with ScFv proteins selected from Molecular Biosensor and Imaging Center. In addition to the experimental work, calculations were done in collaboration with Prof. David Yaron of the Chemistry Department to relate structural properties of the dyes to their optical (light absorption and emission) properties.

CHARACTERIZATION OF INTERNALLY-LABELED PEPTIDE NUCLEIC ACID (PNA) FLUORESCENT PROBES

STUDENT Michelle Moon *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:30 am

The significance of peptide nucleic acid (PNA) and its applications as a fluorescent probe have been growing. Because a reliable detection is needed, there have been efforts to improve the brightness of the PNA probe. One way to do so is by labelling the probe internally with more dyes. This project will provide more information on the effect of dyes at internal positions of the probe on the duplex stability, selectivity, and brightness. A "U" PNA monomer with a modified Cy3 dye was incorporated into a PNA probe. This probe was characterized using UV melting curve analysis and fluorescence spectroscopy. The results confirmed that the internally labeled PNA probe selectively binds to its target sequence with high binding affinity, which ultimately suggests the feasibility introducing multiple dyes within a PNA probe in order to improve its brightness.

DEVELOPMENT OF BROAD-SPECTRUM ANTIBIOTICS

STUDENTS Julia Atwood *Chemistry* | Emily Harwitz *Chemistry* | Cat Mao *History* | Adam Simpson *Chemical Engineering*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Bacterial infections are of rising concern in the world today. Antibiotics are of massive importance in controlling and eliminating potentially deadly infections, but due to widespread resistance are difficult to profitably research and produce. New classes of antibiotics, with different targets and mechanisms, must be sought and invested in to prevent a relapse to infection mortality of the pre-antibiotic era. The isolation and research of natural antimicrobial peptides offers intriguing drug leads. These molecules demonstrate potent antimicrobial activity in living systems and some have been shown to be immunomodulatory. Resistance to antimicrobial peptides so far has been slower to develop than in conventional drugs and may be combated further by synergistic effects when peptides and conventional drugs are used in combination. RTD-1 is a cyclic antimicrobial peptide in the theta defensin family isolated from rhesus macaque and baboons. It has been found to be effective against viruses, fungi and both gram-negative and gram-positive bacteria. Though effective by itself as an antimicrobial agent, the peptide is difficult to synthesize because of three disulfide cross-linkages that are necessary for the tertiary structure of the peptide. This obstacle was overcome by the incorporation of Peptide Nucleic Acid (PNA) monomers in a mimic of RTD-1, called RTD-1M. Previously, RTD-1M demonstrated similar antibiotic properties to native RTD-1 and low toxicity to human red blood cells.

We present the synthesis of a series of RTD-1M molecules with modifications to increase bactericidal potency and decrease production time and cost. These iterations will be tested via a combinatorial strategy and compared to currently available antibiotics and native RTD-1. Successful versions of RTD-1M could be developed into a novel oral therapeutic of a promising antibiotic class.

FLUORESCENT PEPTIDE NUCLEIC ACID PROBES FOR THE REGENERATIVE BIOLOGY STUDY OF A SEA STAR LARVAL MODEL

STUDENT Lauren Xu *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Sea stars are capable of regeneration, an ability that humans generally lack. Understanding the mechanisms of regeneration would yield invaluable applications for tissue reengineering. In order to study the gene expression and protein modification that occurs during regeneration, a detection method is needed to bind to the sea star's genes known as micro RNA (miRNA). -PNA probes can bind specifically and with high affinity to miRNA involved in the regeneration processes. The fluorescence emitted from the probes' fluorescent dye can be used to visualize the miRNA, giving temporal and spatial information. This project aims to design -PNA miniprobes with modifications for use in a tyramide signal amplification (TSA) assay. The TSA assay can increase sensitivity up to 100-fold, thereby allowing better imaging. The new miniprobes will first be synthesized, characterized and analyzed for efficiency in vitro (in cells outside of the animal). By doing so, we hope to maximize the likelihood of the probes working in vivo (within the living organism).

INHALED CARBON MONOXIDE INDUCES A PHENOTYPIC SHIFT IN MACROPHAGES

STUDENT Ghee Rye Lee *Chemistry*
ADVISOR Edith Tzeng *UPMC*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:15 am

Inhaled carbon monoxide (CO) has potent anti-inflammatory effects in vivo but its mechanisms of action remain unknown. We have previously shown that circulating monocytes/macrophages are essential in exerting these protective effects. We hypothesize that inhaled CO mediates phenotypic shifts in the macrophages to favor anti-inflammatory functions.

Peritoneal macrophages were collected from rats after inhaled CO (250 PPM for 1 hr) or from an air control rat. Cells were cultured overnight and stimulated with and without LPS. Levels of TNFa, IL6 and IL10 in the media were quantified with ELISA and nitric oxide (NO) with the Griess assay. Mouse peritoneal macrophages (F4/80+) were similarly collected for flow cytometry to determine phenotype shifts towards M1 (proinflammatory, CD86+) and M2 (anti-inflammatory, CD206+). Macrophages from CO treated rats had similar baseline cytokine and NO production as cells from air treated rats. Following LPS treatment, CO-macrophages exhibited increased NO, IL6, and IL10 production with decreased TNFa. Similarly, there was no difference in phenotype expression without stimulation. However, with LPS stimulation, CO-macrophages exhibited decreased M1 expression (CD86 MFI; Air+LPS 46,243 vs. CO+LPS 16,500;P=.006) and increased M2 expression (CD206 MFI; Air+LPS 3,221 vs. CO+LPS 4,739; P=.03). Inhaled CO does not alter baseline macrophage phenotype, but with inflammatory stimulus, it induces a shift toward an M2 phenotype. This may, in part, explain the profound anti-inflammatory properties of carbon monoxide. Future studies are needed to understand signaling mechanisms of CO to macrophages.

INVESTIGATING THE ROLE OF WNT SIGNALING IN THE ESTABLISHMENT AND MAINTENANCE OF THE FEMALE DROSOPHILA GERMLINE STEM CELL NICHE.

STUDENT David Vinson *Chemistry*
ADVISOR Brooke McCartney *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:30 am

The function of the stem cell niche is to maintain the self-renewal and differentiation potential of resident stem cells. Signaling networks within the niche have been studied but there are significant questions that remain. Specifically, the molecular mechanisms and signaling networks regulating niche size and architecture are not understood. APC (Adenomatous polyposis coli) regulates cell division and cell movement. This makes it a compelling protein candidate to investigate within the context of the stem cell niche. My research focuses on how APC may influence niche size and architecture. APC2 is a Drosophila version of human APC which is commonly used to study APC. This project will determine the details of APC2's role in the establishment and maintenance of the Drosophila female germline stem cell niche architecture. I will use an RNAi approach to disrupt known APC2 signaling partners and to precisely determine the role of APC2 in this easily visualized and genetically manipulated ovary germline stem cell niche tissue model.

NOVEL FUNCTIONAL POLYMERS FOR USE IN AQUEOUS ELECTROLYTE ENERGY STORAGE DEVICES

STUDENT Nicole Sansone *Chemistry*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:00 am

Large-scale energy storage is required for optimization of renewable energy sources such as solar installations and wind farms, which rely on power generated intermittently. In order to effectively store such energy, it is necessary to employ many battery units, each of which is a complex composite of materials, including electrodes containing active material. In order to maximize the amount of energy stored per dollar, it is necessary to increase the ratio of electrode to other device components within the unit. To do this, thick format electrodes are made through use of binder systems that contain conducting polymers that enhance the usual limitations in conductivity that are encountered in such systems. The polymers that we have tested so far have been polypyrrole (PPy) and poly(3,4-ethylenedioxythiophene) (PEDOT). Conductivity tests have found conductivity values 1000-times higher than typical electrochemical binders and cyclic voltammetry results have indicated that both polymers show promise for use in battery systems.

ONLINE LEARNING: THE EFFECTS OF CONCRETE REPRESENTATIONS OF FRACTIONS ON 4TH AND 5TH GRADERS

STUDENT Julia Pasquale *Chemistry*
ADVISOR Eliane Wiese *Human Computer Interaction Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This research was done through the Human Computer Interaction Institute, under Eliane Wiese, a PhD student. The poster will examine how fourth and fifth grade students solve problems on an online math tutor that contains both abstract and concrete representations of fractions. The data for the participants was collected using voice recording, screen capture, and an eye tracker to follow their gaze and focus patterns. The results obtained for a small population of data are not necessarily conclusive as a whole as to whether the concrete representations of fractions are supporting or detrimental to the students' learning, but several cases are worth further examination. The results of this study will also be compared to previous research, and will hopefully shed light on some of the advantages and/or pitfalls of the modern, overly-"technologized" education system.

SATISFACTION IN THE CMU STUDENT COLLEGE PROGRAM

STUDENTS Robert Citrone *Statistics* | Yeram Lee *Statistics* | Sean Richardson *Chemistry* | Thomas Vielott *History* Qiutong Ye *Statistics*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The Student College (StuCo) program allows CMU students to teach a small, 3 unit course for credit. Courses range in topic from Knitting to Minecraft, to Job Searching. Our goal in this survey is to measure two aspects of student participation in the StuCo program. The first is the satisfaction of StuCo students in both the specific classes they are taking now and the program in general. The second is the participation rate of students in the StuCo program. This mean absence rates, number of StuCo classes taken, willingness to take further StuCo classes and so on.

SYNTHESIS OF A CHIRAL ALPHA HELICAL PEPTIDE AND DETERMINING ITS POTENTIAL AS A SPIN FILTER

STUDENT Kacey Idouchi *Chemistry*
ADVISOR Catalina Achim *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:15 am

There are current studies on spintronics, which are electronics that utilize molecules that can filter electron spins. Filtering spins has allowed for memory materials to have high storage space, high speed, and lower power requirements, as opposed to permanent magnets. It was observed that DNA can filter electronic spins, and now we are trying the study the same effects in peptides. Chiral peptides that are right (D) and left (L) handed are aimed to be synthesized and characterized based on D- and L- monomers of the amino acids, Leucine (L), Alanine (A), and 2-aminoisobutyric acid (Aib). The target sequence is Aib-A-L-Aib-A-L-Aib-A-L-Aib-A-L-Aib-A-L-Aib. The peptide chain will be synthesized by solid-phase synthetic methods. It will be purified using HPLC. ESI/MALDI will then be used to confirm that the correct peptide was made. Then CD spectroscopy will determine their helical structure and handedness. UV-Vis spectroscopy will determine the peptide's concentration and spin filtering characteristics.

SYNTHESIS OF CATIONIC NANOGEL VIA INVERSE MICROEMULSION FOR siRNA DELIVERY

STUDENT Ernesto Acosta *Chemistry*
ADVISOR Antonina Simakova *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

It's known worldwide that genetic diseases such as cancer affect an overwhelming number of people annually. In an effort to find a cure or treatment for such diseases, a small interfering nucleic acid (siRNA) was developed. The siRNA was observed to have a post-transcriptional gene silencing effect that could help treat cancer and genetic diseases. Although siRNA shows great promise as an antigene agent, the administering of siRNA into organisms causes difficulties because most cancer treatment of organs has to be done intravenously. The difficult arises because the body detects the siRNA as a foreign molecule and is immediately degraded by the immune system, enzymes, and once inside the cell may not target the correct gene. Therefore, the Matyjaszewski lab proposes the development of a synthetic cationic nanogel to be used as a drug delivery mechanism for the siRNA that will protect the siRNA from degradation, improve cell uptake specificity and reduce cell toxicity from the nanogel itself. The developed nanogel will help protect siRNA from degradation so it may reach its target, improve cell uptake to provide the maximum efficiency of drug delivery into cancerous cells to effectively reduce tumors, and reduce the toxicity of already developed nanogels as well. This will be done by developing an array of differently sized, and charged nanogels that will be tested for delivery and cell toxicity to determine the optimal nanogel for siRNA delivery to the body to combat diseases much like cancer.

THE ANALYSIS OF COWPEA MOSAIC VIRUS (CPMV) USING STJ CRYODETECTION MALDI TOF MASS SPECTROMETRY

STUDENT Jonathan Feldman *Chemistry*
ADVISOR Mark Bier *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Superconducting tunnel junction (STJ) cryodetectors allow for the detection of higher m/z ions than what is possible with conventional micro-channel plate (MCP) ionizing detectors. By coupling a STJ detector with matrix-assisted laser desorption ionization – time of flight (MALDI-ToF) mass spectrometry (MS), it is possible to measure the m/z of large intact protein complexes. Recently, we have been able to measure cowpea mosaic virus using this method. The genome of cowpea mosaic virus is encapsulated in two separate molecules, one containing RNA-1, weighing 5.61 MDa, and the other containing RNA-2, weighing 4.87 MDa. This marks the first time the intact virus has been weighed using MALDI mass spectrometry.

MATHEMATICS

CHARACTERIZATION OF UNCONFINABILITY FOR CERTAIN CLASSES OF POLYGONAL CELLS

STUDENT Katherine Borst *Mathematics*
ADVISOR John Mackey *Mathematics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We address an open question posed by Alfeld, Piper, and Schumaker in 1987 and again by Alfeld in 2000 regarding the characterization of unconfinable cells. For cells with 6 interior edges, we obtain a geometric characterization of confinability in terms of cross-ratios. This characterization allows us to show that a hexagonal cell in which the diagonals intersect at the interior vertex is unconfinable if and only if the lines containing opposite edges and the diagonal through the remaining points are either parallel or are concurrent.

CLASSIFYING KEPLER OBJECTS OF INTEREST

STUDENTS Eric Alpert *Mathematics* | Ronald Yurko *Statistics*
ADVISORS Peter Freeman *Statistics* | Rebecca Nugent *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

NASA's Kepler Mission surveys a region of the Milky Way galaxy to search for exoplanets. The goal of the Kepler Mission is to identify exoplanets with conditions similar to the Earth, as well as to expand the knowledge of stars and their potential orbiting exoplanets. Before the exoplanets can be studied however, they must be identified. The Kepler Telescope has identified 7348 objects of interest (KOI) in attempt to identify exoplanets. Of the KOI, 993 are classified as confirmed exoplanets with 3170 false positives while 3185 are still unlabeled candidates. Utilizing statistical methods this project explores the relationships between the KOI classification and numerous covariates. A random forest and other classification models are fit to the labeled KOI in order to predict whether the remaining 3185 candidates are confirmed exoplanets or false positives. Furthermore, unsupervised learning methods are also used to view the natural structure of the remaining candidates in comparison to the labeled KOI.

DEVELOPMENT OF DETERMINISTIC AND STOCHASTIC MODELS FOR A T7 PHAGE-E. COLI SYSTEM WITH VACCINATION STRATEGY IMPLEMENTATION

STUDENT Abigail Smith *Mathematics*
ADVISOR John Mackey *Mathematics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Vaccination is widely considered the most effective method of preventing the spread of infectious disease. Pulse vaccination strategy, the repeated application of a vaccine over a defined population at a set time interval is gaining prominence as a strategy for the elimination of diseases such as measles, hepatitis, and smallpox. In order to study the effectiveness of this strategy, a bench experiment will be designed using E.coli bacteria and T7 bacteriophage, and studying the interactions and mechanisms in a chemostat. Using this system allows us to study the spread

of infectious disease in laboratory setting. To test vaccination in system, a concentration of IPTG will be used to induce expression of the rcsA gene (immunity) in E. coli. Results can be generalized from an experimental bench system (E. coli bacteria and T7 phage) by developing a deterministic compartmental model, and then factoring in noise to form a stochastic model. Additional classes were added to track phage populations and experiment with vaccination strategy. Preliminary studies were designed to study early warning signs for approaching a bifurcation point and critical slowing down, by examining the phage being driven to extinction.

DNA SORTING WITH GAME THEORY

STUDENT Samuel Simon *Mathematics*
ADVISOR Russel Walker *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Ciliates have two copies of their genomes, one an encrypted version, the ``ciphertext" version, of the other. Ciliate genome maintenance involves decryption of the ciphertext genome to replace their current ``plaintext" genome. According to the current biological model this decryption is accomplished through two specialized permutation sorting operations. Not all permutations are sortable by these. For one of these sorting operations random applications to even a sortable permutation can result in a failed sorting. This suggests that either ciliates have a strategy to sort a permutation, or else there is a rescue mechanism to recover from errant sorting attempts. Strategic ciliate permutation sorting can be modeled by two-player games. Using newly developed graph theoretic tools we prove a strict bound for when a player has a winning strategy in some of these games. Using graph-based techniques we also prove that the current biological model provides a rescue mechanism for ciliate permutation sorting.

GOOD GRAPH HUNTING

STUDENT Philip Garrison *Mathematics*
ADVISOR András Gyárfás *Alfréd Rényi Institute of Mathmetics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

For a graph H, a number k, and a family of graphs F with integer parameters, what is the smallest n such that every graph in F with parameter n will contain a monochromatic copy of H when its edges are colored with k colors? The traditional Ramsey problem is to determine this value n when F is the set of complete graphs and the parameter of each graph is its number of vertices. Here, we consider a generalization where F is the set of all (finite) graphs parameterized by chromatic number. Bialostocki and Gyárfás conjectured that when H is acyclic, these two problems have the same answer n (for all k). In this paper, we develop a new technique for proving this conjecture for certain cases, and apply it successfully to a handful of graphs.

IMAGE SEGMENTATION WITH DYNAMIC ARTIFACTS DETECTION AND BIAS CORRECTION

STUDENT Nicholas Takaki *Mathematics*
ADVISOR William Hrusa *Mathematics* | Dominique Zosso *UCLA*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We propose a new model for segmenting damaged images. Our model introduces a dynamic artifact class to the Chan-Vese functional, which prevents outliers from skewing the segmentation. Our new functional effectively segments both damaged and undamaged images. We also developed a minimization scheme based on diffusion and thresholding, which runs significantly faster than traditional gradient descent techniques. We include results and comparisons with existing methods.

LEARNING FRENCH ONLINE

STUDENTS Anusha Kukreja *Statistics* | Akhil Prakash *Mathematics*
ADVISOR Rebecca Nugent *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Given that more and more people are moving to online courses, it is important for teachers to understand how to tailor the course and how students are utilizing the online resources. Although research has been conducted in this area, it has been generally limited to Math or Science classes. We will be looking at data from the Online Learning Initiative (OLI) Spring 2014 French 1 class. The class is conducted across many universities and high schools, including: Carnegie Mellon University, San Jose City College, UC Boulder, etc. The data was collected from the DataShop web application offered through the Pittsburgh Science of Learning Center. The anonymized data is on a problem by problem basis, including timestamp, school, and actions such as clicking on a button. The main questions we wish to answer are where in the course students drop out, how students navigate through the course, which features of the course are used effectively, and where students struggle. For the initial phase of the project, we will focus on the CMU students only. We will visualize the transaction based data as a student path through the course with network models and the Spearman Correlation Coefficient. We will also use clustering to see if course performance correlated with specific actions or paths within the course. Once we have working visualizations and models for the CMU population, we will check our conclusions by comparing to an in-depth video study of 3 students, and then generalize across other university populations for the same course.

MATHEMATICAL METAPHYSICS

STUDENT Luke Serafin *Mathematics*
ADVISOR Clark Glymour *Philosophy*
ROOM/TIME Pake / 1:20 pm

Since the time of Plato and Aristotle, philosophy of mathematics has been dominated by platonism, which holds that the mathematical and the physical inhabit separate realms, and nominalism, which rejects the existence of mathematical objects. I advance a third option, dubbing it mathematical metaphysics, which rejects the existence of a separate physical realm and holds that to be is to be a mathematical object. We shall see that this view has many philosophical advantages over platonism and nominalism, and that it is not as counterintuitive as it initially appears.

MODELING EBOLA TRANSMISSIONS

STUDENTS Adrian Botta *Economics and Statistics* | Andersen Chang *Statistics* | Abigail Smith *Mathematics*
ADVISORS William Eddy *Statistics* | Rebecca Nugent *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The most recent Ebola Hemorrhagic Fever (EHF) epidemic has grown to over twenty-five thousand cases, and over ten thousand deaths. Following the EHF outbreak in 2013-2014, a lot of research has been published in search for a model that could accurately simulate the spread of this disease. While existing research focuses on applying compartmental models to the data from each country and expanding the simpler SIR model into a more complicated SEIHFR model, we use compartmental models to simulate the spread of the EHF virus across the borders of the three countries most affected by the outbreak, Guinea, Liberia, and Sierra Leone. Using the EpiModel package in R, we optimize for the parameters of each model and assess a goodness of fit for each individual country. We then look at ways to combine cross-border movement data in Western Africa to model the spread of disease from one country to another.

MODELING THE RELATIONSHIP BETWEEN QUERIES AND QUESTIONS IN BIOMEDICAL TEXT

STUDENT Vijay Viswanathan *Mathematics*
ADVISOR Eric Nyberg *Language Technologies Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Queries on a search engine are expressions of information needs. This information need can generally be stated as one (or a combination of many) questions in natural language. For the task of providing decision support in the biological domain via question answering systems, we worked towards a query-to-questions “converter”, based on papers from PubMed. Taking the information retrieval approach to this problem, we sought to find the best question based on relevant selections from search engine results. we broke this task into two subtasks: sentence retrieval and sentence-to-question conversion. For sentence retrieval, we used a language model with query expansion based on WordNet, compared to a baseline of smoothed query likelihood. Based on syntactic structure, the sentence was converted into a question. The ambiguity of the information need in a short query, relative to the specific content of PubMed articles, was a major challenge.

NEWMAN'S CONJECTURE IN FUNCTION FIELDS

STUDENTS David Mehrle *Mathematics* | Tomer Reiter *Mathematics*
ADVISOR Russel Walker *Mathematics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 10:00 am

The Riemann hypothesis is a famous unsolved problem in mathematics concerning the zeros of the Riemann Zeta function. Newman reformulated the Riemann Conjecture as the qualitative statement that a certain constant is non-positive, but evidence suggests that this same constant is non-negative. The latter statement is known as Newman's Conjecture; it is often accompanied by the statement that "the new conjecture is a quantitative version of the dictum that the Riemann hypothesis, if true, is only barely so."

Andrade, Chang and Miller extended Newman's conjecture to a different family of functions, called L-functions, closely related to the Riemann Zeta function. We study Newman's conjecture for L-functions. Using number-theoretic and geometric techniques, we show that the Newman constant is zero for a very large number of L-functions, which is exciting because it proves Newman's conjecture in many cases.

ON GLOBALLY DEFINED SOLUTIONS OF THE GENERALIZED CLM EQUATION

STUDENT Samantha Davies *Mathematics*
ADVISOR Johnny Guzman *Brown University*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 10:15 am

We consider a generalized one dimensional model of the three dimensional vorticity equation, proposed by Constantin, Lax, and Majda. Results for the one dimensional model may provide insight to the behavior of solutions of the Navier Stokes equation. Specifically, we studied the effect the parameter that controls the amplification of the convection term has on solutions to this equation. Cordoba and Okamoto showed that nonpositive parameter values lead to singularities in finite time. While the behavior of solutions for positive values of the parameter are unknown, it is conjectured by Okamoto et al. that the solutions undergo a bifurcation from blow up to global existence for some parameter value between 0 and 1. Several different numerical and analytic methods, including the Finite Difference Method, Fefferman-Stein Decomposition and Pseudo Spectral Method, are utilized to analyze whether or not solutions form singularities in finite time.

ONLINE DOMINATING SET

STUDENT Fan Yang *Mathematics*
ADVISOR William Hrusa *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

We consider a greedy online algorithm that finds a dominating set of a graph. This algorithm is online because vertices of the graph are revealed one by one. From a practical perspective, this algorithm is easy to implement and can be applied to graphs that are not fully known.

We analyze the performance of this algorithm and study how graph operations affect the performance. There are two main results:

1) We calculated expected dominating set sizes of paths, cycles, stars, multi-stars and bipartite graphs using this algorithm.

2) We found examples where adding edges to the graphs actually increases their expected dominating set sizes. Because of its simplicity, this online algorithm can also be used to find chromatic numbers of graphs and etc. We hope our analysis of the algorithm can inspire more applications in the future.

OPTIMAL INVESTMENTS

STUDENTS Keenan Gao *Mathematics* | Nathan Wu *Chemical Engineering*
ADVISOR William Hrusa *Mathematics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 9 / 10:30 am

This project seeks to understand optimal investments in a one stock binomial model through the relationship dynamic of a hedge fund agent and a client with differing utility functions. We introduce a price commission scheme for the agent and analyze how each entity's behavior changes as the parameters of the scheme vary. Through this analysis, we can understand the conditions when the agent and client's utility functions are simultaneously maximized and create an equal objective for investing the market.

REDUCING BLOOD COAGULATION IN THORACIC ARTIFICIAL LUNGS

STUDENT William Croughan *Mathematics*
ADVISOR Keith Cook *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Each year, 127,000 patients die due to chronic lung conditions. Currently, the only long-term treatment for most of these conditions is lung transplantation; only roughly 1,800 of these transplants occur every year. Current bridge to transplant treatments only have an effective life span of a month or less, and can lead to systemic complications. The Thoracic Artificial Lung being developed shows promise as an improved bridge to transplant, allowing patients to be sustained longer with fewer complications. Additionally, with further development they could serve as destination therapy, allowing patients to survive for years without a lung transplant. In vivo experiments are being run to test one modification's effects of thrombogenesis. Current preliminary results show a promising trend toward reduced coagulation in one of these device variants.

RESEARCH ON CHARACTERIZATION OF 4-ORDERED CYCLE IN PLANAR GRAPHS

STUDENTS Tian Guo *Mathematics* | Shuai Shao *Computer Science*
ADVISOR Jie Ma *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Planar graphs are graphs that can be embedded in the plane so that no edges cross one another.
A 4-ordered cycle is a cycle passing through four fixed vertices with a specific order.
An open problem we would like to attack is to characterize all planar graphs which do not contain 4-ordered cycles. In this proposal, we will briefly discuss some ideas in our approach to this problem as well as other ingredients to our project.

THE DEVELOPMENT OF AUTOMATIC MORPHEMIC ANALYSIS IN SCONE'S NATURAL LANGUAGE PIPELINE

STUDENT David Bayani *Mathematics*
ADVISOR Scott Fahlman *Language Technologies Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

We overview Scone's natural language processing system, focusing primarily on the components necessary for automatic morphemic analysis of input text. Material discussed will include existing tools for automatic morphemic analysis, the tools tried for use in Scone's NLP system, and the tools ultimately selected and developed for use in Scone's NLP system.

PHYSICS

ALGORITHMS FOR SOCIAL GOOD: KIDNEY EXCHANGE

STUDENT Benjamin Plaut *Physics*
ADVISOR Tuomas Sandholm *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Suppose you need a kidney transplant, and you have a willing but incompatible donor. What if there were another patient in the same situation, but they are compatible with your donor (and vice versa)? Kidney exchange is a recent innovation that allows patients in this situation to "swap" donors. Such swaps can occur in pairs, as described above, or in longer cycles or chains. Given a network of patient/donor pairs and compatibilities with no limit on cycle length, the optimal exchange can be found in polynomial time by maximum-weight matching. However, for logistical reasons, there is a hard limit on the length of these cycles, making this problem NP-hard. We describe an integer linear program approach (with a variety of sub-algorithms and heuristics) that finds the optimal exchange, allowing the most patients to receive an often life-saving kidney transplant.

ANALYSIS OF RECONSTRUCTED J/ MESON CANDIDATES IN PRONTO ANTI-PROTON COLLISIONS

STUDENT Yongshan Ding *Physics*
ADVISOR James Russ *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:00 am

We present a RooFit analysis of inclusive J/ meson production in proton-antiproton collisions. We reconstruct J/ decays with transverse momentum pT (J/) > 6GeV/c, in both of the invariant mass and decay lifetime dimensions. We determine the probability density function forms and perform the maximum likelihood fit of signal and background shapes to data distributions. Using the lifetime significance profiles, we distinguish the fraction of J/ prompt decay events from the decay of the long-lived b hadrons.

BUGGY CRASH TEST SURG

STUDENTS Ryan Davis *Physics* | Rachael Schmitt *BHA*
ADVISOR Kathryn Palko *Student Affairs*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Crash testing in the Carnegie Mellon sport of buggy has to this date not been conducted. The only information we have on crashes are testimony and medical reports from drivers who experienced a crash. In the wake of two recent, very serious crashes and injuries, concern about safety in buggy is appropriately amplified, but our knowledge is very little. Our research project proposes to apply readily available science and engineering talent to the goal of improving driver safety. We will use a professional crash test dummy, a donated buggy, and robotic steering to perform crash tests. The expected result will be a comprehensive recommendation for a) procedural changes, b) improvements in safety features, c) modifications to the racing cource, and d) safety performance criteria. We have full support from Sweepstakes, the Sweepstakes advisor, the Buggy Alumni Association, and Emergency Medical Services.

COMPARING GRAPHENE AND TRANSITION METAL DICHALCOGENIDES (TMDs) BY ANALYZING THEIR USABILITY AS CHANNEL MATERIALS IN FIELD-EFFECT TRANSISTORS

STUDENT Alaaddin Ismail *Physics*
ADVISOR Randall Feenstra *Physics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

According to Moore's Law, the development of computing hardware is almost entirely limited by the size of the transistors on a dense integrated circuit. Until the advent of Graphene, the growing concern of most experts in the field of computer development was that at the current rate of progress, transistors would become only a few atoms in width – which would introduce the quantum effect known as tunneling. Physicists and Material Scientists are now looking at Graphene and TMDs as a way to utilize, rather than avoid this effect, and continue decreasing the size of transistors. This poster aims to summarize the vertical tunneling capabilities of Graphene in intraband transitions versus those of TMDs, specifically Molybdenum Disulfide (MoS2), in interband transitions. As well, it attempts to predict future applications for both of the aforementioned semiconducting materials and list some of the obstacles preventing the current projection of research and development related to them.

CREATING A CARBON FIBER TROMBONE: STAGE 1

STUDENT Andrew Ye *Physics*
ADVISOR Peter Sullivan *Music*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:15 am

Alternative-material wind instruments are gaining popularity. The majority of instruments in this market are plastic. Their major drawback is that they sound nothing like the actual instruments being mimicked. Recently, instruments making use of carbon fiber components have been adopted by professionals; therefore carbon fiber instruments do not suffer from the same acoustic tradeoff that affects plastic ones. I have created an entirely carbon fiber trombone bell-section with the goal to prove that composite material instruments are worthwhile. The next step of my project is to create the slide section. My objective differs from the current carbon fiber instrument

market because I intend to create an entirely carbon fiber instrument. Current horns that make use of this material still rely on brass parts. By making instruments wholly carbon fiber, the manufacturing process is greatly simplified, thereby reducing cost and increasing appeal to musicians. I have chosen to use carbon fiber because it is both lighter and less prone to damage than the brass of traditional instruments. For musicians, the weight reduction offered by carbon fiber provides a lifelong benefit. Traditional brass instruments are heavy and un-ergonomic, making musicians susceptible to arm problems. Ultimately, a carbon fiber instrument will be much more resilient to damage than a traditional instrument, but also sound better than a plastic one.

DIPHENYL THIOPHENE-S,S-DIOXIDES FOR USE IN ELECTRON RELAY SYSTEMS FOR WATER REDUCTION

STUDENT Kevin Hunter *Physics*
ADVISOR Kevin Noonan *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:30 am

This presentation will focus on using a thiophene-1,1-dioxide central moiety in diphenyl systems for use in electron relay systems. These electron relay systems show great potential for water reduction systems that can be used for production of hydrogen. These diphenyl compounds can be incorporated into the relay systems to increase the turnover numbers for hydrogen generation, with specific interest in the 2-substituted compound. As can be seen in Figure 1, a substitution in the 2-position of the phenyl group far outperforms the other synthesized compounds. To expand this work done by the Noonan group, I will be working on further investigating the significance of the 2-position of the diphenyl systems.

EFFECT OF INITIAL AMPLITUDE ON THE INTERFACIAL AND BULK DYNAMICS IN RICHTMYER-MESHKOV INSTABILITY UNDER CONDITIONS OF HIGH ENERGY DENSITY

STUDENT Zachary Dell *Physics*
ADVISOR Snejana Abarji *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:45 am

We systematically study the effect of the initial amplitude on the interfacial and bulk dynamics of the Richtmyer-Meshkov instability (RM) induced by strong shocks. The shock propagates from the light to the heavy fluid. The fluid densities differ significantly, with Atwood numbers up to 0.95. The fluid interface is initially perturbed with a cosine wave perturbation. Its amplitude is varied from 0% to 100% of the initial perturbation wavelength. A broad range of the shock strengths and density ratios is considered. Smoothed particle hydrodynamics code is employed to ensure shock capturing and interface tracking. Detailed diagnostics of the flow scalar and vector fields is performed. Whenever possible the simulation results are compared with existing theoretical analyses achieving good agreement. The focus question of our study is how the energy deposited by the shock is partitioned between the interfacial and volumetric components. We analyze the dependence of the initial growth-rate of RMI, the velocity away from the interface, and the transmitted shock velocity as functions of the initial amplitude. Particularly, we found that for a Mach number 5 and an Atwood number 0.8, the initial growth rate is highest and the interfacial energy is the largest when the initial amplitude is about a quarter of the wavelength.

GUIDED ASSEMBLY AND UNIFORMITY OF IRON OXIDE NANOPARTICLE MONOLAYERS

STUDENTS Sonal Nanda *Physics* | Michael Prijatelj *Physics*
ADVISOR Sara Majetich *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:00 am

We created templated monolayers composed of magnetic nanoparticles, which, on average have one particle in each of the template's holes. This was accomplished through a dip-coating method, which consists of submerging an array of 10 nm holes in a solution of iron oxide nanoparticles and utilizes nanoparticle self-assembly. By varying the concentration of the solution from which we withdraw the substrate, we developed a systematic method of creating these monolayers. To ensure the uniformity of the deposition process, the colloidal stability of our nanoparticle dispersions was investigated as a function of time. By using UV-Vis spectroscopy and dynamic light scattering, the rate of nanoparticle agglomeration with regards to stabilizing surfactant coating was evaluated to ensure uniform, one-to-one filling of particles in nanoholes.

METHODS FOR THE USE OF LIPIDS AS SURFACTANT SPREADERS

STUDENT Grace Moraca *Physics*
ADVISOR Stephen Garoff *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:15 am

In order to aid those with chronic lung diseases such as cystic fibrosis, many treatments require the ability to send medicines directly to the affected areas of the obstructed lungs. One accepted method of distribution is the addition of surfactants to the medications; however surfactants often have harmful side effects. We examined the use of lipids as surfactant spreaders to assist in the delivery of drugs to diseased lungs. The lipid DPPC exists in the lungs, so the ability to use lipids as surfactant spreaders minimizes the risk of further contamination or aggravation to the lungs. To model the mucus and lipids in the lungs, we used polyacrylamide (PA) and DMPC respectively. We tested the application of different conformations of DMPC to PA. We found that when dispersions of DMPC in water are applied to PA in the form of droplets, a nearly negligible effect is observed on the surface tension of the PA. We also found that applying flakes of powdered DMPC to water and PA had much more significant effects on the surface tension, but was highly temperature dependent as well as slightly unpredictable. More methods for using lipids as surfactant spreaders are continuing to be investigated.

QUANTIFYING THERMAL FLUCTUATIONS IN SUPERPARAMAGNETIC NANOPARTICLES.

STUDENT Michael Matty *Physics*
ADVISOR Sara Majetich *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Thermal fluctuation driven phenomena in magnetic nanoparticles (MNP) are at the heart of applications extending from biomedicine to information storage. In magnetic recording, thermal fluctuations determine fundamental limitations for the minimum noise level achievable at the recording time scales. Here we study the statistical behavior of the 'telegraph signal' generated during the thermal fluctuation driven switching of isolated MNPs in

contact with a thermal bath. Our approach is based on numerical integration of the stochastic

Landau-Lifshitz-Gilbert (LLG) equation, where we generate time-dependent sequences of switching events of the MNP moments. The residence times for the 'up and 'down' moment orientations are evaluated assuming different uniaxial anisotropy values K, external fields H, and damping constant. This allows quantification of the differences between the mean residence times and the Neel-Brown model, and the deviations between statistical distributions of residence times and Poisson distribution, both expected to be valid in the limit of high K and damping constant. Our study complements the recent experiments mapping the fluctuating behavior in single MNPs using conducting atomic force microscopy.

STRAIN-EFFECTIVE DEBYE-WALLER FACTOR STRAIN-BOURNE INTENSITY MODULATION FOR PURE ZIRCONIUM

STUDENT Weichen Yin *Physics*
ADVISOR Robert Suter *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:30 am

The structure of polycrystals can be studied in-situ using X-ray scattering methods. This project analyses scattering data from the Advanced Photon Source, Argonne National Laboratory, of a zirconium alloy sample under increasing strain. For each individual grain, we study the contribution of different Bragg planes to the intensity of the total scattering image. It is predicted that the contribution decreases for increasing strain states, and this effect is more prominent for planes oriented perpendicular to the direction of strain. Codes are developed to test this prediction.

TRANSITION FROM HIGH HARMONIC FAST WAVE TO WHISTLER REGIME IN TOKAMAKS

STUDENT Steven Harris *Physics*
ADVISOR Robert Pinsker *General Atomics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Experiments are being prepared on DIII-D in which fast waves at 500 MHz will be used to drive current non-inductively in the mid-radius region. Previous DIII-D experiments used fast waves at 100 MHz to drive central current; in this work we examine the frequency dependence of wave propagation and damping in the 100 MHz to 1 GHz range. Wave propagation and accessibility is studied with ray tracing models in slab geometry. Full and approximate polarization relationships are studied and compared with varying frequency, and are used to determine the strength of electron damping at different frequencies.

SCHOOL OF COMPUTER SCIENCE

COMPUTER SCIENCE

A COMPUTATIONAL APPROACH TO STUDYING MELODIC STRUCTURES IN INDIAN CLASSICAL MUSIC

STUDENTS Vivek Shankar *Computer Science* | Anirudh Sridhar *Electrical & Computer Engineering*
ROOM/TIME Peter / 12:20 pm

The goal of this project is to analyze an audio recording of Indian Classical Music and correctly identify the piece's raga. A raga is a class of melodic structures which is more prominently characterized by the mood it conveys rather than its mere notes. A basic filtering mechanism for deciding a raga based on its constituent notes has been designed and implemented through a fourier analysis of the audio file as well as finding candidates for the correct raga from a database. In addition, we characterize key melodic structures beyond single-frequency notes called gamakas which include, but are not limited to, note oscillations, curved or ornamented phrases, and accentuated stresses. We attempt to extend our basic interface to include these more complex characterizations of Indian Music. By emulating an experienced listener's process, we hope to shed light on the underlying mechanisms of the deeper threads of music and understanding.

A LIGHT TOUCH

STUDENTS Marlena Abraham *Computer Science* | John Lareau *Electrical & Computer Engineering*
ADVISOR Paolo Pedercini *Art*
ROOM/TIME Connan / 3-5 pm

While virtual reality is an incredible emerging technology, especially for games, it is very easy for small inconsistencies to shatter their illusion. Uncomfortable jolts back to the real world often manifest when the player reaches out to touch something in front of them. They find that not only can they not feel anything, they cannot even see their hands.

This project seeks to create an experience that accounts for both of these problems. The environment invites you to reach out and the hardware allows you to touch.

A SECURE HUMAN-COMPUTABLE AUTHENTICATION SCHEME

STUDENT Shaun Allison *Computer Science*
ADVISOR Manuel Blum *Computer Science*
ROOM/TIME Class of '87 / 10:00 am

In a world where everyone is constantly watching, secure authentication is still possible. We propose a provably-secure authentication protocol that is both resistant to eavesdropping attacks, and can be carried out directly between you, the human user, and the authenticating computer, without any additional devices. The catch is that you must perform all the calculations in your head. However, we demonstrate that most humans are capable of this. We also give evidence that an adversary would have to spy on a significant number of authentications before being able to impersonate you. (Compared to the standard password scheme, where the adversary only has to see it

once.) Specifically, we show that statistical adversaries must see 10^Omega(r) authentications in order to break the protocol, where r measures the length of the secret that the human user memorizes. Our work is based on recent results of Blocki et al. and Feldman et al. on statistical algorithm lower bounds which we apply to our protocol relying on the intractability of the k-junta problem.

ACTIVE SAMPLING FOR ESTIMATING GAUSSIAN GRAPHICAL MODELS

STUDENT Jong Hyuk Park *Computer Science*
ADVISOR Gautam Dasarathy *Machine Learning* | Aarti Singh *Machine Learning*
ROOM/TIME Class of '87 / 10:20 am

We consider the problem of learning the structure of high-dimensional Gauss Markov Random fields using L1-regularized linear regression. In many applications, such as in sensor networks and proteomics, it may be costly to obtain joint observations repeatedly from all the variables involved. To address this, we propose an active learning algorithm that directs the learning process by selectively focusing the sampling resources on more uncertain variables as it proceeds. We show theoretically that this results in significant savings in terms of the number of samples required per variable. Furthermore, we demonstrate experimental results that corroborate our theoretical findings.

AN AUTOENCODER TRIAGING ALGORITHM FOR ACUTE PANCREATITIS

STUDENT Jack Paparian *Computer Science*
ADVISOR Christopher Langmead *Computer Science*
ROOM/TIME Class of '87 / 10:40 am

As more data is collected from clinical studies, predictive medicine will advance to the state where triaging can be automated using raw patient data. For acute pancreatitis, several scoring systems, such as Ranson and APACHE II, are employed clinically to measure the severity of acute pancreatitis; however, these criteria have limited accuracy. Designing more accurate scoring systems is difficult due to the small number of patients typically enrolled in studies and the small percentage of patients with acute pancreatitis whose condition becomes severe. In this thesis, we present scoring systems derived from machine learning classifiers that are trained on both raw patient data and clinical scores. We focus on measuring severity by predicting whether a patient will develop organ failure, the most common cause of death in patients with acute pancreatitis. Using stacked autoencoders, we attempt to learn deep feature representations of organ failure in acute pancreatitis, and we compare the results to those of shallow architectures. Ultimately, we found single autoencoder networks to perform with the best sensitivity (lowest number of false negatives). In addition to our results, we discuss our techniques for compensating for imbalanced data classes and missing patient data.

AN EXPLORATION OF FOOD DETECTION

STUDENTS Vivek Krishnan *Computer Science* | Jackson Michalak *Computer Science* | Akul Penugonda *Computer Science*

ADVISOR Kris Kitani *Robotics Institute*

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

In our project, we explore the application of current recognition techniques in computer vision to the realm of food management and consumer utility. We test out various recognition methods, such as Naive-Bayes Nearest Neighbor Classifier or a Bag of Words Classifier, in combination with various key point detection algorithms on common food items. Analyzing the predictive accuracy of the various techniques will give us greater insight into the methods by which to improve our system. We also experiment with some methods to identify partially occluded items.

BENCHMARKING ALGORITHMS ON THE XEON PHI

STUDENT Oliver Daids *Computer Science*

ADVISOR Guy Blelloch *Computer Science*

ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Intel's Many Integrated Core processors differ significantly in design from their usual processors or typical graphics processing units While offering a higher number of cores than a normal x86 processor, the cores are much weaker. The goal of this project was to learn the differences in performance characteristics and adapt several algorithms of the Problem Based Benchmark Suite, such as Minimum Spanning Forest and Maximal Independent Set, to this architecture.

CACHE EFFICIENT DYNAMIC PROGRAMMING ALGORITHMS

STUDENT Ian Huang *Computer Science*

ADVISOR Guy Blelloch *Computer Science*

ROOM/TIME Class of '87 / 1:20 pm

Parallel dynamic programing algorithms typically have undesirable I/O complexities. We studied solutions to two different problems which are representative of many problems with dynamic programming solutions.

One is Local Alignment, which has a constant number of dependencies. We studied multiple algorithms and implemented some in C++ and Cilk+. We also analyzed the algorithms from a theoretical and practical standpoint, and then compared it to other dynamic programming algorithms for solving Local Alignment.

The other is Optimal Binary Search Trees which contains problems with varying numbers of dependencies. For this problem, we designed and implemented a cache efficient dynamic programing algorithm using a divide and conquer technique. We also analyzed the algorithm theoretically and practically. Our algorithm has the same work complexity as current dynamic programming algorithms, but lower I/O complexity.

COMPARING LIKELIHOODS OF SUBCELLULAR ORGANIZATION MODELS

STUDENT Rachel Kositsky *Computer Science*
ADVISOR Robert Murphy *Computational Biology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The location and distribution of subcellular components, such as proteins or microtubules, can help identify biological processes within cells. CellOrganizer is an open source software package that learns generative models of subcellular organization from images of cells. Our research was to develop of a tool within this software that allows us to compare the likelihoods of different models for the same cell image data. Currently we compare model performance on only a single component of the cell data (e.g. nuclear shape, cellular shape, or protein distribution), but further research will involve finding the joint likelihood of a model involving several organizational components. This comparison tool will allow users of CellOrganizer greater analytic power in their biological research.

COOPERATIVE LOCALIZATION WITH SYMBIOTIC ROVERS

STUDENTS Ananya Kumar *Computer Science* | Sunny Nahar *Computer Science*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Traditional planetary rovers explore what is safe but uninteresting, mostly limited to vast expanses of flat terrain. They avoid high-risk areas, such as lunar pits, which are of paramount importance for scientific purposes. Using a symbiotic multi-rover system is a possible paradigm for taking risk without risking mission. Rovers can be assigned different tasks and operational priorities. Essential to the co-exploration is the ability for each rover to know its location. Typically, planetary rovers estimate their location independently and over time the position estimate accumulates error. We seek to develop and test a model where the rovers communicate current state information and pairwise distance measurements in order to improve their position estimates.

DATA-AWARE AUTO-TUNING AND TECHNIQUES FOR IMPROVING PARALLEL SORTING PERFORMANCE

STUDENT Klas Leino *Computer Science*
ADVISOR Guy Blelloch *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:30 am | Class of '87 / 12:40 pm

Sorting algorithms are essential in many contexts, and can make good use of parallelism, which modern machines make increasingly leverageable. We explore the use of auto-tuning to achieve high-performance parallel sorting. While auto-tuning is a technique that has been used in a variety of domains to automatically find parameters that optimize performance, most applications of auto-tuning involve algorithms that are data-indifferent. A particular sorting algorithm, by contrast, can vary quite a bit in performance depending on the distribution of the data being sorted. We develop an auto-tuner that allows us to easily optimize and evaluate a number of parallel sorting algorithms on many different architectures and datasets. Our auto-tuner allows us to explore how properties of the dataset affect the optimal tuning parameters, and we achieve performance improvement by letting these properties drive how parameters are selected. We also explore novel ways of using data-specific heuristics for further improving sorting performance. Our tuned sort outperforms the hand-tuned Problem-Based Benchmark Suite (PBBS) comparison sort (on which our code is based), achieves good performance on a wide variety of datasets, and parallelizes well over many cores.

DEVELOPING PRACTICAL SOFTWARE FOR REAL-TIME WEB NEWS ARTICLE SUMMARIZATION

STUDENT Wenxuan Li *Computer Science*
ADVISORS James Bagnell *Robotics Institute*
ROOM/TIME Peter / 4:40 pm

When browsing news articles online, people are often only interested in the main story of the article rather than the fine details. Our project goal is to develop a practical and scalable software that automatically produces a few sentences that best summarize any news article when given as input. Such a software system could be useful in a variety of ways. For example, it can be used by news websites to automatically select "article highlights". It can also be developed into mobile apps or browser extensions as front-end that allows end users to request an automated summary of any news article.

DEVELOPING SMARTER ARTIFICIAL INTELLIGENCE FOR COMPANION CHARACTERS IN GAMES

STUDENT Rikky Roy Koganti *Computer Science*
ADVISOR Maxim Likhachev *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

The current research project is focused on developing smart goal-oriented action planning for a video game companion non-player character (NPC). Many games have companion NPCs in the roles of bodyguard, squad-mate, etc. Contemporary game AI is often built on developer-tailored state machines or behavior trees. These methods are only as smart as the author makes them and don't afford players the opportunity to interact with companions in complex ways like teaching and demonstration.

We endeavor to create a system which allows a player in a game to teach its companions complex game strategies including what to do in the game world and how to do it (e.g. which enemies to attack, in which order, with which weapons, under which circumstances, etc.). At the core of the project will be a search-based planning algorithm. A crucial component of this is a software model of the game world so that the search algorithm can explore possible game futures without actually having the game execute those possibilities in full detail.

The project is currently being implemented in Bethesda's Skyrim game, using the Skyrim Creation Kit game editing tool and the Skyrim Script Extender (SKSE) utility to insert our custom pieces into the existing game. Our algorithmic code is being developed in C++ for performance, which is crucial to this sort of search-based planning framework.

FAST APPROXIMATION OF MINIMUM 2-HOP LABELS ON TREES

STUDENTS Terence An *Computer Science*
ADVISOR Guy Blelloch *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:45 am | Class of '87 / 1:00 pm

Distance queries on graphs is a fundamental problem for numerous real-world applications. Constant queries can be done with an APSP algorithm but that requires storing every pair of distances in O(n2) space, whereas dynamically resolving distances requires O(m+n log(n)) time on m-edge n-vertex graphs. An algorithm that stores

fewer precomputed values and reduces dynamic query time is the 2-hop labeling scheme where every vertex stores its distance (called a label) to a subset of the other vertices such that for any pair of vertices, they both have their distance to at least one vertex on their shortest path. The problem we study is minimizing the number of labels needed to correctly query distances. There is now a log(n) approximation algorithm for m-edge n-vertex graphs that runs in O(mn3) time for this. We demonstrate this problem is NP-Complete, and we present the currently fastest algorithm which gives a log(n) approximation on n-vertex trees in O (nlog(n)) time which we show is optimal.

FIELD TESTING AND VALIDATION FOR FLYOVER MODELING

STUDENT Neal Bhasin *Computer Science*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Flyover modeling of recently discovered skylights on the moon and Mars could identify the presence of subterranean lava tubes. These caves are vital to the future of human space habitation. Autonomous spacecraft landing presents a novel opportunity to collect the data necessary to generate a high-resolution 3D model of these features for scientific analysis and exploration. My research investigates approaches for testing and validation of computer vision methods for flyover modeling.

FORMAL VERIFICATION OF A CONTROLLED FLIGHT BETWEEN TWO ROBOTS: A CASE STUDY

STUDENT Annika Peterson *Computer Science*
ADVISOR Andre Platzer *Computer Science*
ROOM/TIME Class of '87 / 11:20 am

Robots moving within controlled flight paths are complex systems that require formal verification of collision avoidance. A flight path dependent upon a coded program requires confidence of its ability to avoid crashing, which we show with a formal proof. Inspired by the controlled flight of two robots within the Disney-Pixar film WALL•E, we have designed a controller for a robot flying within a complex controlled flight path, a helix with another robot. We have formally proven collision avoidance within the proof rules of differential dynamic logic, a logic for hybrid systems consisting of discrete controlled steps and continuous physics, using a deductive verification tool, KeYmaera, when this flight path is viewed in two dimensions as well as three dimensions. We formally prove safety as well as an additional property that the two robots are within some delta of each other. This case study also applies to aircraft collision avoidance and unmanned aerial vehicles where unsafe operation is potentially fatal and similar 3D motion is relevant.

FROM PREDICTION TO DECISION MAKING IN INTELLIGENT TUTORING SYSTEMS

STUDENT Joseph Rollinson *Computer Science*
ADVISOR Emma Brunskill *Computer Science*
ROOM/TIME Class of '87 / 11:40 am

Intelligent tutoring systems provide their students with an adaptive personalized learning experience.

To do so, intelligent tutoring systems attempt to capture the state of their students through a student model. Student models have two primary uses: prediction of future student performance and instructional decision making. Since prediction performance is easier to quantify, student models are frequently judged by their predictive power. This has bred student models that are very powerful predictors, but cannot be easily used in decision making.

In this work, we leverage these powerful predictors using novel decision algorithms that are compatible with almost any predictive student model.

In particular we consider two decision problems: when to stop providing questions to the student and which skill to practice next.

Our simulation results suggest that our when-to-stop decision algorithm acts similarly to existing decision algorithms with the added benefit of stopping when students are unable to progress given the current material.

Our preliminary work on deciding between skills suggests that logistic regression models, previously only used for prediction, can be used to pick between skills and even learn a skill hierarchy.

GRAPH-BASED SEMI-SUPERVISED LEARNING FOR TEXT CATEGORIZATION THROUGH SUPERVISED RANDOM WALKS

STUDENT Tom Shen *Computer Science*
ADVISOR William Cohen *Machine Learning*
ROOM/TIME Class of '87 / 11:00 am

Recently, many effective graph-based semi-supervised learning methods have been developed. For text categorization, a common method is label propagation through a bipartite graph of documents and features or a k-nearest neighbor graph of documents. In this talk, we consider a new approach based on supervised random walks.

HAL: A CONTINUOUS VOICE-TRANSCRIBING AND CONTEXT-AWARE SYSTEM

STUDENT Mukund Tibrewala *Computer Science*
ADVISOR Anthony Rowe *Electrical & Computer Engineering*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Our goal with the HAL Project at CMU's WiSE Lab was to develop a distributed, always-listening voice recognition system that continuously transcribes conversation to infer user context. This user context can then be used to select task-specific dictionaries and grammars to improve recognition accuracy.

HERB TASK PLANNING

STUDENTS Robert Fernau *Computer Science* | Evan Shapiro *Computer Science*
ADVISOR Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

I worked in the Personal Robotics Lab to create high level tasks for the robot HERB to accomplish. I began creating simple tasks for HERB such as moving a sphere. This led to being able to create more complex tasks.

IMPROVED METHODS FOR OPTICAL MUSIC RECOGNITION

STUDENT Dan Ringwalt *Computer Science*
ADVISOR Roger Dannenberg *Computer Science*
ROOM/TIME Class of '87 / 1:40 pm

Optical music recognition (OMR) is the problem of converting scanned music scores into a symbolic format such as MIDI. Basic information about the score is necessary for later steps, but is useful in itself to support many computer music applications. We developed new and improved methods to extract this information, which are used in a live score display application. Furthermore, we developed methods to estimate the quality of a scan, which can be used to select the highest-quality version of a score to use for OMR.

INCREASING RAPPORT BETWEEN A USER AND A VIRTUAL ASSISTANT THROUGH USER INTERFACE DESIGN

STUDENT Emily Zhou *Computer Science*
ADVISOR Justine Cassell Human *Computer Interaction Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Exploring the user interface designs and features that are most helpful when it comes to building rapport with a virtual agent and using an Android application with maximum ease.

INTENT EXPRESSIVE ROBOTIC POINTING

STUDENT Rachel Holladay *Computer Science*
ADVISOR Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:00 am

Clear communication is critical to seamless human-robot interaction. Given the wide range of communication modalities we focus on gestures, specifically the referential gesture of pointing. Building upon our previous work in creating legible pointing we now propose an implementation of intent expressive pointing that generalizes to three dimensional spaces and arbitrary object geometries. We formulate pointing as an instance of a TSR (Task Space Region) that considers other objects in the scene when constructing a clear pointing configuration. We have applied to our robot, HERB and has already been integrated within our code base. This initial pointing work serves as the basis for future work where we plan to build a full library of gestures for robots.

INVERTIBLE BINARY TRANSDUCERS AND AUTOMORPHISMS OF THE BINARY TREE

STUDENT Tsutomu Okano *Computer Science*
ADVISOR Klaus Sutner *Computer Science*
ROOM/TIME Class of '87 / 2:00 pm

Transducers are examples of finite state machines that have found applications in group theory. We focus on the structure of these machines and expand upon the results of Nekrashevych and Sidki. From the automata theory perspective, we prove some structure theorems and answer a few decidability questions. From the group theory perspective, we prove some theorems that strengthen the connection between linear algebra and the study of abelian subgroups of Aut(2*).

LITERARY SOCIAL NETWORK INFERENCE

STUDENTS Philip Massey *Computer Science* | Patrick Xia *Computer Science*
ADVISOR Noah Smith *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

The goal of this project is to analyze social networks in fictional novels. This is done by using machine learning and natural language processing to label edges in social network graphs according to relationship type.

NIPPING BUGS IN THE BUD – STUDENT MISTAKES IN INTRODUCTORY COMPUTER SCIENCE CLASSES

STUDENT Nivedita Chopra *Computer Science*
ADVISORS Roy Maxion *Computer Science* | Robert Simmons *Computer Science*
ROOM/TIME Class of '87 / 3:00 pm

Bugs in software are often caused by misconceptions in the programmer's thought process. Such misconceptions ought to be 'nipped in the bud,' in introductory computer science classes where there is a focus on underlying concepts. We aim to mitigate common misconceptions in the Principles of Imperative Computation course (15-122, taught in C0 and C) by analyzing the bugs committed by students in the class, determining the misconceptions behind these bugs, and devising ways to mitigate these misconceptions.

We collected data about bugs committed by students throughout the course of the Fall 2014 semester (335 students) and during one lab in the Spring 2015 semester (288 students). We classified each bug according to a taxonomy based on the IEEE Standard Classification of Software Anomalies, determined the misconceptions behind commonly-seen bugs, and proposed teaching methods to eliminate them. The bugs observed were logic bugs (60 instances), data bugs (21), and interface bugs (7), as per the IEEE Standard Classification for Software Anomalies (2010). An additional category of bugs emerged called "comprehension errors" (32 instances) which are caused by a misunderstanding of concepts, specifications or error messages.

In one of our weekly labs in Fall 2014, we noticed that 30% of the bugs were caused by lack of attention to edge cases, which are situations that occur at extremes that the programmer may not have considered. We performed an experiment during this lab in the Spring 2015 semester where we split the students in the class in two groups. We encouraged one group of students to spend five minutes thinking about edge cases in the problem before beginning

to code, and did not give any special instructions to the second group. We expect that students who think about edge cases prior to coding will perform better in terms of faster completion times, more incremental progress to solution, and better quality of the final code.

PRIVACY GRADE: GRADING THE PRIVACY OF SMARTPHONE APPS

STUDENT Kevin Ku *Computer Science*
ADVISOR Jason Hong *Human Computer Interaction Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

In this project, we crawled the Google Play Store and statically analyzed the apps. For each app, we retrieved information about the API permissions and third party libraries that it uses. This permission to library mapping allows us to infer how the app is using the user's information, based on which we were able to assign a privacy grade to the app.

PRIVACYGRADE: AIDING ANDROID USERS WITH MOBILE PRIVACY DECISIONS

STUDENT Bharadwaj Ramachandran *Computer Science*
ADVISOR Jason Hong *Human Computer Interaction Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

In smartphone applications, there is often an unapparent disconnect between the perceived purpose of a requested permission and the actual reason for the permission. Given the ubiquity of smartphone applications as well as the amount of sensitive information on a smartphone, users might unknowingly allow applications to use sensitive information in unintended ways. PrivacyGrade is a tool to directly inform users about privacy-related behaviors of smartphone apps. We have built a privacy model that measures the gap between people's expectations of an application, and the application's actual behavior. In order to directly interface with Android users, we have built an Android application for PrivacyGrade to convey all the information on PrivacyGrade.org. We analyze the feedback that users have given us through the application to gain a better understanding of how the application affects privacy-related behavior by Android users.

QUADRATIC ENCODING FOR 3D HAND POSE RECONSTRUCTION

STUDENT Maria Khutoretsky *Computer Science*
ADVISOR Nancy Pollard *Robotics Institute*
ROOM/TIME Class of '87 / 3:20 pm

Hand pose reconstruction has many uses in animation and virtual reality. However, because the movements are so fine and occlusion occurs frequently, it is difficult to accurately track hand motion. In cases where the full hand cannot be seen, it is often still possible to identify the fingertips. Our quadratic encoding method provides a way to reconstruct the full hand pose from fingertip position data to generate natural-looking hand motion in real time.

ReCFI: TRANSPARENT CFI SECURITY FOR ARM

STUDENT Alison Kao *Computer Science*
ADVISOR David Brumley *Electrical & Computer Engineering*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

ReCFI is a Control Flow Integrity framework that operates on source code. Our framework is source-based and open-source. It handles several code constructs that other CFI frameworks do not handle, namely function pointers passed as arguments to external library functions.

REFINEMENTS FOR SESSION-TYPED CONCURRENCY

STUDENT Cosku Acay *Computer Science*
ADVISOR Frank Pfenning *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

We propose to develop a refinement system for SALL, a concurrent functional language based on session-typed message-passing, that allows the specification of behavioral properties of concurrent programs. We aim for a system that is expressive enough to specify linear capabilities and security protocols while retaining useful properties such as decidability of type inference.

We plan to implement a prototype and demonstrate the usefulness of our system through examples. We hope that our system is able to enhance safety with minimal annotation burden on the programmer. Finally, we might adapt our system to an imperative language with effects and possibly also to the object-oriented setting.

RESEARCH ON CHARACTERIZATION OF 4-ORDERED CYCLE IN PLANAR GRAPHS

STUDENTS Tian Guo *Mathematics* | Shuai Shao *Computer Science*
ADVISOR Jie Ma *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Planar graphs are graphs that can be embedded in the plane so that no edges cross one another.

A 4-ordered cycle is a cycle passing through four fixed vertices with a specific order.

An open problem we would like to attack is to characterize all planar graphs which do not contain 4-ordered cycles.

In this proposal, we will briefly discuss some ideas in our approach to this problem as well as other ingredients to our project.

SESSION TYPING IN CONCURRENT C0

STUDENT Harold Willsey *Computer Science*
ADVISOR Frank Pfenning *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

A concurrent extension to the C0 language is discussed, specifically focusing on the runtime implementation. Session typing has opened opportunities for an efficient message passing implementation.

SPLIDDIT — UNLEASHING FAIR DIVISION ALGORITHMS

STUDENT Jonathan Goldman *Computer Science*
ADVISOR Ariel Procaccia *Computer Science*
ROOM/TIME Class of '87 / 3:40 pm

The field of fair division has been rapidly expanding in recent years, capturing the interest of researchers in economics, mathematics, and computer science. The literature encompasses provably fair solutions for a wide variety of problems — many of them relevant to society at large. However, few fair division systems are used in practice, with even fever available to the public. Enter Spliddit, a first-of-its-kind website which provides easy access to carefully designed methods for dividing rent, goods, credit, chores, and fares. Since launching in November 2014, Spliddit has received coverage in popular technology websites such as Gizmodo and Fast Company, and has been used by tens of thousands of people. In this talk, we'll discuss the overall design and implementation of Spliddit, as well as the algorithmic details of Spliddit's various applications.

STAYING FAIR

STUDENT Elias Szabo-Wexler *Computer Science*
ADVISOR Ariel Procaccia *Computer Science*
ROOM/TIME Class of '87 / 4:00 pm

Fairness in the context of the allocation of goods is a universal construct whose violation elicits extremely strong reactions. It has nonetheless historically been mathematically ill-defined. In recent years, the situation has improved as economists, mathematicians, and computer scientists have tackled the issue of an axiomatic treatment of fairness. These axioms enable researchers to qualify algorithms for fair allocation and to meaningfully compare different mechanisms. None have yet extended this axiomatic approach to fairness over time: there is no axiomatic treatment of situations with multiple allocation events whose outcomes are linked beyond the naive iterated application of existing (ill-suited) axioms. I have extended the current core axioms for time invariant fair allocation to account for time. In particular, I have extended the axioms of strategyproofness, envy-freeness, and efficiency to be historically aware. Using the extended axioms, I have generalized the seminal probabilistic serial allocation mechanism of Bogomolnaia and Moulin to attain a strictly superior allocation mechanism in the canonical and iterated fair allocation settings. There may be better constructions of the axioms, and there are likely better mechanisms. My work lays the foundation for continued research in this space, and suggests that it is interesting, feasible, and worth pursuing.

TESTING FRAMEWORK FOR AUTOLAB

STUDENT Yiming Zong *Computer Science*
ADVISOR David O'Hallaron *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

My objective for the semester is to build an extensive testing framework for Autolab and to improve the maintainability of the front-end code base. Recently, Autolab team decided to become open-source, and we anticipate that there will soon be many users of Autolab outside Carnegie Mellon. And, as our code is updated, the testing framework allows us to know whether the new code functions properly or not automatically. The main technologies used for this project include RSpec for testing framework, Capybara for acceptance testing, and Travis CI for continuous deployment.

As a side project, I also built a Ruby API client library for Autolab front-end to communicate with back-end Tango autograding service. This separates Autolab front-end from Tango, such that it is easier to test each component individually, and the autograding module can be ported to other back-end autograding services with ease.

THE RESULTS OF APPLYING KALMAN FILTERS ON SPECTRAL EMBEDDING REPRESENTATION OF VIDEO DATA FOR MOTION PREDICTION

STUDENTS Jacob Imola *Computer Science* | Sidhanth Mohanty *Computer Science*
ADVISOR Geoffrey Gordon *Human Computer Interaction Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Kalman filters are a well studied technique for prediction from datasets where there is a certain amount of noise. Spectral embeddings are a way of representing data based on connectivity and similarity measures of data rather than geometric proximity of data points in space. This research studies the effectiveness of applying Kalman filters on data represented in a spectral embedding form.

THE TREE OF LIFE

STUDENT Tian Jin *Computer Science*
ADVISOR Fernando De La Torre Frade *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

This project provides a new visualization of photographs in social networks using semantic understanding of people in images. Using CMU's IntraFace technology, the system automatically detects faces in images and recognizes gender, ethnicity, age and emotion for each person in the images. The tree of life, organizes and displays this large amounts of information in a unique manner.

USING ONTOLOGICAL CONSTRAINTS FOR WORD SENSE DISAMBIGUATION

STUDENT Jakob Bauer *Computer Science*
ADVISOR William Cohen *Machine Learning*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

We use ontological constraints extracted from WordNet to do word sense disambiguation.

VISUAL AND GEOMETRIC MODELING OF LUNAR SURFACE FEATURES

STUDENT Kerry Snyder *Computer Science*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Class of '87 / 4:20 pm

In recent years, the discovery of skylights on the surface of the Moon and Mars has driven scientific interest, as they would make an ideal location for human settlement. This project develops the software and remote sensing capabilities necessary to generate a high resolution 3D mesh model of a skylight from observations of a landing spacecraft. Skylights are believed to be collapsed entrances to underground lava tubes, which could shelter a settlement from radiation, thermal extremes, and micrometeorites. At a much higher resolution then presently available orbital imagery, these techniques will allow scientists to study of the genesis of these skylights and determine the properties of possible caves underneath.

XTRANSPORT

STUDENT Tianyuan Ding *Computer Science*
ADVISOR Srinivasan Seshan *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:15 am

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.

LANGUAGE TECHNOLOGIES INSTITUTE

A SCONE-BASED SEMANTIC PARSER

STUDENT Jacob Buckman *Language Technologies Institute*
ADVISOR Scott Fahlman *Language Technologies Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:30 am

The Scone project is an open-source effort to create a flexible system for representing real-world knowledge. In this work, the researcher created a novel parsing algorithm, based on Hobbs's principle of abduction, to convert text into its corresponding Scone representation. The algorithm was tested on children's stories, and found to be able to correctly understand simple sentences. We also hope to be able to leverage this knowledge to effectively answer simple questions about the stories.

LOSEWAIT

STUDENT Minfu Zhang *Language Technologies Institute*
ADVISOR Maxine Eskenazi *Language Technologies Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

People wait in lines for virtually everything. People wait in lines to be seated at restaurants, wait in lines for security checks in airport, and even more. It would be nice if people are able to know how long the line is before going there. To solve the ubiquitous line problem, this project start by trying to solve the line problem in front of the student package pickup window. We will gather both ground truth data from package pickup history and crowdsourced data to model and predict how long the line will be at the package pickup window. This could be later extend to a much larger context, to solve the line problem at any venues.

SCIENCE & HUMANITIES SCHOLARS

SCIENCE AND HUMANITIES SCHOLARS

CARNEGIE MELLON UNDERGRADUATE STUDENTS' ATTITUDES TOWARDS THE UNIVERSITY'S CURRENT ATHLETIC FACILITIES AND THEIR ANTICIPATION FOR THE NEW CUC GYM.

STUDENTS Charlton Cheng *Economics* | Leeann Choi *Statistics* | Yifan Leng *Statistics* | Michelle Ong *Economics* | Danielle Peters *Science and Humanities Scholars*

ADVISOR Jared Murray *Statistics*

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

Our project topic is relevant to Carnegie Mellon University's plans to upgrade the current athletic facilities by expanding the Cohon University Center. In the midst of CMU's heavy workload and and stress culture, it is beneficial for each student to maintain a healthy lifestyle by taking advantage of the athletic facilities provided by the university. Therefore, implementing a survey of students' attitudes regarding the existing university athletic facilities' gym equipments, layouts and other services offered is relevant and timely. The athletic facilities consist of the Cohon University Center (CUC) Gym, Skibo Gym, and several gyms located in different campus dorms. Since the university has planned major improvements for its athletic facilities in the CUC, it will also be beneficial to understand students' attitudes on the upcoming improvements.

These responses will provide useful information to the university as it seeks to refine its athletic facilities to better cater to the student population. The university can also incorporate this information into future efforts to design and plan the new athletic facilities.

EFFECT OF INITIAL AMPLITUDE ON THE INTERFACIAL AND BULK DYNAMICS IN RICHTMYER-MESHKOV INSTABILITY UNDER CONDITIONS OF HIGH ENERGY DENSITY

STUDENT Zachary Dell *Science and Humanities Scholars*

ADVISOR Snejana Abarji *Physics*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:45 am

We systematically study the effect of the initial amplitude on the interfacial and bulk dynamics of the Richtmyer-Meshkov instability (RM) induced by strong shocks. The shock propagates from the light to the heavy fluid. The fluid densities differ significantly, with Atwood numbers up to 0.95. The fluid interface is initially perturbed with a cosine wave perturbation. Its amplitude is varied from 0% to 100% of the initial perturbation wavelength. A broad range of the shock strengths and density ratios is considered. Smoothed particle hydrodynamics code is employed to ensure shock capturing and interface tracking. Detailed diagnostics of the flow scalar and vector fields is performed. Whenever possible the simulation results are compared with existing theoretical analyses achieving good agreement. The focus question of our study is how the energy deposited by the shock is partitioned between the interfacial and volumetric components. We analyze the dependence of the initial growth-rate of RMI, the velocity away from the

interface, and the transmitted shock velocity as functions of the initial amplitude. Particularly, we found that for a Mach number 5 and an Atwood number 0.8, the initial growth rate is highest and the interfacial energy is the largest when the initial amplitude is about a quarter of the wavelength.

EFFECTS OF MOBILE APPLICATIONS ON PUBLIC HEALTH IN HONDURAS

STUDENTS Omobolanie Ayo-Ani *Information Systems* | Wendy Chou *Psychology* | Jacqueline Pan *Self-defined* | Leslie Tay *Science and Humanities Scholars* | Emily Wells *Social & Decision Sciences* | Ming Y. Wu *Information Systems*

ADVISOR Jason Hong *Human Computer Interaction Institute*

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

Developing countries often lack the funding and resources necessary to educate communities on public health, leading to the spread of preventable diseases. Existing research has indicated that distance education through online and mobile settings have proven to be effective in public health education. In Honduras, a steady increase in the mobile phone penetration rate implies that mobile applications could be a viable low-cost solution to public health education that would allow for widespread dissemination of knowledge. Our mobile public health application will use interactive tutorials to educate users on sanitation and hygiene in order to reduce the spread of preventable diseases within local Honduran communities.

EXAMINING THE RELATIONSHIP BETWEEN EDUCATION INEQUALITY AND INCOME INEQUALITY

STUDENTS Kelsey Choing *Economics* | Danielle McKinney *Science and Humanities Scholars*

ADVISOR Ariel Zetlin-Jones *Economics*

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

For our senior project, we are interested in understanding the relationship between income inequality and inequality in educational attainment, as well as understanding the relationship between inequality in educational attainment and GDP growth. Using data on educational attainment from 26 countries globally, we construct educational attainment Gini coefficients, which consider the dispersion of the percentage of years of attainment across shares of the population, as a measure of inequality in educational attainment levels across time and countries. Through this inequality measure, we find that educational attainment is becoming more equitable with time, as evidenced through decreasing values of our educational attainment Gini coefficients, and overall average levels of schooling are increasing globally as well as across developing, emerging, and developed economies.

Our analysis reveals an insignificant negative correlation between income inequality and inequality in educational attainment, such that, contrary to our hypothesis, higher levels of income inequality are correlated with lower levels of inequality in educational attainment on a global scale. This relationship becomes significant when restricted to analysis in developed countries. Additionally, contrary to our expectations, there is an insignificant positive correlation between educational attainment inequality and the ten-year average growth rate of GDP per capita globally. This positive relationship is strongest in developed countries. The correlation is negative for developing countries. Overall, our largely insignificant results suggest limited effectiveness of policies targeting these types of inequality and a need for further analysis to better understand what is driving these relationships.

EXPLICIT BOUNDS FOR THE PSEUDOSPECTRA OF MATRICES AND OPERATORS

STUDENT Jeremy Meza *Science and Humanities Scholars*
ADVISOR Russel Walker *Mathematics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

We give several equivalent definitions for the ϵ-pseudospectrum of square matrices and investigate the behavior of the pseudospectra for non-normal matrices. We give a complete characterization of the pseudospectrum of 2×2 matrices and describe the asymptotic behavior of the pseudospectrum of a square matrix of arbitrary size, as ϵ approaches 0. We also give explicit upper and lower bounds for the ϵ-pseudospectra of bidiagonal matrices, as well as for finite rank operators.

HEMISPHERIC DIFFERENCES IN FACE DISCRIMINATION AFTER PRIMIN

STUDENT Adam Dickter *Science and Humanities Scholars*
ADVISOR Marlene Behrmann *Psychology*
ROOM/TIME Pake / 1:00 pm

Studies show that the accuracy of face recognition is correlated with the laterality of processing and is mediated by the right hemisphere. This study sought to determine whether one can bias the perceptual processing of faces by introducing information that enhances the global or local precedence of the right hemisphere prior to the onset of a face stimulus. Specifically, we 'primed' participants by presenting local or global information to the right or left hemisphere (using visual half-field paradigms) and then examined the effect of this information on face processing performance. Subsequent analysis revealed local priming enhancement of left hemisphere face discrimination and no performance facilitation for either hemisphere after global priming of facial features. Further exploration of laterality effects may improve the understanding of priming conditions that facilitate selectivity in facial recognition tasks.

IMAGE SEGMENTATION WITH DYNAMIC ARTIFACTS DETECTION AND BIAS CORRECTION

STUDENT Nicholas Takaki *Science and Humanities Scholars*
ADVISOR William Hrusa *Mathematics* | Dominique Zosso *UCLA*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We propose a new model for segmenting damaged images. Our model introduces a dynamic artifact class to the Chan-Vese functional, which prevents outliers from skewing the segmentation. Our new functional effectively segments both damaged and undamaged images. We also developed a minimization scheme based on diffusion and thresholding, which runs significantly faster than traditional gradient descent techniques. We include results and comparisons with existing methods.

INCREASING ENGINEERED CARDIAC MUSCLE TISSUE ALIGNMENT IN 2D

STUDENT Sean Kim *Science and Humanities Scholars*
ADVISOR Adam Feinberg *Biomedical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:45 am

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. One of the key factors in developing such engineered cardiac tissue in vitro 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 surfaces with extracellular matrix (ECM) proteins micropatterned on them 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. Two new patterns were developed; a pattern of 10μmwide lines of fibronectin with 4μmspacing, and a software-generated fiber-like pattern that mimics ECM structure in native chick myocardium. Statistical analysis showed that 10μmx 4μm pattern produced greater cell alignment compared to the 20μmx 20μm(control pattern), while the synthetic biomimetic pattern showed a statistically insignificant difference. The findings of this study show that the alignment of cardiac muscle cells in 2D can be improved by controlling the structure of the ECM protein.

INSTRUCTION-DRIVEN CHANGES IN KNOWLEDGE ORGANIZATION

STUDENT Rachel Walsh *Science and Humanities Scholars*
ADVISORS Anna Fisher *Psychology* | Layla Unger *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Prior research indicates that semantic knowledge becomes increasingly differentiated and organized with age. For instance, with development, knowledge about living organisms becomes increasingly differentiated into taxonomic groups of biologically related organisms. To test whether these changes that have been observed developmentally can be induced in young children using direct instruction, we assessed organization of knowledge about living organisms that belong to three taxonomic categories in a group of preschool children over the course of approximately one month, and administered instruction sessions to half of the children during this time. During the instruction sessions, children were taught about biological features that are shared by organisms that belong to the same taxonomic category (e.g., mammals have fur and give birth to live babies). Our results did not reveal greater increases in the influence of taxonomic categories on semantic organization in children who received instruction versus children who received no instruction.

INVASION OF CANDIDA ALBICANS INTO POLYACRYLAMIDE HYDROGEL

STUDENT Tammy Ying *Science and Humanities Scholars*
ADVISOR Frederick Lanni *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:15 am

My research is aimed at understanding the invasion of hyphal cells (elongated filamentous cells) of the fungus Candida albicans into cross linked elastomer. The proposed theoretical model is that strains use turgor equal to the Young's modulus of the substrata to gain an invasive phenotype. This was tested experimentally using two approaches. Elastic substratum with varying elastic moduli was used to assess the depth of invasion of wild-type C. albicans. Wild-type and mutant strains deficient in glycerol were also assayed for intracellular osmolarity in order to further quantify and prove our hypothesis that C. albicans hyphae use osmotic pressure to drive invasion in solid substrata. My proposal is novel in that it studies the biophysical invasion of C. albicans hyphae into elastomer during biofilm formation. This project is actually part of a larger research question on the effects of the gene RHR2 on biofilm formation and invasion. RHR2 encodes the enzyme glycerol-3-phosphatase, which is responsible for producing glycerol, the suspected osmolyte. In a mutant strain where this gene is missing, the biofilm integrity is compromised along with defects in invasion into substrata. Thus, RHR2 is necessary for biofilm formation and invasion in C. albicans.

INVERTIBLE BINARY TRANSDUCERS AND AUTOMORPHISMS OF THE BINARY TREE

STUDENT Tsutomu Okano *Science and Humanities Scholars*
ADVISOR Klaus Sutner *Computer Science*
ROOM/TIME Class of '87 / 2:00 pm

Transducers are examples of finite state machines that have found applications in group theory. We focus on the structure of these machines and expand upon the results of Nekrashevych and Sidki. From the automata theory perspective, we prove some structure theorems and answer a few decidability questions. From the group theory perspective, we prove some theorems that strengthen the connection between linear algebra and the study of abelian subgroups of Aut(2*).

LABELING STEM CELLS AND IMMUNE CELLS WITH FERUMOXYTOL FOR CELLULAR MAGNETIC RESONANCE IMAGING: A BIO-MIMIC LABELING METHOD

STUDENT Lanya Tseng *Science and Humanities Scholars*
ADVISOR Chien Ho *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:30 am

Cellular magnetic resonance imaging (MRI) can effectively, safely, and non-invasively track cells labeled with superparamagnetic iron oxide particles (SPIO). Cellular MRI may lead to a better understanding of the pathogenesis of many diseases. An effective method of tracking engrafted cells in an intact living organism is also crucial for the success of cell therapy, which depends on precise dosing, timing, and delivery of cells to a desired site.

Ferumoxytol (Feraheme) is an SPIO particle approved as an iron supplement for the treatment of iron deficiency

anemia in adult patients with chronic kidney disease, and is currently the only intravenous, FDA-approved SPIO nanoparticle. However, Ferumoxytol does not effectively label cells ex-vivo without transfection agents; the only ex-vivo cell-labeling method is the ferumoxytol-heparin-protamine (HPF) nanocomplexes methodology [Nat Med 18, 463-467 (2012)]. The objective of this study is to develop a new ex-vivo method for labeling mesenchymal stem cells (MSCs) and macrophages (MØs) with Ferumoxytol, without the use of transfection agents and/or electroporation. MSCs, which are multipotent cells being explored clinically as a therapeutic for many diseases, can be labeled with Ferumoxytol in-vivo (i.v. injection) [Radiology 269, 186-197 (2013)], but not readily ex-vivo (in cell culture) [Nat Med 18, 463-467 (2012)]. MØs, which are important players in organ transplantation and disease, can also be labeled effectively with Ferumoxytol in-vivo [Circ Cardiovasc Imaging 5: 559-565 (2012)], but not ex-vivo without transfection agents [Nat Med 18, 463-467 (2012)]. Our hypothesis is that an ex-vivo¬ method which mimics in-vivo conditions could effectively label MSCs and MØs with Ferumoxytol.

Our new ex-vivo method for labeling MSCs is: (i) flush bone marrow cells from femurs and tibias of Brown Norway (BN) rat and incubate for 24 hours at 37°C; (ii) remove the supernatant from the adherent cells; (iii) expand the number of MSCs for 7 days; (iv) prepare fresh supernatant by repeating step (i), using another BN rat; (v) trypsin-EDTA digest MSCs from step (iii) and wash MSCs with phosphate buffered saline (PBS); (vi) add Ferumoxytol (100 µgFe/mL) to the cells and add the supernatant from step (iv); and (vii) allow the cells to incubate overnight, remove the supernatant, and allow the purification and expansion of the cells for 3 days. Steps iv, v, and vi are different from the traditional ex-vivo method (which involves adding Ferumoxytol directly to the cell culture). Our new ex-vivo¬ MØ labeling method follows a similar procedure.

The intracellular iron concentrations of cells labeled by the traditional method were 0.16 ± 0.02 pg/MSC and 0.51 ± 0.02 pg/MØ. Using our new method, the intracellular iron concentrations increase to 2.50 ± 0.50 pg/MSC and 4.30 ± 1.42 pg/MØ. These results are comparable to those obtained using the heparin-protamine labeling method: 2.12 ± 0.11 pg/MSC and 2.56 ± 1.1 pg/monocyte [Nat Med 18, 463-467 (2012)]. The labeled cells exhibit over 95% viability. Labeling efficiency is verified by MR microscopy, transmission electron microscopy, and Prussian blue iron staining. Our new bio-mimic method can be used to label MSCs and MØs with Ferumoxytol, without using transfection agents and/or electroporation, for cell-tracking by MRI.

MODELING EBOLA TRANSMISSIONS

STUDENTS Adrian Botta *Economics and Statistics* | Andersen Chang *Science and Humanities Scholars* | Abigail Smith *Mathematics*
ADVISORS William Eddy *Statistics* | Rebecca Nugent *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The most recent Ebola Hemorrhagic Fever (EHF) epidemic has grown to over twenty-five thousand cases, and over ten thousand deaths. Following the EHF outbreak in 2013-2014, a lot of research has been published in search for a model that could accurately simulate the spread of this disease. While existing research focuses on applying compartmental models to the data from each country and expanding the simpler SIR model into a more complicated SEIHFR model, we use compartmental models to simulate the spread of the EHF virus across the borders of the three countries most affected by the outbreak, Guinea, Liberia, and Sierra Leone. Using the EpiModel package in R, we optimize for the parameters of each model and assess a goodness of fit for each individual country. We then look at ways to combine cross-border movement data in Western Africa to model the spread of disease from one country to another.

NHL SHOT LOCATION ADJUSTMENT

STUDENT Andersen Chang *Science and Humanities Scholars*
ADVISOR Andrew Thomas *Statistics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Since 1997, the National Hockey League (NHL) has used the Real Time Scoring System (RTSS) in order to keep track of and record the details of the events that occur in every game. The logging of all of the data in the RTSS is done manually while the game is in progress. We are interested the recorded shot locations in the data; as these locations are judged by human eye, we suspect that they might be inaccurate. We look at the distribution of recorded shot locations at each arena and compare it to the league-wide distribution, which we assume is the expected distribution of shot locations in each stadium, using kernel density estimation. We then try to develop methods to correct for the shot location bias in each arena using iterative regression and gradient adjustment. Ultimately, our goal is to find the best adjustment functions, unique to each NHL rink, to correct the RTSS shot locations.

ONLINE DOMINATING SET

STUDENT Fan Yang *Science and Humanities Scholars*
ADVISOR William Hrusa *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

We consider a greedy online algorithm that finds a dominating set of a graph. This algorithm is online because vertices of the graph are revealed one by one. From a practical perspective, this algorithm is easy to implement and can be applied to graphs that are not fully known.

We analyze the performance of this algorithm and study how graph operations affect the performance. There are two main results:

1) We calculated expected dominating set sizes of paths, cycles, stars, multi-stars and bipartite graphs using this algorithm.

2) We found examples where adding edges to the graphs actually increases their expected dominating set sizes.

Because of its simplicity, this online algorithm can also be used to find chromatic numbers of graphs and etc. We hope our analysis of the algorithm can inspire more applications in the future.

POPULAR AND ORGANIZED PROCESSES OF POLITICAL LEGITIMATION: THEORETICAL ANALYSIS AND HISTORICAL APPLICATION

STUDENT Christophe Combemale *Science and Humanities Scholars*
ADVISOR John Modell *History*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

In this project, I consider the reign of King Francis I of France (1515-1547) through the lens of a novel theory of state and social evolution. The period I have selected serves as a case study for the evaluation of the functionality and robustness of an institutional theory of political processes, which I developed over the course of my studies at Carnegie Mellon under the working title of "Legitimacy Theory".

In brief, the theory understands human populations as fora for the organization of individual and, when they

achieve a sufficient scale, community interests according to institutions that moderate interaction and define the sphere of opportunity and action for both the body public and narrower aggregations of people and power. The institutions in question may be expressed explicitly, as when political agencies such as states develop and impose laws, or implicitly, as in the case of culture or similar social convention which arises from the internalization of longstanding accords into traditions and norms. Importantly, the state may encompass subordinate agencies, which serve to project the interests of particular social segments with the will but not the power to assume the role of the state, or at least the will and the power to affect its operation. These distinct interests interact with the state either through formal channels provided by explicit institutions or through the application of their separate power in conditions where the state's operation may be diverted in their favor.

The Legitimacy Theory provides observations on the efficacy and the context of the policies which transformed the French monarchy under Francis I, and this assessment enables a rigorous evaluation of the theory by instantiating it historically. It incorporates the domestic and foreign pressures affecting France during the period into an understanding of the catalysts in the decidedly uncertain movement of the monarchy toward centralization and the rudiments of absolutism. Domestically as well as internationally, Francis's reign entailed the navigation of the complex landscape of explicit and implicit institutions which underwrote the organization of rival and parallel interests in the noble, clerical and merchant estates. My project's principal objective is to both construct the theory and evaluate its validity and analytical merit through its application to the case study of the reign of Francis I.

REDSHIFT DEPENDENCE OF THE POWER SPECTRUM FOR SLOAN DIGITAL SKY SURVEY DATA RELEASE 11 QUASARS

STUDENT Kathryn McKeough *Science and Humanities Scholars*
ADVISORS Peter Freeman *Statistics* | Shirley Chan Wan Ho *Physics*
ROOM/TIME Dowd / 2:00 pm

Matter in the Universe is not uniformly distributed. Some regions are over-dense while some are under-dense. Astronomers traditionally assume that matter density is a Gaussian random field. The matter power spectrum is a vector of summary statistics that describe fluctuations in the matter density of the field. The power spectrum evolves with time. We can constrain the properties of the power spectrum near present day by using galaxy surveys. However, for earlier times there are not enough observed galaxies to provide sufficient constraint. Astronomers use the spatial distribution of quasars to infer the underlying structure of our universe. Quasars are luminous and distant galaxies that surround a super massive black hole. The Sloan Digital Sky Survey (SDSS) recently released its 11th set of data (DR11) which contains a sufficient number of quasars in which to apply effective cosmological probe. We use 137,562 objects from the northern hemisphere of quasars of the Baryon Oscillation Spectroscopic Survey (BOSS) survey that was part of DR 11. Quasars and galaxies are biased tracers of the matter distribution because they only exist in denser regions. We will statistically investigate the bias function to and see if the SDSS DR 11 quasars are capable of yielding scientific insight about matter density or whether they are indicators of un-modeled systematic error.

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*
ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

THE BATTLE OF MONMOUTH

STUDENT Christopher Sickler *Science and Humanities Scholars*
ADVISORS Kevin Gonzalez *English*
ROOM/TIME Pake / 4:20 pm

My project is a collection of stories that explore relationships between people in different settings. Specifically, my project will deal with these questions: where does meaning come from in regard to other people? What does it take to have a friendship with someone? How do family ties impact worldview?

As with all writing, some of the impact will be on myself, as I explore the topic through characters I have invented, but I also hope to share my exploration with a wider audience. I hope that my project can ultimately shed some light on the nature of human to human interaction, and can treat the characters and readers with respect and dignity.

WHAT'S IN A NAME? AN EXPANDED CLASSIFICATION OF XENOLOGS

STUDENT Charlotte Darby *Science and Humanities Scholars*
ADVISOR Dannie Durand *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:00 am

Horizontal gene transfer (HGT) occurs when a species acquires a gene from a source other than its ancestor. The term "xenolog" is used to refer to genes related through HGT. However, this general term does not distinguish between the many different ways HGT can affect a gene family, depending on how many transfer events occurred, when they occurred, and which species were involved. We propose a formal framework for classifying xenologs into different subtypes, based on comparison of the gene family tree with the associated species tree. Our framework imparts structure and meaning to evolutionary relationships in any gene family history. It also provides the foundation required to develop a software package to automate the classification process. We also show how our conceptual framework can be applied to genes in the S. cerevisiae biotin synthesis pathway. This example demonstrates how our terminology facilitates interpretation of functional relationships between xenologs.

TEPPER SCHOOL OF BUSINESS

BUSINESS ADMINISTRATION

CARNEGIE MELLON DINING HABITS

STUDENTS Ajit Bopalkar *Business Administration* | Willa Lu *Business Administration* | Anita Ramamurthy *Business Administration* | Jia Wan *Business Administration* | Danning Wang *Business Administration*

ADVISOR Jared Murray *Statistics*

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

The purpose of our survey is to study CMU Undergraduate students' eating habits in terms of cooking versus purchasing dinners. This topic is interesting to us because we realized that a lot of students tend to start cooking dinner as they become older and start moving off campus. It is important for this survey to be conducted now because rising tuition is causing students to tighten their wallets, and inclement weather is causing students to cook dinner more or eat near their houses/on campus. It is also important to study this topic so that we can evaluate CMU's dining options and see how they can be improved to better cater to students of all years and of all different levels of involvement on/proximity to campus. We want to survey how frequently students cook their own dinners or purchase the meals either on or off campus. If they purchase dinner, we would like to see how much they spend, and how those variables correlate with students' involvement on campus. In our survey, we are including both dinners eaten at Carnegie Mellon dining locations using blocks, cash, or credit cards as well as off campus dinners, as purchasing a meal. Using that data, we hope to serve potential clients such as Carnegie Mellon and local restaurants, to give them valuable data and recommendations on how to understand the eating habits of students and what factors go into a student deciding on whether to cook or eat out.

CMU FRESHMEN MEAL PLAN SATISFACTION

STUDENTS Elizabeth Chang *Statistics* | Izaia Haynes *Statistics* | Elissa Maercklein *Business Administration* | Henry Neale *Self-defined* | Tias Sen *Statistics*

ADVISOR Jared Murray *Statistics*

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

On November 13, 2014, the State Assembly in New Jersey passed legislation (with a 53-17 vote) banning both public and private universities, with the exception of Princeton, from requiring their students to purchase a meal plan. The bill also requires schools to offer meal plans in the form of pre-paid debit cards, with a refundable balance at the end of the term.

Meal plans on college campuses are widely criticized, notorious for being overpriced and lack necessary nutrients. A study published in the Journal of Nutrition Education and Behavior stated that many college students are not even eating one serving of fruits and vegetables per day. This is surprisingly lower than the average government recommendation of 4.5-5 servings of each per day. NBC published an investigative report last year on the meal plan at Ohio State University, focusing on how overpriced on-campus dining is. One student admitted to paying $35 (seven blocks on their $5/block system) for a case of Powerade – the same size case that is sold at Sam's Club for$12.48. The article published by NBC also discusses how students are often forced to purchase such a high number of these nonrefundable blocks, causing "people go into panic mode" to use up their balance of blocks at the end of the semester. This recent attention to the issues surrounding college campus meal plans made us question the

merits of the meal plan system here at Carnegie Mellon.

Earlier in January, Carnegie Mellon announced they would be raising the price of the required meal plan for first-year students to an exorbitant $5,310 (an increase from $5,120 in the 2014-2015 school year, which was already an increase from $4,920 the previous year). Consequently, we would like to conduct a survey to gauge the sentiment of the Carnegie Mellon community towards the meal plan, specifically focusing on the "block" system. Our study will address the primary issue associated with campus meal plans: cost. We would like to look into the average amount of money that is wasted on unused blocks biweekly, as they do not roll-over into the subsequent period for first year meal plans. We would answer the following questions in conducting this study: What is the true monetary value of a block and how does this compare to how much students not on the meal plan are spending? Would students be more satisfied with the meal plan if their blocks would roll-over per biweekly period?

This survey would be extremely beneficial to both CulinArt and the Carnegie Mellon administration, allowing them to identify specific issues within the current meal plan system and adjust accordingly. The meal plan is something that affects everyone who attends CMU, so our findings will be significant and informative for those who attend CMU. There is often major discontent expressed about the forced meal plan for first-year students and conducting this survey would provide the statistics to support that dissent, making the issue more apparent. The results of our survey will also allow us to make an informed recommendation on how to improve the meal plan.

CUSTOMER SATISFACTION: STEEL CACTUS

STUDENTS Mary Behnke *Statistics* | Darun Kwak *Business Administration* | James Lee *Statistics* | Guillermo Marce-Santurio *Statistics* | Brooke Tsu *Statistics*

ADVISOR Jared Murray *Statistics*

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

Market research is vital for the success of any business. Whether planning to launch a new startup or expanding current operations, businesses need market data that highlights its opportunities and marks its challenges. Every business can benefit from the contributions and marketing strategies suggested in this proposal.

We aim to work with a small, local business. We'd like to help them promote business through better understanding how they attract customers. This survey/research project could help a local business grow and succeed.

We believe that we can contribute to the local economy by helping a local business better strategize its operations. We will choose a local business with high numbers of Carnegie Mellon student clientele. We will analyze purchasing patterns made by clients, measure customer satisfaction, and survey about product quality. We hope that understanding Walnut Street's economic activity and studying the purchasing behavior of clients will help us learn how to better promote local business.

The results of this survey may be helpful not only to the local business we examine, but to other businesses around Walnut Street and the Carnegie Mellon campus.

INVESTIGATING THE EFFECTIVENESS OF COMPUTER GAMES THAT EMBED LITERACY CONTENT CREATED BY TEACHERS

STUDENT Lucy Pei *Business Administration*
ADVISOR Mary Bernardine Dias *Robotics Institute*
ROOM/TIME McKenna / 2:00 pm

English literacy can often improve the quality of life of underserved populations. Achievement of English literacy requires a great deal of practice, and educational games can help increase motivation to practice. Although games with content intrinsically integrated into the game mechanism have been shown to increase the motivational appeal of educational games, the barriers to scalability of intrinsically integrated educational games prevents this solution from becoming widespread. We investigate the motivational appeal of extrinsically integrated educational games that have customizable content and game themes through comparative user-testing of an extrinsically integrated educational game versus exercises and intrinsically integrated educational games, with ESL adult populations and deaf middle-school populations. We find that the motivational benefits of customizability outweigh the effects of intrinsic versus extrinsic integration of the educational content. Extrinsically integrated educational games with customizable content and game themes could provide a scalable solution to motivate students to practice literacy and other skills.

PERCEPTION OF GREEK LIFE AT CMU

STUDENTS Andrew Fernandes *Statistics* | Theodore Peterson *Statistics* | Maxwell Ponte *Statistics* | Alice Ye *Business Administration*
ADVISOR Jared Murray *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Greek organizations have been negatively depicted in the media as of late due to a perceived connection between partying and sexual assault. However, greek organizations undoubtedly have a positive impact on the beneficiaries of their community service projects. Greek life also seems to benefit the members by giving them a loyal group of friends and a stronger than normal social network. In our study, we aim to find out if CMU students perceive Greek life as having a positive community impact. We suspect that CMU has a generally negative opinion about Greek Life, perhaps due to media influence. Surveys like these could help the University decide if they should place further restrictions on Greek life or "give them some slack." Perhaps also national insurance providers that insure Greek organizations would be interested why?

STREAM: SENSOR THAT REPORTS ENDOCRINE ACTIVATING MOLECULES

STUDENTS Alexandra Celentano *Business Administration* | Dominique MacCalla *Biomedical Engineering* | Nicole Matamala *Civil and Environmental Engineering* | Danielle Peters *Science and Humanities Scholars* | Courtney Pozzi *Design* | Niteesh Sundaram *Electrical & Computer Engineering* | Lena Wang *Biological Sciences*
ADVISORS Diana Marculescu *Electrical & Computer Engineering* | Natasa Miskov-Zivanov *Electrical & Computer Engineering* | Cheryl Telmer *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Hormones are molecules that allow cells to communicate with each other and are used by organisms to alter growth and metabolism. The steroid hormones such as estrogen can diffuse across the plasma membrane, bind

their receptor in the cytoplasm, migrate to the nucleus and act as transcription factors to alter cell's physiology and behavior. Naturally occurring steroid hormones include estrogen, progesterone, testosterone and cortisol.

Detection of hormones in the environment has raised concerns in recent years because of their potential to affect both humans and wildlife. Estrogens from natural, synthetic, plant, and fungal sources can manifest endocrine disrupting properties and even at low concentrations can have harmful effects due to receptor activation. Estrogenic activity can occur in water sources including waste, drinking and freshwater. In freshwater, estrogens are harmful to the ecosystems, feminizing fish and disrupting the overall populations of organisms in the ecosystem. Estrogenic substances can also be present in what we drink, however since the presence of hormones in water is a relatively new area of study, there have been no previous restrictions or regulations regarding filtration of estrogenic compounds.

Due to concern with the compounds in water, our project was to develop a sensor to detect the molecules in water that will bind to the estrogen receptor. We anticipate that our STREAM, Sensor That Reports Endocrine Activating Molecules, will be sensitive and informative of water quality. A BioNetGen model of the sensor and NetLogo model of fish populations were constructed to improve our understanding of these systems.

ECONOMICS

CARNEGIE MELLON UNDERGRADUATE STUDENTS' ATTITUDES TOWARDS THE UNIVERSITY'S CURRENT ATHLETIC FACILITIES AND THEIR ANTICIPATION FOR THE NEW CUC GYM.

STUDENTS Charlton Cheng *Economics* | Leeann Choi *Statistics* | Yifan Leng *Statistics* | Michelle Ong *Economics* | Danielle Peters *Science and Humanities Scholars*

ADVISOR Jared Murray Statistics

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

Our project topic is relevant to Carnegie Mellon University's plans to upgrade the current athletic facilities by expanding the Cohon University Center. In the midst of CMU's heavy workload and and stress culture, it is beneficial for each student to maintain a healthy lifestyle by taking advantage of the athletic facilities provided by the university. Therefore, implementing a survey of students' attitudes regarding the existing university athletic facilities' gym equipments, layouts and other services offered is relevant and timely. The athletic facilities consist of the Cohon University Center (CUC) Gym, Skibo Gym, and several gyms located in different campus dorms. Since the university has planned major improvements for its athletic facilities in the CUC, it will also be beneficial to understand students' attitudes on the upcoming improvements.

These responses will provide useful information to the university as it seeks to refine its athletic facilities to better cater to the student population. The university can also incorporate this information into future efforts to design and plan the new athletic facilities.

IMPROVING PORTFOLIO PERFORMANCE USING MARKET TIMING: EXAMINING IF A PREDICTING VARIABLE CAN INCREASE PORTFOLIO PERFORMANCE

STUDENTS Matthew Greenberg *Economics* | Anton Razanav *Economics* | William Sanders *Economics*
ADVISOR Ariel Zetlin-Jones *Economics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This paper analyzes the theory that it is possible to increase a portfolio's risk adjusted returns over time by adjusting the allocation of capital within asset classes based on predictive variables. Namely, our study examines whether it is possible to predict the relative outperformance of Hi-Tech versus the S&P 500 in any given year, based on the real trailing 10-year average silicon price. This analysis revealed that as the real 10-year average silicon price declined, the excess returns to Hi-Tech were expected to increase. By backtesting our model and adjusting our allocation to Hi-Tech upwards and downwards based on the real 10-year average silicon price, we were able to achieve superior absolute, and risk adjusted returns, versus the set optimal allocation to Hi-Tech.

SPECIAL COMPETITIONS

SPECIAL COMPETITIONS

ALCOA UNDERGRADUATE RESEARCH AWARDS

Alcoa Inc. is sponsoring this award for projects in Information Technology, with a focus on disruptive technologies, including cloud and mobility. Today's disruptive technology will be the de facto future state for all computing, where connectivity from anywhere to anywhere with myriad devices and for unlimited uses will be expected…and needed. How can we prepare to connect any-to-any seamlessly and securely, and how can this new paradigm add value to companies like Alcoa?

Jillian DePoy, *Financial Rotational Analyst, Alcoa*

Marty Marinack, *Senior Engineer, Alcoa*

Joyce Mitole, *Manager, HR Finance, Alcoa*

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;

SPECIAL COMPETITIONS

ALUMNI AWARD FOR UNDERGRADUATE EXCELLENCE IN COMPUTER SCIENCE

(CONTINUED)

potential societal impact; accessibility; quality of the written, oral, and poster presentations; and generated excitement among the alumni community participating in the process.

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.

Harrison Apple, *Artist in Residence, Center for the Arts in Society*

Jennifer Bannan, *Adjunct Instructor, English*

Krista Campbell, *Associate Director for Stewardship, Office of Foundation Relations David Danks, Department Head, Professor of Philosophy and Psychology, Philosophy*

Sharon Dilworth, *Associate Professor, English*

Gabi Eichmanns, *Associate Teaching Professor of German, Modern Languages*

Sarah Emory, *Language Development Specialist, Intercultural Communication Center*

Tim Haggerty, *Director, Humanities Scholars Program, History*

Joe Mannino, *Professor of Art, School of Art*

John Modell, *Professor Emeritus, History*

Mame-Fatou Niang, *Assistant Professor of French and Francophone Studies, Modern Languages*

Candace Skibba, *Assistant Teaching Professor of Hispanic Studies, Modern Languages*

Ona Taylor, *Team Leader & Interim Head of Access Services, Carnegie Mellon University Libraries*

Danielle Wetzel, *Teaching Professor & Director of First-Year Writing, English*

Jesse Wilson, *Desktop Publishing Coordinator/Webmaster, History*

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, 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, *Senior Leader, Boeing Info Technology – 777X Production Transformation Program*

Jeff Heisserman, *Associate Technical Fellow, Boeing Info Technology – Technical Assurance*

Denise Holiman, *Manager, Information Technology Functional Excellence*

Garret Lee, *Senior Software Engineering Manager, Boing Defense, Space & Security – Software Engineering*

Dexter Reitman, *Enterprise Architecture*

Brandon Tyson, *Global Information Technology Infrastructure Engagement*

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.

Burcu Akinci, *Professor, Civil and Environmental Engineering*

Paul Christiano, *Professor, Civil and Environmental Engineering*

Michael Bockstaller, *Professor, Materials Science Engineering and Chemistry*

Kelvin Gregory, *Associate Professor, Civil and Environmental Engineering*

Michael Lancet, *Adjunct Professor, Electrical and Computer Engineering*

Shawn Litster, *Professor, Mechanical Engineering and Materials Science Engineering*

Alan McGaughey, *Professor, Mechanical Engineering and Materials Science Engineering*

Albert Presto, *Assistant Research Professor, Mechanical Engineering*

Satbir Singh, Assistant Teaching Professor, Mechanical Engineering

Bob Tilton, Professor, Chemical Engineering and Biomedical Engineering

Newell Washburn, Associate Professor, Department of Chemistry and Biomedical Engineering

John Wesner, Adjunct Fellow, Institute for Complex Engineered Systems

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

SPECIAL COMPETITIONS

DIETRICH HUMANITIES PRIZE (CONTINUED)

problem solving, the humanities at Carnegie Mellon seek ongoing dialogues with – not isolation from – the arts, sciences and technologies.

Harrison Apple, *Artist in Residence, Center for the Arts in Society*

Jennifer Bannan, *Adjunct Instructor, English*

Krista Campbell, *Associate Director for Stewardship, Office of Foundation Relations David Danks, Department Head, Professor of Philosophy and Psychology, Philosophy*

Sharon Dilworth, *Associate Professor, English*

Gabi Eichmanns, *Associate Teaching Professor of German, Modern Languages*

Sarah Emory, *Language Development Specialist, Intercultural Communication Center*

Tim Haggerty, *Director, Humanities Scholars Program, History*

Joe Mannino, *Professor of Art, School of Art*

John Modell, *Professor Emeritus, History*

Mame-Fatou Niang, *Assistant Professor of French and Francophone Studies, Modern Languages*

Candace Skibba, *Assistant Teaching Professor of Hispanic Studies, Modern Languages*

Ona Taylor, *Team Leader & Interim Head of Access Services, Carnegie Mellon University Libraries*

Danielle Wetzel, *Teaching Professor & Director of First-Year Writing, English*

Jesse Wilson, *Desktop Publishing Coordinator/Webmaster, History*

JOHNSON & JOHNSON UNDERGRADUATE RESEARCH AWARD

Johnson & Johnson is proud to support innovative projects in the field of Information Technology, with a focus on Healthcare Innovation. The Johnson & Johnson IT Innovation organization is responsible for identifying possibilities to drive the Johnson & Johnson business forward.

Taylor Hamilton, *IT Lead, Johnson & Johnson*

Vic Rios, *CIO, Vision Care / Diabetes Care, Johnson & Johnson*

Mark Speer, *Senior IT Manager, Johnson & Johnson*

Beth Weeman, *IT Analyst, Johnson & Johnson*

SPECIAL COMPETITIONS

MATHEMATICS POSTER COMPETITION

This competition is sponsored by the Department of Mathematics, through the generosity of 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.

John Mackey, *Associate Head and Director of Undergraduate Program, Mathematics*

Bill Hrusa, *Professor, Mathematics*

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.

Chante Cox Boyd, *Associate Teaching Professor, Psychology*

Anna Fisher, *Associate Professor, Psychology*

Vickie Helgeson, *Professor, Psychology*

Laurie Heller, *Associate Teaching Professor, Psychology*

Charles Kemp, *Associate Professor, Psychology*

Erik Thiessen, *Associate Professor, Psychology*

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.

Joe Ayoob, *Assistant Professor, University of Pittsburgh School of Medicine*

Mike Bockstaller, *Professor, Materials Science and Engineering*

Maggie Braun, *Assistant Department Head for Undergraduate Affairs, Biological Sciences*

Boris Bukh, *Assistant Professor, University of Pittsburgh School of Medicine*

Gregory Cary, *Postdoctoral Research Associate, Biological Sciences*

Jill Dembowski, *Postdoctoral Researcher, Mathematical Sciences*

Emily Drill, *Assistant Teaching Professor, Biological Sciences*

Ilhem-Faiza Hakem, *Research Associate, Materials Science and Engineering*

SPECIAL COMPETITIONS

SIGMA XI POSTER COMPETITION (CONTINUED)

Tom Ferguson, *Professor, Physics*

Mark Fichman, *Associate Professor, Tepper School of Business*

Robert Heard, *Teaching Professor, Materials Science and Engineering*

Stewart Heitmann, *Postdoctoral Research Associate, University of Pittsburgh*

Ron Heller, *Senior Principal Systems Engineer, Bayer Healthcare*

Colin Horwitz, *Acting CEO, Chief Technology Officer, GreenOx Catalysts, Inc. and Adjunct Professor, Chemistry*

Aaron Johnson, *Fellow, Robotics Institute*

Chelsea Marsh, *CIT'09, Senior Systems Engineer, Bayer Healthcare*

Deanna Matthews, *Associate Department Head for Undergraduate Affairs, Engineering and Public Policy*

Armaghan Naik, *Lane Fellow, Computational Biology Department*

Parul Nisha, *MCS'07, Clinical Research Associate, Philips Respironics*

Joe Orens, *ECE'67, President of Berkeley Research Associates*

Ira Rothstein, *Professor, Physics*

Bipin Salunkhe, *Senior Director, New Product Development, Bayer Healthcare*

Ralph Schriver, *Deputy Director, Systems and Advanced Systems Integration, Bayer Healthcare*

Gloria Silva, *Assistant Teaching Professor, Chemistry*

Kaustubh Sinha, *Postdoctoral Researcher, Biological Sciences*

Raja Sooriamurthi, *Associate Teaching Professor, Information Systems Program*

Shoba Subramanian, *Assistant Department Head for Graduate Affairs, Biological Sciences*

Cheryl Telmer, *Research Biologist, Biological Sciences*

Karen Thickman, *Assistant Teaching Professor,Computational Biology*

Scott Whalen, *CIT'81, Director, Proctor and Gamble*

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.

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.

Xizhen Cai, *Assistant Teaching Professor, Statistics*

Max G'Sell, *Assistant Professor, Statistics*

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*

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.

Carol Goldburg, *Executive Director of Undergraduate Program, Economics*

Yaroslav Kryukov, *Assistant Professor, Economics*

Rebecca Lessem, *Assistant Professor, Economics*

Chris Sleet, *Professor, Economics*

SPECIAL COMPETITIONS

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.

YAHOO UNDERGRADUATE RESEARCH AWARD

Yahoo! will be looking for interesting and creative projects in the area of mobile computing/ applications and use of location awareness and Web-accessed local information.

DONORS & SPONSORS

DONORS & SPONSORS

SURG/SURF SELECTION COMMITTEE

Robert Bingham, *Associate Head of School of Art and Professor, Art*
Michael Braxton, *Major Gift Officer, University Advancement*
Emma Brunskill, *Assistant Professor, Computer Science*
Wayne Chung, *Associate Professor, Design*
Joanna Dickert, *Fulbright and International Awards Advisor*
Mark Fichman, *Associate Professor, Organizational Behavior*
Annette Jacobson, *Associate Dean of Undergraduate Studies, Chemical Engineering*
Linda Kauffman, *Teaching Professor, Biological Sciences*
Thomas M. Keating, *Assistant Teaching Professor, Computer Science*
Jennifer Keating-Miller, *Assistant Director of Undergraduate Research and National Fellowships*
Erica Linke, *Associate Dean of University Libraries*
H. Scott Matthews, *Professor, Civil & Environmental Engineering and Engineering & Public Policy*
Rebecca Nugent, *Assistant Teaching Professor, Statistics*
Erik Thiessen, *Associate Professor, Psychology*
Stephanie Wallach, *Associate Vice Provost of Undergraduate Education*

UNDERGRADUATE RESEARCH OFFICE SPONSORS

The Undergraduate Research Office and Meeting of the Minds Symposium are made possible through the generosity of the Carnegie Mellon University Office of the Provost and:

ENDOWED FUNDS

Rae Altman Memorial Undergraduate Research Fund
Anonymous Undergraduate Research Fund
Bauhinia Foundation Undergraduate Research Fund
Victor M. Bearg (S'64) Undergraduate Research Fund
David and Janet Brashear Undergraduate Research Fund
Professor William E. Brown Memorial Undergraduate Research Fund
W. James Carr Jr., PhD, MCS 1950, Memorial Undergraduate Research Fund

DONORS & SPONSORS

UNDERGRADUATE RESEARCH OFFICE SPONSORS (CONTINUED)

Anju and Sanjay Chopra Undergraduate Research Fund
Natale A. Christiano (E'39) Undergraduate Research Fund
Janice Seiner Colker (A '51) Undergraduate Research Fund
Wesley Cowan Undergraduate Research Fund
Loyd (E'59) and Linda Crawley Undergraduate Research Fund
Arthur Vining Davis Foundations SURG Grants for Humanities Research
eSite Entrepreneurship Fund
Dr. J. Paul Fugassi & Linda E. Monteverde Award
Stacy Rae Gross (A'00) Memorial Undergraduate Research Fund
James J. Huttner, M.D., Ph.D. (S'74) Undergraduate Research Fund
Inspire Wonder Undergraduate Research Fund
Jennings Family Brave Companions Fund
Kannan Srinivasan and Chandra Kannan Undergraduate Fund
Richard Kelson Undergraduate Research Fund
Walter P. Ketterer Undergraduate Research Fund
Jennifer Kye Hyun Kim Undergraduate Research Fund
Linda Daley Kosturko Undergraduate Research Fund
Frederick Kuo Jr. (E'69) Undergraduate Research Fund
Lathers Local #33 of Western Pennsylvania Undergraduate Research Fund
Barbara B. Lazarus Undergraduate Research Fund
Barbara Lazarus Undergraduate Research Fund for the Humanities
William and Chloe Lee Undergraduate Research Fund
Leisser Art Fund
Barry B. and Janet M. Luokkala Undergraduate Research Fund
Mahoney Platt Family Endowed Undergraduate Research Fund
Deidre Maloney-Cutler Memorial Undergraduate Research Fund
Simon Markowski Endowed Undergraduate Research Fund

DONORS & SPONSORS

Thomas A. McConomy (E'55) Undergraduate Research Fund
McMullen Family Student Undergraduate Research Fund
Robert W. Morris (E'81) Undergraduate Research Fund
Indira Nair Undergraduate Research Fund
John V. Nelson (S'76) Undergraduate Research Fund
Marie Colontoni Pechet (S'84, IA'91) Undergraduate Research Fund
Hugh F. Porter Jr. Undergraduate Research Fund
Proctor & Gamble Technical Undergraduate Research Endowment
Sam Soo Pyo Undergraduate Research Fund
Jessie B. Ramey Alumni Undergraduate Research Fund
William H. and Frances S. Ryan Undergraduate Research Fund
Harry M. (E'39, '50) and Lila O. (MM '45) Schadel Jr. Undergraduate Research Fund
James V. Sheridan (S'33) Undergraduate Research Fund
Frederick Osborne Stebbins Undergraduate Research Fund
John C. and Suzanne R. Steven Undergraduate Research Fund
H. Guyford and Louise Stever Undergraduate Research Fund
Donald E. (S '63) and Peggy Stitzenberg Undergraduate Research Fund
Hideto Tombabechi Undergraduate Research Fund
Toyota Ideas for Good at Carnegie Mellon University Fund
Jill Van Wart Hood Undergraduate Research Fund
William Wallach Undergraduate Research Fund
Weinsten Family Undergraduate Research Fund
Whalen Family Undergraduate Research Fund
Everard M. Williams Memorial Undergraduate Research Fund
Robert K. Zurawin Undergraduate Research Fund

DONORS & SPONSORS

INDIVIDUAL CONTRIBUTORS

Henele I. Adams (E'99, CS'99, E'01), Katherine Anne Blakely (A'12, DC'13), Linda S. Brown, Bernita Buncher, Kathleen L. (S'78) & James L. Carr (S'77), Robert D. Carr (S'84, S'87, S'95), Jennifer L. Cerully (CS'04) & Jonathan Chu (CS'04), Christina Maria Collura Lloyd (E'10) & Evan Phillip Lloyd (S'09), Wayne I. Cutler (DC'83), Cliff I. (CIT'72) & Megan Davidson, Marciela DeGrace (CMU'07) & Ioan Teodor Ifrim (DC'07), Joanna L. Dickert, Nicole J. Donatelli (DC'08), Laurie Zittrain Eisenberg, Vianey Garcia-Osorio (E'03) & Garth R. Goodson (E'98, '00, CIT'04), James H. (E'82, '83, '86) & Ruth Ann (E'82) Garrett, Jr., Steven M. Graham (DC'02, DC'05), Todd S. Gross (E'75), Nicole Rose Hallinen (CMU'09, DC'09) & Ross Hamden Kukulinski (E'09), Martha Harty & Richard Scheines, Matthew W. Heath (E'96), Farrel B. Helfer (E'76), Heidemarie Ruth Hoover (DC'93) & Michael Tod Rose (DC'91), Wesley Louis Horner (E'97), Josh Hyman, Jessica Michelle Jankowitsch (DC'09), Katherine & Larry E. Jennings, Jr. (S'84, TPR'87), Christos Kapoutsis, Shruti Kataria (CS'12, DC'12), Beng Liang Koh (E'99), Lina R. Kontos (E'02), Wladimir Labeikovsky (S'98), Megan Elizabeth Larcom (TPR'10), C. Kampmann Lasater (E'03), Tom Lee, William W. Lee (E'94), Christina Maria Collura (E'10) & Evan Phillip Lloyd (S'09), Caitlin M. Lovett (DC'05), Simon E. Markowski (E'08, E'09), Myrna G. Marshall & Jon S. Saxe (E'57), Carol C. McMullen Rush & Sean C. Rush, Roderick T. McMullen (CMU'07, CS'08), Laurie Lee McPherson (S'85), Amnon J. Meir (S'89), Robert W. Morris (E'81), Robb F. Moskowitz (DC'99), Heather (DC'96) & Daniel Jay Myers (S'95), John V. Nelson (S'76), Daniel Nichols (TPR'82), Stephen R. Palm (E'89), Gordon E. Pike (S'63), Jessie B. Ramey (DC'91, '03, '09) & John D. Zimmerman (A'98), Johanne A. Rokholt (E'13, E'14), Donald K. Routh, Naomi R. Schwartz (DC'95, E'01), Marvin A. Sirbu, Suzanne R. (TPR'03) & John C. Steven (E'94), Peggy & Donald E. Stitzenberg (S'63), Janel Ann Sutkus, Erich M. Velandia (E'99, E'00), Daniel Music Vogel (S'02), Randi L. (E'04) & Ryan M. (E'04) Voss, Andrew B. Wallach, Audrey Wallach, Stephanie Wallach & Steven Schlossman, Jung-Kuan Wang (E'79, '83), Jennifer A. Weidenhof, Mark R. Weinsten (DC'85)

CORPORATE & FOUNDATION SPONSORS

Alcoa Incorporated, Boeing Company, Jack G. Buncher Charitable Fund, Google, Inc., Intel Foundation, Jesy Foundation, Johnson & Johnson, Schwab Fund for Charitable Giving, SRC Education Alliance, Yahoo! Incorporated

INDEX BY DEPARTMENT

COLLEGE OF ENGINEERING

BIOMEDICAL ENGINEERING

CHEMICAL ENGINEERING

CIVIL AND ENVIRONMENTAL ENGINEERING

ELECTRICAL & COMPUTER ENGINEERING

ENGINEERING AND PUBLIC POLICY

MATERIALS SCIENCE ENGINEERING

MECHANICAL ENGINEERING

COLLEGE OF FINE ARTS

ARCHITECTURE

ART

DESIGN

DRAMA

CROSS-COLLEGE

BCSA

BHA

BIOLOGY AND PSYCHOLOGY

BSA

HUMANITIES AND SOCIAL SCIENCES

SELF-DEFINED

SOCIAL & DECISION SCIENCES

STATISTICS

MELLON COLLEGE OF SCIENCE

BIOLOGICAL SCIENCES

LANGUAGE TECHNOLOGIES INST.

SCIENCE AND HUMANITIES SCHOLARS

SCIENCE AND HUMANITIES SCHOLARS

TEPPER SCHOOL OF BUSINESS

BUSINESS ADMINISTRATION

ECONOMICS

INDEX BY STUDENT

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

X

Y

Y

Z

UNDERGRADUATE RESEARCH OFFICE

Stephanie Wallach, *Assistant Vice Provost for Undergraduate Education*

Jennifer Keating-Miller, *Associate Director of Undergraduate Research and National Fellowships*

Joanna Dickert, *Fulbright and International Awards Advisor*

Jennifer Weidenhof, *Program Coordinator*

CARNEGIE MELLON UNIVERSITY

5000 Forbes Avenue | Pittsburgh, PA 15213 | (412) 268-5702 |
sw4s@andrew.cmu.edu | www.cmu.edu/uro

MEETING OF THE MINDS

MAY 6, 2015