CARNEGIE MELLON UNIVERSITY

MEETING OF THE MINDS

2014

UNDERGRADUATE RESEARCH OFFICE CMU.EDU/URO

WELCOME

A warm welcome to the 19th annual Meeting of the Minds, our campus-wide celebration of undergraduate research at Carnegie Mellon.

The range and quality of work presented at this event is a good barometer of what takes place everyday and everywhere on our campus. Congratulations to our students for their amazing contributions, whether it be in the laboratory, out in the community, in an archive, or working in a studio. The results of their research on display today give all of us good reason to be proud of them, their faculty mentors, and the work that takes place at Carnegie Mellon.

Please feel free to browse through the abstracts in this program; peruse the diverse posters on the first and second floors of the University Center, including Rangos Ballroom; attend the oral presentations taking place in the various rooms on the second floor corridor; visit the art installations on the first floor for the visual arts presentations; or enjoy a performance or film in McConomy Auditorium.

There are two times during the day when we hope you will be on hand. At **2:30 p.m.**, Vice Provost Amy Burkert will address the audience in the first floor Kirr Commons area. We will also hold a drawing for students of some fun items during this time—see if you can be a winner. At **5:00 p.m.**, we hope you will join us for an Awards Ceremony in McConomy Auditorium. At this time, we will present awards for many competitions that are taking place during the day. Perhaps you and many of your friends will be recognized with awards for their research—a listing of these competitions is included near the end of this program booklet.

Please enjoy Carnegie Mellon's 19th Annual Meeting of the Minds!

Stephanie Wallach, Ph.D.
Assistant Vice Provost for Undergraduate Education

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SPECIAL THANKS

WE EXTEND OUR SPECIAL THANKS TO:

- **ALUMNI RELATIONS FOR THE CORPORATE BREAKFAST**
- **CARNEGIE INSTITUTE OF TECHNOLOGY DEAN'S OFFICE FOR THE MID-AFTERNOON WELCOME**
- **SCHOOL OF COMPUTER SCIENCE DEAN'S OFFICE FOR THE JUDGES' RECEPTION**

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

Many thanks to Kourtney Bandish, Amy Burkert, Catherine Copetas, Thomas Cortina, Joanna Dickert, Marcia Gerwig, Jen Keating-Miller, M. Stephanie Murray, Matt Lambert, Kurt Larsen, Katherine Mashek, Catherine Spence, Shoba Subramanian, Joanne Ursenbach, Jen Weidenhof, MediaTech, University Catering Staff, University Center Staff, AlphaGraphics, A.G. Trimble Company, Airheads Balloon Art, 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 CHOOSE 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 p.m. in Rangos 2 and 3. Students participating in the CIT poster competition will be by their posters from 12 noon to 2:30 p.m. in Rangos 1. Students participating in the general poster session will be by their posters from 12 noon until 2:30 p.m. or from 3 p.m. until 5 p.m. in the common areas of the 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 six rooms along the second floor corridor (Dowd, Pake, McKenna, Peter, Wright or Class of '87). Students have been instructed to prepare a 10-minute oral presentation about their research, leaving five minutes for questions from the audience and five minutes to gather up their materials and make way for the next presentation.

3 VISUAL ARTS

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

4 PERFORMING ARTS PRESENTATIONS

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

ABSTRACTS

CARNEGIE INSTITUTE OF TECHNOLOGY

BIOMEDICAL ENGINEERING

ANALYSIS AND IMPLEMENTATION OF LOW COST RENEWABLE BIOFUELS

STUDENTS Benjamin Avery *Mechanical Engineering* | Anchal Bhargava *Mechanical Engineering* | Daniel Cushman *Mechanical Engineering* | Conor Fitzgerald *Biomedical Engineering* | Laura Fleury *Mechanical Engineering*

ADVISORS Cecil Higgs *Mechanical Engineering*

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

The goal of our research is to restore a cost-efficient as well as energy-efficient biodiesel electrical generator that will be used to help power the Margaret Morrison building on CMU's campus. In 2008, over $675,000 was spent to install the biodiesel electrical generator in the basement of Margaret Morrison with the hope that it would be used to produce clean energy on campus. Though its feasibility has been proven and presented as part of a PhD thesis from a student in the CMU Departments of Architecture and Mechanical Engineering (Betz, 2009), it has largely been unused for two reasons: (1) lack of students who have a budget to get it working again and (2) the cost of the electricity produced from the generator has been too high to compete with energy from the grid. We will work with Professor Higgs in the CMU Department of Mechanical Engineering to restore this engine and address the high cost of the fuel. Specifically, we will use non-traditional sources of oil such as waste cooking oil, which is being converted to biodiesel by another group of undergraduate researchers. We will then test it in a smaller biodiesel electrical generator, which will allow us to estimate the energy output and cost efficiency. We will then restore the biodiesel generator in Margaret Morrison and use it to produce clean, renewable energy for CMU.

CHROMATIN CONDENSATION AND DNA TEXTURE

STUDENTS Jennifer Elkin *Biomedical Engineering*

ADVISORS Kris Dahl *Biomedical Engineering*

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

The objective of this project is to assess the level and organization of chromatin condensation within the nucleus using computational image analysis to study the "texture" of the fluorescent staining. This will be done by treating cells with fluorescent DNA-binding dyes, and observing the amount of condensation or decondensation of the DNA within the cell nucleus using a combination of fixed and live cell imaging.
By using fluorescent dyes with near stoichiometric binding to DNA, we will be able to use fluorescent intensity as a relative measure of chromatin condensation state whereby high intensity coincides with high DNA concentration and, thus, densely packed chromatin. We will confirm these effects using chemical treatments that globally condense and decondense chromatin. These will provide us with positive and negative controls to assess changes in chromatin condensation state and distribution in cells in response to stimuli, where global changes in gene expression often manifest themselves in large-scale changes in chromatin condensation and gene position. This work will provide important information related to genome reorganization during stem cell differentiation, stimulated changes in gene organization and expression, age-related changes in nuclear organization, and changes in chromatin organization corresponding with cancer metastasis.

DESIGN AND DEVELOPMENT OF THE FUEL CELL CAR WITH DATA ACQUISITION

STUDENTS Xavier Artache *Mechanical Engineering* | Maggie Chen *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Teresa Gelles *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Biomedical Engineering* | Danielle Maly *Chemical Engineering* | Patricia Pan *Biomedical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The ChemECar Data Acquisition and Fuel Cell Teams continued research in preparation for the April 2014 regional competition. The newly formed Data Acquisition team is focusing on the fabrication and implementation of computerized systems for the efficient and comprehensive collection of data. The data will then be analyzed to research factors that affect the performance of all ChemECar vehicles. The Fuel Cell team is a continuation of previous work and will work closely with Data Acquisition. Key research goals for the Fuel Cell team include working with the Data Acquisition team to gather more accurate data regarding the operation of the car and independently producing hydrogen to run the car.

DEVELOPING MICROFLUIDIC DEVICES FOR STUDYING AXONAL TRANSPORT IN NEURONS

STUDENT Yang Choo *Biomedical Engineering*

ADVISOR Ge Yang *Biomedical Engineering*

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

Studying axonal transport is important for understanding how neurons function and the mechanisms which drive neuronal disease. Microfluidic devices are especially useful for this purpose as they allow the experimenter to isolate individual axons and observe the effect of physical and chemical gradients. In this poster, a method for developing such devices is outlined, as well as preliminary experimental results from the developed masks.

DEVELOPMENT OF FIBRONECTIN NANOFIBER STRAIN SENSORS FOR MEASURING FORCES DURING EMBRYONIC MORPHOGENESIS

STUDENT Rahul-Anaadi Kurl *Biomedical Engineering*

ADVISORS Adam Feinberg *Biomedical Engineering* | Quentin Jallerat *Unknown*

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

Extra Cellular Matrix (ECM) is an important component of tissues that allows cells to interact with their environment. ECM plays a role in important cell processes such as adhesion, proliferation, and differentiation. It has recently become clear that mechanical forces also play a role in these processes, and need to be understood to be able to improve tissue engineering design. By using fibronectin (FN) nanofibers, an ECM protein important during embryonic morphogenesis, it is possible to measure the forces produced during morphogenesis. embryonic chicken skin will be used as a model because it continues to grow and differentiate in vitro after explantation. FN nanofibers will be embedded into embryonic chicken skin to act as strain sensors allowing the characterization of the forces present during morphogenesis.

DOSE-RESPONSE EFFECTS IN TREATMENT OF PARTIAL-THICKNESS BURNS WITH ANTI-TNF-HYALURONIC ACID CONJUGATES

STUDENT Evan Fisch *Biomedical Engineering*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:30 am

Acute inflammation resulting from burns spanning partial thickness of the dermis can lead to secondary necrosis. Unmediated burns can result in hypertrophic scarring, fluid shifts, sepsis, and multi-organ failure. Preventing secondary necrosis and preserving viable tissue is useful in progressive burn healing. The Washburn group has developed a topical burn treatment consisting of anti-TNF- conjugated to a high molecular weight hyaluronic acid (HA) polymer, in an effort to locally mediate the immune response in burns. The dose concentration and dose schedule of (anti-TNF-)-HA conjugate in the burn wounds of rats were investigated and compared to four control treatments. Tissue cross sections were stained for macrophage infiltration and vimentin to quantify the highly localized immune response. A three time dose of 100 µganti-TNF- conjugated to 3% HA had the best results with surface and peripheral macrophages of 2.63 ± 1.49 mm-2 (n=4) and 12.14 ± 2.91 mm-2 (n=4), respectively. Both counts were less than 55% the concentration than that of rats treated with saline, and significantly less than in rats treated with HA or HA + anti-TNF- (unconjugated). Free anti-TNF- was able to best inhibit macrophage infiltration peripherally as compared to HA alone, (anti-TNF-)-HA, HA + anti-TNF- (unconjugated), and saline, however it was much less effective at the surface. Additionally, vimentin was found at depths averaging 182.58 ± 62.97 (n=4) µminto the burn, 60% less than unconjugated antibody-polymer mixture, 63% less than free antibody, 68% less than HA alone, and 74% less than saline. These results indicate that with use of an antibody conjugated polymer, local mediation of tumor necrosis factor alpha (TNF-) looks promising in minimizing necrotic tissue post-burn.

INVESTIGATING THE USE OF PMMA-GRAFTED LIGNIN AS A BINDER FOR GRAPHENE NANOCOMPOSITES

STUDENT Brittany Couture *Biomedical Engineering*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Rangos 3 / 12-2:30 pm

Lignin is an aromatic biopolymer that is an important structural component of wood. Given its strong interfacial adhesion and excellent mechanical properties, we investigated using lignin grafted with poly(methyl methacrylate) as a binder for graphene nanocomposites. The purpose of this project was to determine if adding graphene nanocomposites as a filler to PMMA-grafted lignin would further improve upon the mechanical properties of the composite. Using graphene is desirable because it is lightweight, has good mechanical properties, and is electrically conductive. Increasing weight percentages of graphene were added, from 0% to 75%, and conductivity tests and tensile tests were performed on the samples. It was found that as the binder content goes down (amount of graphene increases), the strain, ultimate tensile strength, and Young's Moduli all decreased. Electrical conductivity increased as binder content decreased.

SOLAR STERILIZATION AND DISTILLATION UNIT FOR WATER FOR RESOURCE-POOR SETTINGS

STUDENTS Anshul Dhankher *Biomedical Engineering* | Gryphon Drake *Materials Science Engineering* | Jinie Haytko *Chemical Engineering* | Yatindra Patel *Biomedical Engineering* | Christine Sidoti *Biomedical Engineering*

Gihoon Song Design

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

In many resource-poor settings, there is not an effective way for hospitals to sterilize surgical equipment, leading to a higher prevalence of healthcare associated infections in developing countries as opposed to developed countries. In order to address this issue, we have designed a solar sterilization and distillation unit for local clinics and hospitals in resource-poor settings with the goals of sterilizing surgical equipment and producing potable water. In designing the device, cost of materials and operations was the biggest constraint, as we wanted to keep costs as low as possible, taking advantage of cheap materials, simple operations, and existing local infrastructure or resources. The design uses a system of mylar and solar pressure cookers as an autoclave to accomplish our goals.

SURFACE TENSION OF SURFACTANT MIXTURES IN CYSTIC FIBROSIS

STUDENT Caitlyn Dipietro *Biomedical Engineering*

ADVISOR Robert Tilton *Chemical Engineering*

ROOM/TIME Rangos 3 / 12-2:30 pm

Patients with cystic fibrosis have mucus deposits in their lungs that make it difficult for drugs to reach the infected area. Lowering the surface tension of the drug should allow the drug to flow across the mucus membrane by a difference in surface tension gradient. Currently, mixtures of two different surface tension lowering surfactants, Tyloxapol and Fluorosurfactant 3100, are being studied for this ability to allow spreading on mucus and possible synergies between the two different surfactants.

THE CHARACTERIZATION OF UV ABSORPTION IN PHOTOACTIVE COMPOSITES.

STUDENTS David DePoi *Computer Science* | Andrew Garibaldi *Mechanical Engineering* | Theodore Houlis *Biomedical Engineering* | Robert Isopi *Materials Science Engineering* | Gabriel Rodriguez *Materials Science Engineering* | Mariana Rodriguez *Materials Science Engineering*

ADVISORS Michael Bockstaller *Materials Science Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:00 am

This intention of this projection is to study the effects of different photo-active composites. We will begin this project by constructing our own x,y,z gantry from basic materials. Once it is constructed, we begin to mix metals with photoactive composites and attempt to curate the composite. Different combinations of certain composites will be mixed to see which outcome has the most effecient results.

THE EFFECTS OF MORINGA PROTEIN ON BACTERIAL WALLS

STUDENT Jaqueline Budz *Biomedical Engineering*
ADVISOR Robert Tilton *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

While there are many several differing antibiotics available today, no antibiotic specifically targets all bacteria. The discovery of a protein to break down bacterial walls may lead a universal antibiotic. This project focuses on the ability of the Moringa protein to break down lipid vesicles modeled to simulate bacterial walls, and the further discovery of its kinetic abilities.

USE OF CONDUCTIVITY DETECTOR TO DETECT AND SIZE SAMPLE SEPARATORS IN A MICROFLUIDIC SYSTEM

STUDENTS Robert Winkelman *Biomedical Engineering*
ADVISORS Alan Rosenbloom *ICES*
ROOM/TIME Rangos 3 / 12-2:30 pm

Current methods for the collection of fluid serial samples in human patients are inefficient and costly. Additionally, existing sample collection systems are mechanical and bulky. An alternative to current methods is to collect samples in continuous stream with sample separator. We demonstrate how sample separators can be sized using readings provided by a conductivity meter.

CHEMICAL ENGINEERING

BIO-FUEL FUEL CELL CAR WITH MANOMETER STOPPING MECHANISM

STUDENTS Joetsaroop Bagga *Chemical Engineering* | Anna Bandecca *Chemical Engineering* | Katia Bazzi *Chemical Engineering* | Jonathan Berman *Chemical Engineering* | Madison Calhoun *Chemical Engineering* | Alisa De Bruyn Kops *Chemical Engineering* | Isaiah Edmonds *Chemical Engineering* | Onyenma Enwereji *Chemical Engineering* | Eleanor Kwik *Chemical Engineering* | Rinko Maeshima *Chemical Engineering* | Brigid McGovern *Chemical Engineering* | Johnathan Roppo *Chemical Engineering* | Anand Sastry *Chemical Engineering* | Ryan Yeh *Chemical Engineering* | Dina Yerlan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering*
ADVISOR James Miller *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The following poster outlines the results of the research of a Chemical Engineering Car (ChemE Car) team. ChemE Car is an organization that works to design and construct shoebox-sized cars that start and stop based on chemical reactions which are then raced against the ChemE Car teams of other schools. This poster focuses on the specific design functions, testing procedures, and results for a bio-fuel fuel cell driving mechanism with a manometer-based stopping mechanism.

CHARACTERIZATION OF AN AFFINITY CHROMATOGRAPHY COLUMN MODIFIED WITH POLY(ETHYLENE GLYCOL)

STUDENT Annette Ko *Chemical Engineering*
ADVISOR Todd Przybycien *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Affinity chromatography is a powerful and widely used bioseparations technique that takes advantage of specific binding interactions in order to purify complex biological mixtures. One application of affinity chromatography, namely Protein A chromatography, utilizes immobilized Stapylococcal Protein A (SPA) ligands on porous media to target specific binding groups of IgG class monoclonal antibodies (MAbs). MAbs are a fast growing class of biopharmaceuticals and Protein A chromatography typically plays a central role in the downstream purification of the final product. Hence, possible improvements to the process are of great interest to the pharmaceutical industry. Previous studies have suggested that attachment of poly(ethylene glycol) (PEG) chains to SPA ligands improves selectivity by decreasing non-specific binding interactions and improves robustness by increasing ligand stability. However, it is possible that PEGylation of the ligands may adversely affect the mass transport within the porous media by restricting the average pore size for molecules to diffuse into. To determine the effect of PEGylation on SPA media, we characterized the porosities and pore size distribution of a pre-packed RepliGen CaptivA PriMAB column with a 20.7 kDa PEG modification using inverse size-exclusion chromatography (iSEC). The iSEC experiments were carried out using a series of dextran and PEG standards with molecular weights ranging between 180 and 1,000,000 Da. We determined the interstitial porosity of the column to be 0.37, the particle porosity to be 0.97, and the average pore diameter to be 35.1 nm. The interstitial and particle porosity of the PEGylated media were similar to literature values while the pore diameter was found to be significantly smaller than the literature value of 49.4 nm. These results suggest that PEGylation of the SPA media may hinder pore diffusion of molecules within the media.

CHARACTERIZING COLLOIDAL DEPOSITION AND ATTACHMENT TO PATTERNED POLYMERIC SURFACES USING MASS-BASED CHARACTERIZATION TECHNIQUES

STUDENT Sara Kelly *Chemical Engineering*
ADVISOR Meagan Mauter *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This project was aimed at developing and characterizing novel membrane materials for water desalination. These new membranes aim to reduce the energy consumption of desalination by limiting the rate at which bacteria and organic colloids attach to and foul the surface. My specific project worke on developing a protocol for spin coating QCM-D crystals with a variety of novel polymers and use these coated crystals to test foulant adhesion to the new polymer surfaces. I used a mass-based technique, quartz crystal microbalance with dissipation monitoring (QCM-D), to monitor attachment of organic particles to polymer membranes that varied in size, polymer alignment, and chemical composition. The first objective of the project was to create a protocol for spin coating the QCM-D crystals with the novel polymers being researched. These coatings mimicked the membranes used for desalinization. I attempted to optimize this spin coating protocol by varying parameters such as polymer solution composition, solution concentration, and spin speed to produce polymer coatings with thin uniform coatings. I then varied these parameters to create a coating with desired structure for use in water desalination. This protocol will be applied in my future research to develop structure-function

relationships between domain characteristics and the adsorption of a model foulant, bovine serum albumin (BSA). These tests are important in developing more efficient technologies for water desalinization, a central focus of the WE3 lab group, led by Dr. Meagan Mauter, where I perform my research.

CHIRAL SEPARATIONS WITH GOLD NANOPARTICLES

STUDENT William Records *Chemical Engineering*

ADVISOR Nisha Shukla *ICES*

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

Chemical synthesis of spherical gold nanoparticles using reduction of gold (III) chloride with sodium borohydrate. Coating with L-cysteine and D-cysteine ligands to impart chirality onto nanoparticles. Chiral separation of racemic form of common pharmaceutical, Verapamil, via enantiospecific adsorption onto the chiral gold nanoparticles.

DESIGN AND DEVELOPMENT OF THE COMBUSTION CAR

STUDENTS Xavier Artache *Mechanical Engineering* | Luke Bruce *Chemical Engineering* | Alexandra Cerny *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Peter Crampton *Chemical Engineering* | Dennis Guo *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Sanjana Padmanabhan *Chemical Engineering* | Alexander Peterson *Chemical Engineering* | Yijie Qiu *Chemical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Brian So *Chemical Engineering* | Nicole Tom *Chemical Engineering* | Nicholas Torres *Chemical Engineering* | Maximilien Vachon *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The purpose of this project is to design and develop a combustion car that runs on fermented bio-ethanol to compete in the AIChE Chemical Engineering Car competition. The Chemical Engineering Car Competition (ChemE Car) is a national, collegiate event based on the challenge of designing and building a model-sized car that is powered and timed by chemical reactions. The car must stop at a distance between 15 and 30 meters and carry a certain load of water. Both parameters are specified on the day of the competition. Designed to give student engineers the opportunity to apply their knowledge to a design project and gain research experience, the ChemE Car Competition also allows students to network and share their ideas across the nation. Our team developed a car using a hobby-grade internal combustion engine which is fueled by ethanol. The car uses automated speed control and has an on-board data acquisition system. The timing reaction is an iodine clock. The reaction solution changes color after a period of time dictated by the reactant concentrations, and the color change is detected to signal the car to stop.

DESIGN AND DEVELOPMENT OF THE FUEL CELL CAR WITH DATA ACQUISITION

STUDENTS Xavier Artache *Mechanical Engineering* | Maggie Chen *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Teresa Gelles *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Biomedical Engineering* | Danielle Maly *Chemical Engineering* | Patricia Pan *Biomedical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The ChemECar Data Acquisition and Fuel Cell Teams continued research in preparation for the April 2014 regional competition. The newly formed Data Acquisition team is focusing on the fabrication and implementation of computerized systems for the efficient and comprehensive collection of data. The data will then be analyzed to research factors that affect the performance of all ChemECar vehicles. The Fuel Cell team is a continuation of previous work and will work closely with Data Acquisition. Key research goals for the Fuel Cell team include working with the Data Acquisition team to gather more accurate data regarding the operation of the car and independently producing hydrogen to run the car.

DYNAMICS OF A SELF-DIFFUSIOPHORETIC PARTICLE IN SHEAR FLOW

STUDENT Alexandra Frankel *Chemical Engineering*
ADVISOR Aditya Khair *Chemical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:15 am

Colloidal particles can self-propel by self-generated solute concentration gradients. For instance, if a particle has an asymmetric surface reactivity, a solute concentration gradient will result that can propel the particle via self-diffusiophoresis. Theoretical analyses of the motion of such particles has mostly been considered in quiescent flow, where the concentration gradient is usually assumed to be dependent solely on diffusion of solute particles. In practical applications, self-propelled colloidal particles can be expected to reside in flowing fluids. Here, we examine the role of ambient flow on self-propulsion through self-diffusiophoresis by quantifying the dynamics of a model Janus particle in a simple shear flow. Importantly, the imposed flow can distort the self-generated solute concentration gradient. The extent of this distortion is quantied by the Peclet number, Pe, associated with the shear flow. Utilizing matched asymptotic analysis, we determine the concentration gradient surrounding a Janus particle in shear flow at small, but finite, Peclet number and resulting particle motion. In particular, when the symmetry axis of the particle is aligned with the imposed flow, the Janus particle experience O(Pe) cross streamline drift and O(Pe^3/2) reduction in velocity along the symmetry axis. We then analyze the planar trajectory of the Janus particle in shear. We find that the particle orbits around its initial position in the flow, oscillating across the streamlines and continuously moving forward in the direction of flow.

EFFECT OF VARYING THE NUMBER, LOCATION, AND VOLTAGE GATED CALCIUM CHANNELS ON SYNAPTIC FACILITATION IN THE FROG

STUDENT Sara Saheb Kashaf *Chemical Engineering*
ADVISOR Markus Dittrich *Pittsburgh Supercomputer Center*
ROOM/TIME Rangos 3 / 12-2:30 pm

Neurotransmitter release at the neuromuscular junction (NMJ) is responsible for transmitting signals from nerve fibers to muscle cells. When a neuron is stimulated in rapid succession, the amount of quantal release at the NMJ increases, a phenomenon known as synaptic facilitation.

Computational methods provide insights on the NMJ active zones that can't be obtained through experimentation. I have used a spatially realistic computational model of an entire active zone, where model parameters have been assigned using experimental data. The calcium binding underlying neurotransmitter release was simulated using Monte Carlo simulation methods.

In this project, I have investigated the effect of varying the number and location of voltage gated calcium channels on synaptic facilitation in the frog. I have measured synaptic facilitation by calculating the paired pulse facilitation (PPF) as the ratio of postsynaptic vesicle release to the presynaptic vesicle release.

ENANTIOSEPARATION OF CHIRAL DRUGS USING CHIRAL GOLD NANOPARTICLES

STUDENT Darwin Yang *Chemical Engineering*

ADVISOR Nisha Shukla *ICES*

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

Gold nanoparticles modified with D- and L-cysteine become chiral and are capable of selectively adsorbing one enantiomer of a chiral probe molecule such as propylene oxide (PO). Previous experiments have shown that PO interaction with nanoparticles causes a change in its optical rotation. As such, addition of racemic PO to D- or L-cysteine coated nanoparticles will cause a finite change in optical rotation that does not occur without the presence of chiral nanoparticles. Hence, polarimetry can be used to quantify the degree of separation of the probe molecule. This concept will be applied to pharmaceutical products in order to determine whether chiral separation of drugs can be accomplished using a chiral gold nanoparticle approach.

ENGINEERING SOLUTIONS IN RURAL HONDURAS

STUDENTS Neil Carleton *Chemical Engineering* | Waritha Chiarnpattanodo *Chemical Engineering* | Korey Haug *Mechanical Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Taylor Hughes *Mechanical Engineering* | Hyejin Jang *Chemical Engineering* | Allen Kim *Mechanical Engineering* | Laiyee Kwan *Chemical Engineering* | Yingqiu Lee *Mechanical Engineering* | Esteban Pacheco *Mechanical Engineering* | Holly Stein *Mechanical Engineering* | David Vasquez Chemical Engineering | Anna Zhang *Chemical Engineering* | Sijia Zhang *Electrical & Computer Engineering*

ADVISOR Jason D'Antonio *Computational Biology*

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

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

METAL CLAY PROPERTIES AND PERFORMANCE IN CLAY EXTRUSION ADDITIVE MANUFACTURING

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

ADVISOR Eric Brockmeyer *Architecture*

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

When a part needs to be fabricated in forms unsuitable for traditional subtractive manufacturing companies and individuals have increasingly turned to additive manufacturing (3D printing) to fill their design needs. Additive manufacturing in metal has traditionally been a bulky, expensive, industrial level process only suitable for high price applications. Most metal printers are based on either printing a part in weaker materials such as sand and wax for casting, or sintering metal powders using electrons and lasers which all require very specialized equipment. In order to bring the price of 3D printing in metal down to consumer grade materials we built a 3D printer using existing printer and paste extruder designs to print in metal clay, a mixture of metal particles in a binder which can be sintered using household tools. Our aim is to obtain data on what properties metal clay has when printed and further our understanding of where this technology falls on the spectrum of commercially available technologies. Our findings advance the understanding of how viable metal clay is as a method of additively manufacturing parts on a lower budget.

PLASMID PURIFICATION USING AQUEOUS TWO-PHASE SYSTEMS AND ANALYSIS VIA HYDROPHOBIC INTERACTION CHROMATOGRAPHY

STUDENT Eamon Cullinane *Chemical Engineering*

ADVISORS Michael Domach *Chemical Engineering* | Todd Przybycien *Biomedical Engineering* | James Schneider *Chemical Engineering*

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

Advancements in molecular non—viral gene therapy has brought with it the demand for purified plasmid DNA (pDNA). Insitutions and organizations that conduct work on gene therapy and DNA vaccination require:

-Purified DNA
-90% or more in the supercoiled isoform
-A scalable, cost-effective, and efficient process

Current methods for down stream isolation of pDNA, such as chromatography, are limited with respect to scalability, cost effectiveness, and efficiency.

This research looks to provide a viable solution to this problem using aqueous two phase systems(ATPS). ATPS has the potential to become a feasible large-scale alternative to current pDNA purification processes. Utilizing a thermodynamically favorable setup of a high salt and polyethylene glycol (PEG) system, two phases are formed in attempts to isolate the pDNA to one phase and other cell biomolecules to the other phase. This system is not only economically scalable, but non-toxic for biomolecules.

SEPARATION OF RACEMIC 2-BUTANOL ON ENANTIOMERICALLY PURE CYSTEINE-COATED GOLD NANOPARTICLES

STUDENT Nathan Khosla *Chemical Engineering*

ADVISOR Nisha Shukla *ICES*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:30 am

The creation of noble metal nanoparticles, specifically gold, has been researched in great detail over the past years. One of the features of these gold nanoparticles is that the surfaces can be coated with an enantiomerically pure form of Cysteine, making the nanoparticle essentially chiral and thus enantioselective. These coated nanoparticles have been shown to separate, via adsorbtion, propylene oxide.

However, it has yet to be established whether this enantioselctivity extends to other molecules, such as 2-butanol. By setting up a similar experiment with 2-butanol, it can be established whether this sorting extends to other chiral molecules. Additionally, by using another methodology of separation, the results can be analyzed using a much more simple and elegant mathmatical model that eliminates problems that were encountered when applying previously published models to our data.

SOLAR STERILIZATION AND DISTILLATION UNIT FOR WATER FOR RESOURCE-POOR SETTINGS

STUDENTS Anshul Dhankher *Biomedical Engineering* | Gryphon Drake *Materials Science Engineering* | Jinie Haytko *Chemical Engineering* | Yatindra Patel *Biomedical Engineering* | Christine Sidoti *Biomedical Engineering* | Gihoon Song *Design*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

In many resource-poor settings, there is not an effective way for hospitals to sterilize surgical equipment, leading to a higher prevalence of healthcare associated infections in developing countries as opposed to developed countries. In order to address this issue, we have designed a solar sterilization and distillation unit for local clinics and hospitals in resource-poor settings with the goals of sterilizing surgical equipment and producing potable water. In designing the device, cost of materials and operations was the biggest constraint, as we wanted to keep costs as low as possible, taking advantage of cheap materials, simple operations, and existing local infrastructure or resources.

The design uses a system of mylar and solar pressure cookers as an autoclave to accomplish our goals.

TABLET BASED TOCODYNAMOMETER

STUDENTS Whitney Aaronson *Human Computer Interaction Inst.* | Dale Best *Electrical & Computer Engineering* | Arnob Mallick *Electrical & Computer Engineering* | Sara Saheb Kashaf *Chemical Engineering* | Matthew Sarett *Electrical & Computer Engineering* | Eric Wise *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

A tocodynamometer is a medical device used to measure the frequency and duration of uterine contractions. It is used quite often in hospitals to monitor the condition of a woman's pregnancy. Typically, a tocodynamometer is used at around 39 weeks into a woman's pregnancy. It uses a pressure sensing button that must be strapped tightly to the patient by the nurse or other assistant. This button sends a signal to a box that processes the stimulus. It can output plots and analyses of the contractions.

Another component of pregnancy care is a fetal heart rate monitor. This is another device that is generally confined to hospitals. Specialized equipment must be used due to the inherent challenges of filtering the relatively small fetal heart rate signal from the more prominent electrical signals present in a pregnant woman. Consideration of this device is important because the fetal heart rate monitor is often used in conjunction with a toco to help doctors understand the state of the pregnancy and make important decisions.

Both tocodynamometers and the fetal heart rate monitors suffer from usability issues. For the toco, the patient is dependent on a nurse to strap on the button sensor in exactly the correct position. The patients must remain still to ensure that the reading is based on contractions and not on any shifting of position that may occur while the patient is in pain. Both devices are bulky (~1' x 1' x 0.5'), expensive (~$10,000), and difficult to use, meaning that both are confined to specialized hospitals. Many low resource hospitals do not have tocos and, in general, the toco device is not portable or convenient.

Our goal is to create an Android application and small embedded system to take the place of both of these devices. We will use electrodes to read an electrical signal that may represent heart rate or muscle contractions. The Muscle Sensor v3 takes in an analog value (voltage) from the electrodes, amplifies it, and passes it via a wire to the Arduino Uno. The Arduino Uno converts the analog signal to a digital value that it packages and sends over a serial connection to the Google Nexus 7 tablet via a USB Adapter. The Google Nexus 7 tablet filters the input signal, plots the data, and calculates useful metrics.

THE ADSORPTION OF POLYETHYLENE OXIDE ONTO SILICA SURFACES IN THE PRESENCE OF HOFMEISTER SALTS

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

The adsorption of star and linear polyethylene oxide (PEO) onto silica surfaces was investigated via use of a quartz crystal microbalance with dissipation (QCM-D). This was done in the presence of various Hofmeister salts: the kosmotropes Na3PO4 and Na2CO3, the chaotrope NaSCN, and the middle point of the Hofmeister series NaCl. Adsorption was found to be strongly affected by the kosmotropic salts. Even very low concentrations, on the order of 1mM, prevented adsorption onto the silica surface. At similar concentrations, the chaotrope NaSCN had a much less pronounced effect, decreasing adsorption but not preventing it entirely. NaCl did not have a noticeable effect on adsorption.

THE DEPENDENCIES OF L-CYS AND SUBSEQUENT AU NANOPARTICLE CHIRALITY ON TIME AND PH

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

In the search for stability of chiral Au Nanoparticles, the oxidation of L-Cystine to L-Cystiene has become a major issue. This oxidation reaction is affected not only by time, but also by the pH, which results in different magnitudes of optical rotation, hence, varying levels of chirality.

ZETA POTENTIAL DETERMINATION FOR POROUS SAMPLES

STUDENT Joseph Whitmore *Chemical Engineering*
ADVISOR Paul Sides *Chemical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Existing methods using the ZetaSpin have proven ineffective in determining zeta potential for samples made of porous media. This research attempted to create a novel apparatus that will enable testing for such. This, in turn, will allow an update of theory to permit porous samples.

CIVIL AND ENVIRONMENTAL ENGINEERING

EMERALD VIEW PARK BOARDWALK CONSTRUCTION PROJECT

STUDENTS Miriam Hegglin *Civil and Environmental Engineering* | Eileen Wu *Materials Science Engineering*
ADVISOR Kelvin Gregory *Civil and Environmental Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

For many decades, Mount Washington has been a collection of divided parks with no pedestrian access between green spaces. Emerald View Park (EVP) is one such area has been used as a dump site and illegal hunting ground for many years. In the past few years, the City of Pittsburgh and Mount Washington staff and sponsors have started to clean up the various park sites and construct trails to connect the park in its entirety. Last year, the CMU Engineers Without Borders (EWB) student chapter adopted Emerald View Park and committed to taking over the clean-up efforts. The focus of this research was to determine the optimal materials, design, and construction methods needed to successfully construct a safe and sturdy boardwalk for pedestrians. The constraints faced included the cost, environmental impact, and availability of materials, size restrictions, soil conditions, expected loads, and expected water level rise. Our research included collecting soil samples, assessing current and past site conditions, taking detailed measurements, creating CAD drawings of possible designs, constructing Gantt chart to plan out the construction schedule, and creating a proposed budget for the project. The purpose of the boardwalk is to ultimately connect two existing trails over a wetland area and make Emerald View Park a safe and welcoming site for all Pittsburgh residents

TRADE-OFF ANALYSIS BETWEEN ENERGY EFFICIENT LIGHTING TECHNOLOGIES

STUDENT Miriam Hegglin *Civil and Environmental Engineering*
ADVISORS Paulina Jaramillo *Engineering and Public Policy* | Deanna Matthews *Engineering and Public Policy*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:00 am

With the increasing energy crisis worldwide, many communities are focusing on energy efficiency programs to reduce their energy consumption and environmental impact. Residential lighting is a main area of focus as it contributes to 12% of the national energy demand in the US and over 20% in developing countries. The United States, Colombia, and most Latin American countries are starting to implement incandescent light bulb phase out policies in favor of more energy efficient lighting technologies including compact fluorescent lamps (CFL) and light emitting diodes (LED). Using data from government and private institutions, the specific energy consumption, cost, health, and environmental trade-offs of switching from incandescent to CFL and LED lighting in Latin America and the United States was analyzed. CFLs and LEDs tend to be more expensive than traditional lighting sources and CFLs can in some cases increase mercury emissions. However, both CFL and LED replacements can result in overall reduced energy consumption, carbon dioxide emissions, and increased cost savings over their lifetime. Since the United States uses a larger percentage of fossil fuel sources for electricity generation, the environmental benefits of switching to energy efficient lighting is even more significant than in most developing Latin American countries. Latin American countries such as Colombia tend to use large hydro power and less fossil fuel sources to generate electricity.

UNDERSTANDING THE IMPACT OF TECHNOLOGIES ON INTERNATIONAL COLLABORATION IN CONSTRUCTION MANAGEMENT

STUDENTS Rachel Browne *Civil and Environmental Engineering* | Michelle Couste *Civil and Environmental Engineering*
ADVISOR Burcu Akinci *Civil and Environmental Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

International construction is significant and continually growing despite the economic recession in many countries and as a result many companies are doing international work. As a result, multi-cultural teams are becoming the norm in construction projects, and being able to work across cultures is the key to success. This research will be done on a sample of students working in groups composed of students from several countries on construction management projects for the ICCM course in Spring 2014. Students from Carnegie Mellon University, Technion University in Israel, Middle East Technical University in Turkey, and Universidade Federal Do Rio Grande Do Sul in Brazil will be involved in these projects. The study looks to evaluate the benefits and drawbacks associated with various forms of international communication, and to observe their effects on construction management collaboration.

ELECTRICAL & COMPUTER ENGINEERING

ARDUCARD: AN OPEN SOURCE CARD-SIZED E-PAPER DEVELOPMENT DEVICE

STUDENT Edward Shin *Electrical & Computer Engineering*
ADVISOR James C. Hoe *Electrical & Computer Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

This is an engineering project whose goal is to create an open-source development board for the Arduino platform and e-paper displays. It aims to create a small, credit card sized electronics board that has the same e-paper display technology as e-book readers such as the Amazon Kindle. The audience for this device is Electrical Engineers and electronics enthusiasts/hobbyists, who could use this device to learn how to develop using Arduino and e-paper displays, as well as program it for their own use. Because the design is open source, they may also modify this design to use as the basis for their own projects.

BINSPACE

STUDENTS Siddharth Dedhia *Electrical & Computer Engineering* | Min Kyung Kim *Design* | Yong Joon Kwon *Electrical & Computer Engineering* | Junho Lee *Design* | Joseph Oak *Design* | Zachary Rousselle *Electrical & Computer Engineering*
ADVISOR Pei Zhang *Electrical & Computer Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Mobile application service system that provides real time feedback of available seats in libraries using sensor technology.

BIO-FUEL FUEL CELL CAR WITH MANOMETER STOPPING MECHANISM

STUDENTS Joetsaroop Bagga *Chemical Engineering* | Anna Bandecca *Chemical Engineering* | Katia Bazzi *Chemical Engineering* | Jonathan Berman *Chemical Engineering* | Madison Calhoun *Chemical Engineering* | Alisa De Bruyn Kops *Chemical Engineering* | Isaiah Edmonds *Chemical Engineering* | Onyenma Enwereji *Chemical Engineering* | Eleanor Kwik *Chemical Engineering* | Rinko Maeshima *Chemical Engineering* | Brigid McGovern *Chemical Engineering* | Johnathan Roppo *Chemical Engineering* | Anand Sastry *Chemical Engineering* | Ryan Yeh *Chemical Engineering* | Dina Yerlan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The following poster outlines the results of the research of a Chemical Engineering Car (ChemE Car) team. ChemE Car is an organization that works to design and construct shoebox-sized cars that start and stop based on chemical reactions which are then raced against the ChemE Car teams of other schools. This poster focuses on the specific design functions, testing procedures, and results for a bio-fuel fuel cell driving mechanism with a manometer-based stopping mechanism.

BRIDGE INSPECTION

STUDENT Wei Wang *Electrical & Computer Engineering*

ADVISOR Sebastian Scherer *Robotics Institute*

ROOM/TIME Rangos 3 / 12-2:30 pm

The aim of this project is to construct high-resolution depth image from low-resolution depth image and high-resolution color image. One common problem of the field sensors that are currently being used is that these sensors are very limited to resolution. This project wants to find a way to transcend the limitations of the optical imaging by using image-processing algorithms. The basic assumption of the algorithms we are currently working on is that same textures have same color in the color image. So given a high-resolution image, we can extract edge and other information that are missing in the low-resolution depth map. By doing so, we can reconstruct high-resolution depth image. Currently, the two algorithms we are using are bilateral filter and Markov random field. We first lower the image noise by Markov random field algorithm and then reconstruct the high-resolution depth image by bilateral filter.

BUTLEBOT

STUDENTS Zachary Greenberg *Mathematics* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*

ADVISOR Michael Erdmann *Computer Science*

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

Our overarching objective is to develop the means for a personal robot to perform a wide spectrum of manipulation based tasks around the home. Personal robotics has an immediate need in supporting and assisting the elderly and disabled with household tasks that could be potentially hazardous or difficult. However current personal robotics has failed to address this need. On one end of the spectrum, highly functional personal robots, like Herb and Pr2, are restrained heavily by cost and are relegated to the realm of academia. On the other end, lower cost personal robots sacrifice functionality to the point where they are luxury items and novelties instead of fulfilling a concrete role in the consumer's life. Our goal is to develop a personal robot that has advanced functionality while maintaining low costs. To achieve this we will start with developing a manipulation algorithm that is applicable to a large variety of handheld objects. The long term goal

will be to contribute to the field of personal robotics by developing algorithms to perform robust manipulations of a wide variety, given low performance hardware and computing power. We will demonstrate the set of manipulation and vision algorithms we have developed thus far to this ends.

COMPRESSIVE DEPTH IMAGING IN NON-VISIBLE WAVELENGTHS

STUDENT Nikhil Bikhchandani *Electrical & Computer Engineering*
ADVISOR Aswin Sankaranarayanan *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

There are many applications for range imaging (or depth sensing) in infra-red. The most notable among them are imaging through smoke and fog and sub-dermal (below skin) imaging — in all of these, there are specific wavelengths of light that penetrate the scattering medium significantly better than visible wavelengths. However, obtaining high-resolution cameras for such wavelengths is prohibitively expensive mainly due to the cost of the sensor.

In this project, we develop a novel compressive imaging architecture for depth imaging in non-visible wavelength that costs a fraction of the conventional designs. Our system uses multiple broadband photodetectors and a single projector as a light source to create a photometric stereo that is capable of depth imaging. Photodetectors come in a variety of operating wavelengths and the LED in the projector can be replaced with one in a different spectrum to create a truly flexible depth imaging architecture. This project takes advantage of compressed sensing techniques to enable a real time implementation by reducing the number of measurements needed to generate a 3D image.

CONSOLIDATE: USING NEAR FIELD COMMUNICATIONS TO MERGE SMARTPHONES AND ID CARDS

STUDENT Chris Atkeson *Robotics Institute*
ADVISOR Clayton Ritcher *Electrical & Computer Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This project aims to investigate a potential way of making ID cards more efficient, convenient, powerful. This will be accomplished through NFC, or Near Field Communications, which will allow for ID card information to be stored on a smartphone. The phone could then essentially replace the ID card. This consolidates the phone and ID card, and allows users to take advantage of smartphone features, like password protection to block access to their ID information.

The basic implementation of the system is in two parts. First, there will be a computer, which is similar to the kiosks currently on campus that update ID cards, which will read the data from an ID through a magnetic card reader. The computer will send this data to the NFC reader/writer to be transferred to a NFC-equipped phone. The second part, will then allow the user to go to NFC reader/writers and use their phone to send the ID card information back. Essentially logging in, paying for meals, or doing any task that the ID card information would allow them to do.

CONTINUOUS WAVE FREQUENCY MODULATED RADAR PULSE GENERATION AND REAL-TIME DIGITAL SIGNAL PROCESSING USING A FIELD PROGRAMMABLE GATE ARRAY

STUDENT Julian Binder *Electrical & Computer Engineering*
ADVISOR William Nace *Electrical & Computer Engineering*
ROOM/TIME Pake / 12:20 pm

Short range low power radar is a key area of research in automotive safety technology. Traditional radar requires significant amounts of energy be sent over large antennas demanding vast computational resources in order to process the data in real-time. These types of radar operate at frequencies that are restricted by the FCC and require special licensure in order for use. Existing radar is also not effective at measuring short ranges. I propose to create a continuous wave frequency modulated (CWFM) radar processing unit that is compatible with radar systems operating on the ISM band. Such a system is able to measure short distances with significantly higher accuracy using far fewer computational resources than traditional radar systems and is not subject to FCC oversight.

DEPOSITING METAL ONTO COMPOSITE AND POLYMER STRUCTURES FOR AUTOMOTIVE APPLICATIONS

STUDENTS Joshua Kubiak *Materials Science Engineering* | Christi Martin *Electrical & Computer Engineering* | Alisha Mayor *Electrical & Computer Engineering*
ADVISOR Robert Heard *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

As the effects of global warming become more apparent, and energy resources become limited, the need for more efficient modes of transportation increases. By reducing the weight of crucial automotive components without compromising their structural integrity, lighter and more energy efficient cars can be created. A method of reducing weight that has not been fully investigated is the creation of parts out of light weight composites and plastics that are electroplated in a thin layer of strong metal. The goal of this project is to implement metal-coated, composite suspension links on the Carnegie Mellon Racing (CMR) vehicle and to investigate the possibility of creating structural members, such as pedal-arms and wheel centers, out of 3D-printed plastic that has been coated in metal. Computational analysis, preliminary experimentation, and final validation will be performed for the above mentioned components, and the information collected throughout the process will be used to select additional components that are suitable for future replacement using metal-coated composites or plastics.

DESIGN AND DEVELOPMENT OF THE COMBUSTION CAR

STUDENTS Xavier Artache *Mechanical Engineering* | Luke Bruce *Chemical Engineering* | Alexandra Cerny *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Peter Crampton *Chemical Engineering* | Dennis Guo *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Sanjana Padmanabhan *Chemical Engineering* | Alexander Peterson *Chemical Engineering* | Yijie Qiu *Chemical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Brian So *Chemical Engineering* | Nicole Tom *Chemical Engineering* | Nicholas Torres *Chemical Engineering* | Maximilien Vachon *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The purpose of this project is to design and develop a combustion car that runs on fermented bio-ethanol to compete in the AIChE Chemical Engineering Car competition. The Chemical Engineering Car Competition (ChemE Car) is a national, collegiate event based on the challenge of designing and building a model-sized car that is powered and timed by chemical reactions. The car must stop at a distance between 15 and 30 meters and carry a certain load of water. Both parameters are specified on the day of the competition. Designed to give student engineers the opportunity to apply their knowledge to a design project and gain research experience, the ChemE Car Competition also allows students to network and share their ideas across the nation. Our team developed a car using a hobby-grade internal combustion engine which is fueled by ethanol. The car uses automated speed control and has an on-board data acquisition system. The timing reaction is an iodine clock. The reaction solution changes color after a period of time dictated by the reactant concentrations, and the color change is detected to signal the car to stop.

DESIGN AND DEVELOPMENT OF THE FUEL CELL CAR WITH DATA ACQUISITION

STUDENTS Xavier Artache *Mechanical Engineering* | Maggie Chen *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Teresa Gelles *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Biomedical Engineering* | Danielle Maly *Chemical Engineering* | Patricia Pan *Biomedical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The ChemECar Data Acquisition and Fuel Cell Teams continued research in preparation for the April 2014 regional competition. The newly formed Data Acquisition team is focusing on the fabrication and implementation of computerized systems for the efficient and comprehensive collection of data. The data will then be analyzed to research factors that affect the performance of all ChemECar vehicles. The Fuel Cell team is a continuation of previous work and will work closely with Data Acquisition. Key research goals for the Fuel Cell team include working with the Data Acquisition team to gather more accurate data regarding the operation of the car and independently producing hydrogen to run the car.

DEVELOPMENT OF A UNIFIED FRAMEWORK FOR CYBER PHYSICAL SYSTEMS

STUDENT Arushi Chawla *Electrical & Computer Engineering*
ADVISOR Gabriela Hug *Electrical & Computer Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The focus of this research project is the development of a unified framework that can be used to universally monitor and control the information flow within Cyber Physical Systems. Simply put, a cyber-physical system or CPS, is an integration of computation, networking and physical processes associated with a system. Examples of CPS's include transportation networks, distributed robotics, etc. For the purpose of this research, the focus would be on the electric power systems as well as the water supply systems of North America.

Over the years, communication and information technologies have taken an increasingly important role in monitoring and controlling such systems. While individual CPS's are being studied extensively, there is a need to have a unified framework that can be applied universally to a variety of CPS's to model interactions between the cyber and the physical layers of a system, formulate interference and control strategies and guarantee secure information flow within a network.

Returning to the systems under consideration, it is crucial to mention that the power systems of the future will integrate distributed and flexible loads and demands. The deployment and integration of information and communication is considered to be a key component that enables distributed management and monitoring, i.e., the Smart Grid. Similarly, a unified network needs to be employed to address the issues faced by the water supply systems. For example, as of today, the drinking water infrastructure of North America is facing multiple problems across the spectrum of management, engineering, security, policy and finance. Cyber-infrastructure systems offer the potential to improve these management decisions, increase performance levels, reduce costs and enhance security.

The first step towards designing such a unified framework is to determine whether it is possible to draw analogies among multiple physical systems, and if so, then what kind of common modeling framework can be universally applied to the said physical systems. These are the underlying questions which this research project hopes to address. The goal of my research would be to highlight the common properties between the electric power systems and water supply systems in North America, and then develop a framework that can be applied to both of them in order to ensure better performance.

ENABLING A PR2 ROBOT TO TALK AND LISTEN

STUDENT Vishalsai Daswani *Electrical & Computer Engineering*
ADVISOR Maxim Likhachev *Robotics Institute*
ROOM/TIME Rangos 3 / 12-2:30 pm

The PR2 robot (a human-sized robot with two arms) currently does not interact verbally. The project was to get it to listen and interact verbally, utilizing its speakers and microphone, and listen and react to various commands.

ENGINEERING SOLUTIONS IN RURAL HONDURAS

STUDENTS Neil Carleton *Chemical Engineering* | Waritha Chiarnpattanodom *Chemical Engineering* | Korey Haug *Mechanical Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Taylor Hughes *Mechanical Engineering* | Hyejin Jang *Chemical Engineering* | Allen Kim *Mechanical Engineering* | Laiyee Kwan *Chemical Engineering* | Yingqiu Lee *Mechanical Engineering* | Esteban Pacheco *Mechanical Engineering* | Holly Stein *Mechanical Engineering* | David Vasquez *Chemical Engineering* | Anna Zhang *Chemical Engineering* | Sijia Zhang *Electrical & Computer Engineering*

ADVISOR Jason D'Antonio *Computational Biology*

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

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

FINDING AN EFFECTIVE WAY TO PROVIDE A SPATIAL REPRESENTATION OF THE SURROUNDING ENVIRONMENT TO THE VISUALLY IMPAIRED

STUDENTS Vivek Nair *Electrical & Computer Engineering* | Clayton Ritcher *Electrical & Computer Engineering* | Nora Shoemaker *Electrical & Computer Engineering*

ADVISORS Mary Bernardine Dias *Robotics Institute*

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

This project plans to find an effective way to provide the visually impaired with spatial feedback of their surroundings by expanding upon past efforts from other researchers, as well as addressing issues that these other efforts faced, including problems with responsiveness, portability, and ease of use. The project will consist of four to six head or body mounted ultrasonic range finders. The data these range finders collect about the surroundings will be translated into different types of haptic or audible feedback, and each type of feedback will be tested for effectiveness.

LITHIUM ION BATTERIES IN ELECTRIC RACING VEHICLE APPLICATIONS

STUDENTS Preetam Amancharla *Electrical & Computer Engineering* | Evans Hauser *Electrical & Computer Engineering* | Omar Skalli *Electrical & Computer Engineering*

ADVISOR Tamal Mukherjee *Electrical & Computer Engineering*

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

Electric vehicles are increasingly more prominent in the Automotive Industry, with significant concern over battery system design. While they have benefited from the recent advances in battery technologies driven by consumer electronics, much research has yet to be conducted on the configuration and monitoring methods to optimize efficiency under varying loads, temperatures, and conditions. We will be using rechargeable lithium ion batteries as they have the highest energy density of any cell commercially available. The goal of this project is to test individual cells, design and build a lithium ion cell assembly coupled with an accumulator management system, and evaluate the net performance under racing conditions. The project will also serve as a well-documented design and basis for future iterations, complete with detailed post construction analysis. Applications of this research include use for automotive racing teams, and the electric vehicle industry in general.

METAL CLAY PROPERTIES AND PERFORMANCE IN CLAY EXTRUSION ADDITIVE MANUFACTURING

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

ADVISOR Eric Brockmeyer *Architecture*

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

When a part needs to be fabricated in forms unsuitable for traditional subtractive manufacturing companies and individuals have increasingly turned to additive manufacturing (3D printing) to fill their design needs. Additive manufacturing in metal has traditionally been a bulky, expensive, industrial level process only suitable for high price applications. Most metal printers are based on either printing a part in weaker materials such as sand and wax for casting, or sintering metal powders using electrons and lasers which all require very specialized equipment. In order to bring the price of 3D printing in metal down to consumer grade materials we built a 3D printer using existing printer and paste extruder designs to print in metal clay, a mixture of metal particles in a binder which can be sintered using household tools. Our aim is to obtain data on what properties metal clay has when printed and further our understanding of where this technology falls on the spectrum of commercially available technologies. Our findings advance the understanding of how viable metal clay is as a method of additively manufacturing parts on a lower budget.

NBTI AND PBTI MODELLING FOR FINFET TECHNOLOGY

STUDENT Niharika Singh *Electrical & Computer Engineering*

ADVISOR Diana Marculescu *Electrical & Computer Engineering*

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

Negative Bias Temperature Instability (NBTI), a PMOS aging phenomenon and Positive Bias Temperature Instability (PBTI), its NMOS counterpart, cause significant loss on circuit performance and lifetime. Aggressive technology scaling trends, such as thinner gate oxides without proportional downscaling of supply voltages, necessitate a design optimization flow considering BTI effects at the early stages.I'll be looking at modelling these effects for the newest FinFET transistors and seeing how these degrade over their lifetime.

PARTNERSHIPS AND MODEL-BUILDING FOR SUSTAINABLE KOSOVO

STUDENT Rudina Morina *Electrical & Computer Engineering*

ADVISOR Paulina Jaramillo *Engineering and Public Policy*

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

Kosovo, a western Balkan country, rich in lignite, relies primarily on this source for its energetic sector development. Geological lignite reserves have been estimated to be 12.5 billion [14, 17, 18] tons. Two lignite mines, Bardh and Mirash and two lignite-fired power plants, "Kosovo A" and "Kosovo B", are located in Obiliq municipality, 3 km from Prishtina, the capital. The performance of these existing power plants, built in 1962 ("Kosovo A") and 1984 ("Kosovo B"), due to degradation, underinvestment, and lack of maintenance, is not in compliance with EU laws and regulations. The results obtained from the constant monitoring of air quality in Obiliq and Prishtina municipality [16] show that the air pollution in these areas still exceeds the guideline limit values determined by World Health Organization by a large margin [20]. Furthermore, the population density surrounding these power plants is 600 persons/km2 [4] and lies only 3 km away from Prishtina, a city of

300,000 inhabitants. Comparatively, in Greece, one of Europe's major lignite producers, the population density surrounding the power plant complex is only 50 persons/km2 and lies 8 km from a nearby town of only 8,000 inhabitants [4]. Thus the effect of the pollution on adjacent population presents an issue of great concern.

Today Kosovo faces critical energy and development choices that will impact the energy supply available to meet basic needs, and provide for economic growth. Currently Kosovo is considering the construction of a new coal power plant to fulfill the growing needs for new energy resources. However, aware of the current high air pollution and its health effects on both the inhabitants and power plant employees, a research group from Berkley University, lead by professor Daniel Kammen will be assessing opportunities for aggressive energy efficiency in Kosovo this summer so that an energy plan/model that fulfill the energy needs through a combination of renewable energy resources and fossil fuels can be devised. This assessment is an analytic treatment of the energy options that exist today and that can be created through investigation of new energy efficiency, renewable energy, and the wise use of fossil fuel resources. I have been invited to join this research group over the summer. I will specifically work on developing a model for biomass potential in Kosovo. This will involve devising a plan for a Kosovar biofuel industry and it will be heavily focused on interviews with agricultural, forestry, and other entrepreneurs. The modeling of biofuel and other renewable energy resources will begin with the HOMER modeling software.

PASSWORD RESEARCH

STUDENT Phillip Huh *Electrical & Computer Engineering*
ADVISOR Ljudevit Bauer *Electrical & Computer Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Although they are often insecure and inconvenient, passwords aren't quite about to disappear. This project's goal is to help users create passwords that are easy for them to remember, but hard for attackers to guess. We work towards this goal by trying to deeply understand the password-creation process and the security of the resulting passwords, including by investigating the effects of password-composition policies and password meters on the security and usability of passwords, and by studying metrics for quantifying password strength.

PROCESS-AWARE DESIGN FOR MANUFACTURABILITY (DFM) OF NANOSCALE IC'S

STUDENT Zachary Rousselle *Electrical & Computer Engineering*
ADVISOR Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

This project involves computational work within the ECE and ME departments. In ECE, computer-aided design (CAD) engineers build integrated circuit (IC) designs without knowledge of the semiconductor manufacturing processes (designed by mechanical engineers) that cause topographical variations on the chip surface. In collaboration with the Carnegie Mellon Center for Silicon Systems Implementation (CSSI), this work aims to make them "aware".

SKYLIGHT SURVEY AVIONICS

STUDENTS Neal Bhasin *Computer Science* | Edward Nolan *Electrical & Computer Engineering* | Brent Strysko *Electrical & Computer Engineering*

ADVISOR William Whittaker *Robotics Institute*

ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Recently, pits known as skylights have been observed on the surface of the moon. These pits are hypothesized to be entries to cave networks beneath the lunar surface that could one day provide protection for human housing. Our team's goal is to design and implement the electrical components of a sensor package that could map these geographic features. This sensor package would observe skylights from overhead and use collected camera data to create a 3D model of the features.

TABLET BASED TOCODYNAMOMETER

STUDENTS Whitney Aaronson *Human Computer Interaction Inst.* | Dale Best *Electrical & Computer Engineering* | Arnob Mallick *Electrical & Computer Engineering* | Sara Saheb Kashaf *Chemical Engineering* | Matthew Sarett *Electrical & Computer Engineering* | Eric Wise *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

A tocodynamometer is a medical device used to measure the frequency and duration of uterine contractions. It is used quite often in hospitals to monitor the condition of a woman's pregnancy. Typically, a tocodynamometer is used at around 39 weeks into a woman's pregnancy. It uses a pressure sensing button that must be strapped tightly to the patient by the nurse or other assistant. This button sends a signal to a box that processes the stimulus. It can output plots and analyses of the contractions.

Another component of pregnancy care is a fetal heart rate monitor. This is another device that is generally confined to hospitals. Specialized equipment must be used due to the inherent challenges of filtering the relatively small fetal heart rate signal from the more prominent electrical signals present in a pregnant woman. Consideration of this device is important because the fetal heart rate monitor is often used in conjunction with a toco to help doctors understand the state of the pregnancy and make important decisions.

Both tocodynamometers and the fetal heart rate monitors suffer from usability issues. For the toco, the patient is dependent on a nurse to strap on the button sensor in exactly the correct position. The patients must remain still to ensure that the reading is based on contractions and not on any shifting of position that may occur while the patient is in pain. Both devices are bulky (~1' x 1' x 0.5'), expensive (~$10,000), and difficult to use, meaning that both are confined to specialized hospitals. Many low resource hospitals do not have tocos and, in general, the toco device is not portable or convenient.

Our goal is to create an Android application and small embedded system to take the place of both of these devices. We will use electrodes to read an electrical signal that may represent heart rate or muscle contractions. The Muscle Sensor v3 takes in an analog value (voltage) from the electrodes, amplifies it, and passes it via a wire to the Arduino Uno. The Arduino Uno converts the analog signal to a digital value that it packages and sends over a serial connection to the Google Nexus 7 tablet via a USB Adapter. The Google Nexus 7 tablet filters the input signal, plots the data, and calculates useful metrics.

TAMING NETWORK-ON-A-CHIP: PROGRAMMING FOR THE HUNDRED-CORE SWALLOW SYSTEM

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

The Swallow multicore network-on-a-chip system was collaboratively developed and optimized by researchers at Carnegie Mellon University and the University of Bristol. This platform supports hundreds of cores and has great potential for power-efficient parallel processing applications. We first develop a set of applications to exploit Swallow's capabilities. Then, we attempt to characterize the system's performance and power consumption under various program loads and core mappings. Our ultimate goal is to find effective ways to manage system resources in a network-on-chip environment.

TEST SET REORDERING FOR IMPROVING DIAGNOSTIC RESOLUTION

STUDENT Jaime Kang *Electrical & Computer Engineering*
ADVISOR Ronald Blanton *Electrical & Computer Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This project focuses on reordering the tests applied to integrated circuits (ICs) in order to maximize diagnostic resolution of ICs that are found to be defective. The main challenge is the creation and subsequent validation of a scalable algorithm that is capable of dealing with the significant amount of information associated with modern chips. Several alternative algorithms for reordering tests have been developed along with different metrics to measure and compare their corresponding advantages and disadvantages. Applications of the algorithms to various circuit examples provide empirical results for assessing the tradeoffs. In particular, the experiments performed demonstrated that reordered tests based on the developed algorithms performed approximately 1.1x to 1.8x better than the given ordering and a large number of random orderings.

USING DYNAMIC MOVEMENT PRIMITIVES ON SNAKE ROBOTS TO REDUCE CONTINUOUS MOTION PLANNING FOR DISCRETE OBSTACLE AVOIDANCE INTO A PARAMETER OPTIMIZATION PROBLEM.

STUDENT Dale McConachie *Electrical & Computer Engineering*
ADVISOR Howie Choset *Robotics Institute*
ROOM/TIME Rangos 3 / 12-2:30 pm

Designing motions for snake robots to bypass discrete obstacles is a difficult problem, particularly when trying to develop motions that scale to different sizes of the same class of obstacle. My approach to the problem is to use dynamic movement primitives to reduce the continuous motion planning problem into a parameter optimization problem. By using a path integral approach to machine learning I optimized the motion of the snake past a specific obstacle. Initially using a rectangular beam as the obstacle to move past I show that dynamic movement primitives are suitable for the task. Extensions of these methods could enable a generalized motion plan for overcoming similar obstacles.

WRCT: A RADIO MUSIC DATABASE

STUDENTS Matthew Baron *Electrical & Computer Engineering* | Salem Hilal *Computer Science*
ADVISOR Jeffrey Eppinger *Computer Science*
ROOM/TIME McConomy Auditorium / 11:00 am

Over the past decade, WRCT (CMU's own radio station) has been using the same software system to manage users, shows, playlists, and music.

Although the demands of the station have changed, the software is more or less in the same state it was in ten years ago. Our aim is to fully rewrite the system, perform much needed upgrades and add features.

For example, the old system contains a number of security vulnerabilities, and its difficult interface often leads to multiple copies of artists and albums.

The new system is written using Node.js, Express, MySQL, and Angular.js, and aims to be a usable, secure, well-tested replacement to the existing Perl-based system.

ENGINEERING AND PUBLIC POLICY

ASSESSING THE MAN-NATURE ORIENTATION AND BELIEFS ABOUT ENERGY PROJECTS AND SOVEREIGNTY OF RESIDENTS ON THE NAVAJO NATION

STUDENT Bennett Kriete *Engineering and Public Policy*
ADVISOR Gabrielle Wong-Parodi *Engineering and Public Policy*
ROOM/TIME Rangos 3 / 12-2:30 pm

Currently, little work has been done to survey the attitudes of Native Americans on the Navajo Nations towards different kinds of energy projects despite the large potential for energy developments there. This project set out to assess where the residents' man-nature orientation attitudes fell on the spectrum of subjugation to dominance and then determine how they correlated with support for different energy projects and beliefs about sovereignty.

MATERIALS SCIENCE ENGINEERING

ANALYSIS AND CHARACTERIZATION OF THE HEAT AFFECTED ZONES OF ULTRA SHORT PULSE LASER ABLATED METAL SPECIMEN

STUDENT Heather Thompson *Materials Science Engineering*
ADVISOR Yoosuf Picard *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Ultrashort pulsed lasers continue to see expanded application in many technologies such as microelectronics and precision manufacturing.

The extremely short time duration (picosecond to femtosecond time scales) of these laser pulses create extremely non-equilibrium conditions during the heating and ablation of target materials. The result is generally efficient machining with little to no heat affected zone (HAZ) in the vicinity of ablation. The extent and nature of any possible HAZ continues to be studied by materials characterization methods including electron backscatter diffraction (EBSD) [1] or transmission electron microscopy (TEM) [2]. The effect of pulse duration variation in the ultrashort time scales (ps to fs) has not been widely studied.

In this study, focused ion beam (FIB) cross-sectioning and ion channeling contrast imaging (ICCI) is employed to characterize the microstructure near ultrashort pulsed laser ablated holes in copper. ICCI can reveal microstructure through orientation contrast. Thus, ICCI can be used to evaluate HAZ by determining if there is any evidence of melting and recrystallization, where consequently the local grain size will be reduced. A FEI Nova Nanolab with a Ga+ source operating at 30 keV is used for both cross-sectioning (nA's of current) and imaging (pA's of current). A look at a copper specimen free of any laser irradiation through ICCI shows existing grains in the specimen are tens of microns in size with some twinning evident (rectangular contrast features).

Further work to image cross sections of ablated holes in the copper specimen by a picosecond laser and femtosecond laser was then conducted. A Lumera SUPER RAPID ps laser system operating at 979 Hz repetition rate generated 10 ps duration laser pulses at 1064 nm wavelength. A Clark-MXR CPA 2010 fs laser system operating at 979 Hz repetition rate generated 200 fs duration laser pulses at 775 nm wavelength (the ps laser was triggered to match the pulse rate of the fs laser). Both laser ablated holes resulted from focused laser irradiation for a 100 ms exposure. Comparable laser fluences were used to ensure reasonable HAZ size comparisons; 6.4 J/cm2 and 7.7 J/cm2 for ps and fs lasers, respectively.

The copper microstructure in these areas exhibit typical grain size up to a ~ 5 m region near the ablated hole edge.

At high magnifications, regions are identifiable where the apparent grain size has been reduced to sub-micron length scales. Lack of porosity indicates this zone is not re-deposition of ablated material. By designating these regions as the HAZ, it appears that the HAZ is smaller for the fs laser than the ps laser. This result would be consistent with long standing trends between HAZ size and pulse duration [3]. However, it is worth noting that appreciable strain is evident for the fs laser case. Lines of contrast were visible indicating appreciable curvature within copper grains. This curvature indicates significant plastic strain is present within 5 m of the fs laser ablated hole edge.

Such strain is not evident for the ps laser case. These results indicate a significant transition in the thermo-mechanical behavior of laser ablation between the ps and fs laser scenarios, a consequence of rapid thermal expansion and mechanical shock induced by sub-ps laser pulses [4]. Trends regarding pulse duration and fluence relationship to HAZ will be reported.

CHARACTERIZATION OF METAL ALLOYS FOR USE IN ALGAN/GAN-BASED GAS SENSORS

STUDENT Julia Yang *Materials Science Engineering*
ADVISOR Lisa Porter *Materials Science Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:00 am

Schottky diode gas sensors based on aluminum-gallium-nitride/gallium-nitride (AlGaN/GaN) semiconductor heterostructures are capable of detecting very low (10 parts per million) concentrations of hydrogen gas. They operate under harsh electronic conditions, which include environments with high temperature, high pressure, and corrosive elements. In this project we will be investigating AlGaN/GaN Schottky diode sensors containing metal alloy contacts, which must perform well both electrically and chemically (e.g., as a sensor catalyst).

Specifically, my goal is to measure the height of the electrical energy barrier for alloys of Pd (such as Pd-Cu, Pd-Au, Pd-Ag) in order to understand their performance as catalysts in these gas sensors.

CYTOPROTECTIVE EFFECTS OF PLASTICIZED BLOOD PLASMA BIOMATERIALS

STUDENTS Irini Sotiri *Materials Science Engineering* | Michelle Wolf *Materials Science Engineering*
ADVISOR Phil Campbell *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45 am

Localized drug delivery systems (LDDS) are being increasingly used by physicians to heal musculoskeletal injuries. Spatial control of drug delivery minimizes the risk for systemic toxicity, but commonly used drugs (e.g. antibiotics, anesthetics) often cause local cytotoxicity even when used as directed. Plasticized Blood Plasma as a biomaterial is a new technology, with direct applications in LDDS, that harnesses the natural healing effects of platelet-rich plasma (PRP). In this project, the potential of the bioplastic to decrease the cytotoxicity of several drugs commonly used in LDDS was tested in-vitro using cell lines representative of a wound site. This study details our findings.

DEPOSITING METAL ONTO COMPOSITE AND POLYMER STRUCTURES FOR AUTOMOTIVE APPLICATIONS

STUDENTS Joshua Kubiak *Materials Science Engineering* | Christi Martin *Electrical & Computer Engineering* | Alisha Mayor *Electrical & Computer Engineering*
ADVISOR Robert Heard *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

As the effects of global warming become more apparent, and energy resources become limited, the need for more efficient modes of transportation increases. By reducing the weight of crucial automotive components without compromising their structural integrity, lighter and more energy efficient cars can be created. A method of reducing weight that has not been fully investigated is the creation of parts out of light weight composites and plastics that are electroplated in a thin layer of strong metal. The goal of this project is to implement metal-coated, composite suspension links on the Carnegie Mellon Racing (CMR) vehicle and to investigate the

possibility of creating structural members, such as pedal-arms and wheel centers, out of 3D-printed plastic that has been coated in metal. Computational analysis, preliminary experimentation, and final validation will be performed for the above mentioned components, and the information collected throughout the process will be used to select additional components that are suitable for future replacement using metal-coated composites or plastics.

DESIGN AND DEVELOPMENT OF THE COMBUSTION CAR

STUDENTS Xavier Artache *Mechanical Engineering* | Luke Bruce *Chemical Engineering* | Alexandra Cerny *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Peter Crampton *Chemical Engineering* | Dennis Guo *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Sanjana Padmanabhan *Chemical Engineering* | Alexander Peterson *Chemical Engineering* |Yijie Qiu *Chemical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Brian So *Chemical Engineering* | Nicole Tom *Chemical Engineering* | Nicholas Torres *Chemical Engineering* | Maximilien Vachon *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The purpose of this project is to design and develop a combustion car that runs on fermented bio-ethanol to compete in the AIChE Chemical Engineering Car competition. The Chemical Engineering Car Competition (ChemE Car) is a national, collegiate event based on the challenge of designing and building a model-sized car that is powered and timed by chemical reactions. The car must stop at a distance between 15 and 30 meters and carry a certain load of water. Both parameters are specified on the day of the competition. Designed to give student engineers the opportunity to apply their knowledge to a design project and gain research experience, the ChemE Car Competition also allows students to network and share their ideas across the nation. Our team developed a car using a hobby-grade internal combustion engine which is fueled by ethanol. The car uses automated speed control and has an on-board data acquisition system. The timing reaction is an iodine clock. The reaction solution changes color after a period of time dictated by the reactant concentrations, and the color change is detected to signal the car to stop.

DESIGN AND DEVELOPMENT OF THE FUEL CELL CAR WITH DATA ACQUISITION

STUDENTS Xavier Artache *Mechanical Engineering* | Maggie Chen *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Teresa Gelles *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Biomedical Engineering* | Danielle Maly *Chemical Engineering* | Patricia Pan *Biomedical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The ChemECar Data Acquisition and Fuel Cell Teams continued research in preparation for the April 2014 regional competition. The newly formed Data Acquisition team is focusing on the fabrication and implementation of computerized systems for the efficient and comprehensive collection of data. The data will then be analyzed to research factors that affect the performance of all ChemECar vehicles. The Fuel Cell team is a continuation of previous work and will work closely with Data Acquisition. Key research goals for the Fuel Cell team include working with the Data Acquisition team to gather more accurate data regarding the operation of the car and independently producing hydrogen to run the car.

EMERALD VIEW PARK BOARDWALK CONSTRUCTION PROJECT

STUDENTS Miriam Hegglin *Civil and Environmental Engineering* | Eileen Wu *Materials Science Engineering*
ADVISOR Kelvin Gregory *Civil and Environmental Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

For many decades, Mount Washington has been a collection of divided parks with no pedestrian access between green spaces. Emerald View Park (EVP) is one such area has been used as a dump site and illegal hunting ground for many years. In the past few years, the City of Pittsburgh and Mount Washington staff and sponsors have started to clean up the various park sites and construct trails to connect the park in its entirety. Last year, the CMU Engineers Without Borders (EWB) student chapter adopted Emerald View Park and committed to taking over the clean-up efforts. The focus of this research was to determine the optimal materials, design, and construction methods needed to successfully construct a safe and sturdy boardwalk for pedestrians. The constraints faced included the cost, environmental impact, and availability of materials, size restrictions, soil conditions, expected loads, and expected water level rise. Our research included collecting soil samples, assessing current and past site conditions, taking detailed measurements, creating CAD drawings of possible designs, constructing Gantt chart to plan out the construction schedule, and creating a proposed budget for the project. The purpose of the boardwalk is to ultimately connect two existing trails over a wetland area and make Emerald View Park a safe and welcoming site for all Pittsburgh residents

FINITE ELEMENT ANALYSIS TO DETERMINE LIMITS OF NANOCRYSTALLINE SOFT MAGNETIC MATERIALS FOR USE IN MOTORS

STUDENT Patricia Xu *Materials Science Engineering*
ADVISOR Michael McHenry *Materials Science Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan 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 motor. A previous computational 2D model, coupled with phenomenological frequency dependent loss data(based on a parameterized Steinmetz equation), allowed evaluation of possible size reductions when incorporating this nanocomposite into the motor design. ANSYS Maxwell™ was used to demonstrate that using HTX005C instead of silicon steels could lead to a 70% size reduction and consequent 80% less rare earth permanent magnets. Subsequent research has expanded the model from 2D to 3D, and includes experimentally found mechanical properties for nanocomposite magnetic materials. An analysis of mechanical properties is required to assess the performance of the motor at high operational frequencies achievable using these low magnetic loss materials. In future work, an ANSYS model incorporating mechanical properties specific to HTX005C will be used to solve for mechanical stresses in the rotor to determine the size limitations of motors using HTX005C.

GENIPIN AS A CROSS-LINKER FOR IMPROVED COIL EMBOLIZATION TREATMENT FOR ANEURYSMS

STUDENT Madeline Cramer *Materials Science Engineering*
ADVISOR Christopher Bettinger *Materials Science Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Endovascular embolization is a minimally invasive treatment method for intracranial aneurysms. In this method, platinum coils are inserted into the aneurysm to stimulate clot formation. However, this treatment has a higher incidence of recurrence due to recanalization or deterioration of the clot. This study investigates the use of a genipin loaded poly(lactic-co-glycolic acid) coating on the platinum coils.

Genipin is a chemical compound found in gardenia fruit extract and is a natural cross-linker of primary amines. Cross-linking of the fibrin clot will improve its robustness and therefore decrease the probability of its degradation. The controlled release of genipin from the coating was evaluated, and an increase in the elastic modulus of the fibrin clot was observed following genipin addition. This drug-loaded coating shows promise for improved success rates of endovascular embolization treatment.

INVESTIGATION OF STRUCTURE AND DYNAMICS OF METAL-OXIDE NANOCOMPOSITE FOR ON-CHIP ELECTRONICS

STUDENTS Eli Zoghlin *Materials Science Engineering* | Michael McHenry *Materials Science Engineering*
ADVISOR Vincent Sokalski *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The synthesis of magnetic nanocomposites for high-frequency on-chip electronic applications is being investigated. The metal/oxide composite system FeCo/SiO2 was chose for study because of the large magnetic induction of FeCo and high resistivity of SiO2. Thin films were sputtered with a gradient in the metal:oxide ratio. The resulting nano-structure was comprised of metallic nano-crystalline grains embedded in an amorphous

oxide matrix. Nano-structural features, including grain distribution, size and volume fraction, were investigated by x-ray diffraction (XRD) and small angle x-ray scattering (SAXS). The microstructural evolution in this system was evaluated. Potential phase transformation pathways to result in the end product were investigated using diffusion models incorporating activation energies for defect formation. Published phase diagrams were consulted to predict potential end products. We analyze the microstructural evolution in this system using a Kirkendall model, which relates defects to diffusion in oxides. A series of samples prepared under varying annealing treatments were used to determine the validity of this proposed defect model.

PET THATCH - PLASTIC FUSING

STUDENTS Alexander Lucci *Materials Science Engineering* | Deepak Ravi *Mechanical Engineering* | Annette Ritchie *Materials Science Engineering* | Julia Tucker *Mechanical Engineering* | Tangrui Zuo *Mechanical Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

There are many Ecuadorian communities with a roofing problem: their current metal roofs are hot, noisy, and don't allow in any natural light. Roofs made of plastic thatch would solve all three of these problems, but these roofs are not being made yet. Our research investigates how regular, recycled plastic bottles can be cut up and fused together to form the thatching necessary for these roofs. One fusing method, friction fusing, is particularly promising. This method involves using a power-sander-like machine to vibrate two strips of plastic, while different amounts of heat and pressure are applied to help the fusing process. The combined friction, heat, and pressure should all be enough to create a strong bond between the strips of plastic. Our research will experiment with different oscillation patterns, applied heats & pressures, and different solvents that can also ease along the process. In order for us to further research this method, however, we need funding so that we can buy the necessary equipment. A power sander and several different solvents are needed, and this SURG grant would provide us the appropriate funding to keep our research going strong.

POLYMER MEDIATED SIRNA DELIVERY FOR THE PREVENTION OF FIBRODYSPLASIA

STUDENT Molly Klimak *Materials Science Engineering*

ADVISOR Jeffrey Hollinger *Biological Sciences*

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

Fibrodysplasia ossificans progressiva (FOP) is a congenital syndrome that promotes the progressive heterotopic ossification of striated muscle. There is no cure for FOP and no therapy to prevent bone formation at the site of a flare-up. My research focuses on preventing progression of FOP flare-ups to bone tissue by controlling the bone morphogenetic protein (BMP) signaling pathway. It was hypothesized that abrogation of BMP-signaling in the osteogenic cascade prevents the formation of bone tissue. To test this, two key transcription factors of the osteogenic cascade, Runt-related transcription factor 2 (RUNX2) and Osterix (OSX), will be blocked. Cationic nanostructured polymers (NSPs) were designed to deliver RNA inference therapeutics. These target mRNA produced by the transcription of the mutation, in order to prevent translation into protein. The NSPs were tested according to four performance criteria: biocompatibility, complexation, internalization, and gene knockdown. Throughout this research, I have been working with the NSPs to test their performance in different cell types. Currently, research has indicated that biocompatibility and the multi-stage disruption of BMP-induced bone formation processes. Future research into NSP based therapeutics through the use of RNAi will eventually be used to treat FOP patients.

SINGLE WALL CARBON NANOTUBES (SWCNTS) AS A DELIVERY SYSTEM TO ALTER MITOCHONDRIAL FUNCTION

STUDENT Stephen Chen *Materials Science Engineering*
ADVISOR Kris Dahl *Biomedical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

SWCNTs have been shown to localize around the membrane of the cell. There may be some evidence that SWCNTs also localize around mitochondria due to their negative transmembrane potential, but may be more likely that the SWCNTs are co-localizing around mitochondria due to their vicinity to the membrane. It is hypothesized that SWCNTs are bioinert and can be utilized as a delivery system for components that will alter mitochondrial function. Interactions between SWNCTs and mitochondria are measured through a change in distribution using MitoTracker Orange stains and a change in function using JC-1 dye and the Seahorse assay.

SOLAR STERILIZATION AND DISTILLATION UNIT FOR WATER FOR RESOURCE-POOR SETTINGS

STUDENTS Anshul Dhankher *Biomedical Engineering* | Gryphon Drake *Materials Science Engineering* | Jinie Haytko *Chemical Engineering* | Yatindra Patel *Biomedical Engineering* | Christine Sidoti *Biomedical Engineering* | Gihoon Song *Design*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

In many resource-poor settings, there is not an effective way for hospitals to sterilize surgical equipment, leading to a higher prevalence of healthcare associated infections in developing countries as opposed to developed countries. In order to address this issue, we have designed a solar sterilization and distillation unit for local clinics and hospitals in resource-poor settings with the goals of sterilizing surgical equipment and producing potable water. In designing the device, cost of materials and operations was the biggest constraint, as we wanted to keep costs as low as possible, taking advantage of cheap materials, simple operations, and existing local infrastructure or resources.

The design uses a system of mylar and solar pressure cookers as an autoclave to accomplish our goals.

SYNTHESIS OF MONODISPERSE MAGNETITE NANOPARTICLES FOR THE EXAMINATION OF REMNANT CRUSTAL MAGNETIZATION OF MARTIAN SOIL

STUDENT Blair Graham *Materials Science Engineering*
ADVISOR Michael McHenry *Materials Science Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Titanomagnetite is a pseudobinary oxide system composed of magnetite, Fe3O4, and ulvospinel, Fe2TiO4, that is commonly found in basalts on Mars and the moon. Certain compositions of Titanomagnetite are metastable and have been formulated to undergo spinodal decomposition during a change in temperature or pressure, forming a miscibility gap that consists of immiscible magnetite and ulvospinel. Monodisperse magnetite nanocubes with a side length of 10nm +/- 1nm were synthesized via reductive thermal decomposition of Fe (III) acetylacetonate and characterized using transmission electron microscopy and x-ray diffraction. The magnetite nanoparticles will be deposited onto a carbon-coated copper substrate via convective assembly and coated with a thin layer of ulvospinel to examine the reversed spinodal decomposition kinetics, yielding information regarding the remnant crustal magnetization on Mars.

THE CHARACTERIZATION OF UV ABSORPTION IN PHOTOACTIVE COMPOSITES.

STUDENTS David DePoi *Computer Science* | Andrew Garibaldi *Mechanical Engineering* | Theodore Houlis *Biomedical Engineering* | Robert Isopi *Materials Science Engineering* | Gabriel Rodriguez *Materials Science Engineering* | Mariana Rodriguez *Materials Science Engineering*

ADVISOR Michael Bockstaller *Materials Science Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:00 am

This intention of this projection is to study the effects of different photo-active composites. We will begin this project by constructing our own x,y,z gantry from basic materials. Once it is constructed, we begin to mix metals with photoactive composites and attempt to curate the composite. Different combinations of certain composites will be mixed to see which outcome has the most effecient results.

MECHANICAL ENGINEERING

A PARALLEL WIRE ROBOT FOR EPICARDIAL INTERVENTIONS

STUDENT Adam Costanza *Mechanical Engineering*

ADVISOR Cameron Riviere *Robotics Institute*

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

The Surgical Mechatronics Laboratory in the Robotics Institute has developed a planar parallel wire robot that adheres to the surface of the beating heart and provides a stable platform for minimally invasive epicardial therapies. The device is deployed through a small subxiphoid skin incision and attached to the heart using suction. This methodology obviates mechanical stabilization and lung deflation, which are typically required during cardiac surgery. Using past SURG and SURF funds, over 17 prototypes and an electronic control system have been developed. This device has undergone 4 porcine animal procedures that have proven to be successful and learning experiences.

Future versions of this device will include force sensing as well as robust kinetic PID control.

ANALYSIS AND IMPLEMENTATION OF LOW COST RENEWABLE BIOFUELS

STUDENTS Benjamin Avery *Mechanical Engineering* | Anchal Bhargava *Mechanical Engineering* | Daniel Cushman *Mechanical Engineering* | Conor Fitzgerald *Biomedical Engineering* | Laura Fleury *Mechanical Engineering*

ADVISOR Cecil Higgs *Mechanical Engineering*

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

The goal of our research is to restore a cost-efficient as well as energy-efficient biodiesel electrical generator that will be used to help power the Margaret Morrison building on CMU's campus. In 2008, over $675,000 was spent to install the biodiesel electrical generator in the basement of Margaret Morrison with the hope that it would be used to produce clean energy on campus. Though its feasibility has been proven and presented as part of a PhD thesis from a student in the CMU Departments of Architecture and Mechanical Engineering (Betz, 2009), it has largely been unused for two reasons: (1) lack of students who have a budget to get it working again and (2) the cost of the electricity produced from the generator has been too high to compete with energy from the grid. We will work with Professor Higgs in the CMU Department of Mechanical Engineering to restore this

engine and address the high cost of the fuel. Specifically, we will use non-traditional sources of oil such as waste cooking oil, which is being converted to biodiesel by another group of undergraduate researchers. We will then test it in a smaller biodiesel electrical generator, which will allow us to estimate the energy output and cost efficiency. We will then restore the biodiesel generator in Margaret Morrison and use it to produce clean, renewable energy for CMU.

BIOFUELS CHEMISTRY GROUP

STUDENTS Sean Baron *Mechanical Engineering* | David Chou *Mechanical Engineering* | Jeremiah Mpagazehe *Mechanical Engineering* | Shuyi Zhang *Mechanical Engineering*

ADVISOR Cecil Higgs *Mechanical Engineering*

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

Our research is aimed at understanding the properties of biodiesel by correlating the molecular structures of the feedstock to its biodiesel tribological properties. Such an understanding can theoretically allow us to maniplulate and find the best source of feedstock for biodiesel production, whether it can be canola or microalgae oil. Our end goal, as consist with the beginning of the project is to prove the validity of microalgae, with its many advantages such as higher oil to mass ratio, as a viable alternative for biodiesel feedstock. By understanding how chemical composition can affect tribological properties, we can perhaps find the perfect strain of algae to produce our biodiesel from.

CHIARA MANTIS ROBOT

STUDENT Brian Ferri *Mechanical Engineering*

ADVISOR David Touretzky *Computer Science*

ROOM/TIME Rangos 3 / 12-2:30 pm

The Chiara Mantis is a hexapod robot being developed in the Tekkotsu Lab at CMU. Its design is inspired by the praying mantis insect, but the robot is the size of a large dog and weighs about 25 pounds. Like its namesake, the Chiara Mantis uses its front legs both for walking and as manipulators.

My work on the mantis focused primarily on two areas: leg suspension mechanisms and a gripper to be incorporated into the front legs. The middle and back legs use a spring suspension system that allows the robot to conserve power while standing. I explored several variations of a spring-plunger style shock absorption device for these legs, and several foot designs to provide traction when a leg is at an angle relative to the ground. For the gripper, I created a four-bar linkage design modeled after the Robotiq hand. The linkage allows the fingers to close tightly around small objects but remain open when grasping larger objects. A single Robotis MX-28 servo drives each gripper; its load sensing capability will allow the robot to maintain constant pressure on the object.

All components were designed in SolidWorks and fabricated using a combination of water jet, laser cutting, and 3D printing techniques. The leg suspension is currently being evaluated as the robot's walking algorithm evolves. The gripper prototype is undergoing stand-alone testing, after which an updated version will be installed on the mantis.

COMPUTATIONAL MODELING OF ROCK MECHANICS TO PREDICT BIT-ROCK INTERACTION DURING OIL AND GAS DRILLING.

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

The purpose of this research is to simulate the rock mechanics of Nugget Sandstone, Carthage Marble, and Mancos Shale for a uniaxial unconfined compression test. Our goal is to obtain accurate results from the computational model that reflect the macro-mechanical properties of the rocks gathered from experimental studies. To simulate the behavior of the rocks in compression, micro-mechanical properties of the rocks were determined using discrete element methods (DEM). We hope that by understanding the rock behavior through this study we can work towards solving more complex systems. This research should lead us closer to capturing the bit-rock interaction during oil and gas drilling and be able to provide a solution to the high demand for inexpensive computational models. By predicting failure early, drill optimization can reduce costs and possible damage to the environment.

COMPUTER SIMULATIONS OF GAS/WATER INTERACTION IN MICROCHANNELS OF A PEM FUEL CELL

STUDENT Brian Devincentis *Mechanical Engineering*
ADVISORS Satbir Singh *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

In a polymer electrolyte membrane (PEM) fuel cell, electrons and positively charged hydrogen ions (protons) combine with oxygen to form liquid water at the cathode. Water produced at the cathode is forced out of the channel using continuous flow of high pressure air. Water management inside the channels is a critical issue for design and optimization of PEM fuel cells. A sufficient amount of water is required in the channel to maintain good proton conductivity, while excessive water can flood the channel, blocking the hydrogen and oxygen from reaching the reaction sites. The physical processes governing formation and convection of water drops at the cathode are complex, and require detailed understanding to produce efficient, low-cost, and reliable fuel cells. Therefore to better understand these complex phenomenon, multiphase CFD simulations using OpenFOAM, an open source CFD package, were used to analyze the flow of water through fuel cell microchannels. This allowed for a highly detailed analysis of these microchannel flows.

DESIGN AND DEVELOPMENT OF THE COMBUSTION CAR

STUDENTS Xavier Artache *Mechanical Engineering* | Luke Bruce *Chemical Engineering* | Alexandra Cerny *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Peter Crampton *Chemical Engineering* | Dennis Guo *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Sanjana Padmanabhan *Chemical Engineering* | Alexander Peterson *Chemical Engineering* | Yijie Qiu *Chemical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Brian So *Chemical Engineering* | Nicole Tom *Chemical Engineering* | Nicholas Torres *Chemical Engineering* | Maximilien Vachon *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*
ADVISOR James Miller *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

The purpose of this project is to design and develop a combustion car that runs on fermented bio-ethanol to compete in the AIChE Chemical Engineering Car competition. The Chemical Engineering Car Competition

(ChemE Car) is a national, collegiate event based on the challenge of designing and building a model-sized car that is powered and timed by chemical reactions. The car must stop at a distance between 15 and 30 meters and carry a certain load of water. Both parameters are specified on the day of the competition. Designed to give student engineers the opportunity to apply their knowledge to a design project and gain research experience, the ChemE Car Competition also allows students to network and share their ideas across the nation. Our team developed a car using a hobby-grade internal combustion engine which is fueled by ethanol. The car uses automated speed control and has an on-board data acquisition system. The timing reaction is an iodine clock. The reaction solution changes color after a period of time dictated by the reactant concentrations, and the color change is detected to signal the car to stop.

DESIGN AND DEVELOPMENT OF THE FUEL CELL CAR WITH DATA ACQUISITION

STUDENTS Xavier Artache *Mechanical Engineering* | Maggie Chen *Chemical Engineering* | Alexandra Frankel *Chemical Engineering* | Teresa Gelles *Chemical Engineering* | Duc Hieu Hoang *Mechanical Engineering* | Joshua Kubiak *Materials Science Engineering* | Andria Lemus *Biomedical Engineering* | Danielle Maly *Chemical Engineering* | Patricia Pan *Biomedical Engineering* | Vishnu Razdan *Electrical & Computer Engineering* | Amy Yuan *Chemical Engineering* | Zhaodong Zheng *Electrical & Computer Engineering*

ADVISOR James Miller *Chemical Engineering*

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

The ChemECar Data Acquisition and Fuel Cell Teams continued research in preparation for the April 2014 regional competition. The newly formed Data Acquisition team is focusing on the fabrication and implementation of computerized systems for the efficient and comprehensive collection of data. The data will then be analyzed to research factors that affect the performance of all ChemECar vehicles. The Fuel Cell team is a continuation of previous work and will work closely with Data Acquisition. Key research goals for the Fuel Cell team include working with the Data Acquisition team to gather more accurate data regarding the operation of the car and independently producing hydrogen to run the car.

DEVELOPMENT OF ACCUMULATOR CONTAINER FOR ELECTRIC RACING VEHICLE APPLICATIONS

STUDENTS Thomas Ikuss III *Mechanical Engineering* | Guochen Shen *Mechanical Engineering* | Michael Spinelli *Mechanical Engineering*

ADVISOR Jonathan Malen *Mechanical Engineering*

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

Electric vehicles are becoming an increasing presence in the automotive industry today, with battery integration technology remaining a limiting factor in their continued development. However little research is currently available for public review as to the optimal methods for constructing the containers to properly house these batteries considering all the design factors. The goal of this project will be to design and build an accumulator container (AC) for use in electric vehicle applications to be functional under all conditions, then to research and evaluate its performance. The project will also serve as a well-documented design and basis for future iterations, complete with detailed post construction analysis. Applications of this research include use for at-home builders of electric vehicle, 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.

ENGINEERING SOLUTIONS IN RURAL HONDURAS

STUDENTS Neil Carleton *Chemical Engineering* | Waritha Chiarnpattanodom *Chemical Engineering* | Korey Haug *Mechanical Engineering* | Maya Holay *Chemical Engineering* | Nicole Huang *Mechanical Engineering* | Taylor Hughes *Mechanical Engineering* | Hyejin Jang *Chemical Engineering* | Allen Kim *Mechanical Engineering* | Laiyee Kwan *Chemical Engineering* | Yingqiu Lee *Mechanical Engineering* | Esteban Pacheco *Mechanical Engineering* | Holly Stein *Mechanical Engineering* | David Vasquez *Chemical Engineering* | Anna Zhang *Chemical Engineering* | Sijia Zhang *Electrical & Computer Engineering*

ADVISOR Jason D'Antonio *Computational Biology*

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

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

EXPERIMENTAL SPRING PARAMETER ESTIMATION

STUDENT Rachel Chow *Mechanical Engineering*

ADVISOR Howie Choset *Robotics Institute*

ROOM/TIME Rangos 3 / 12-2:30 pm

A test rig was designed and fabricated to experimentally calculate the spring constants of several variations of a torsional spring. Each spring constant was calculated using an encoder, load cell, Arduino, and MATLAB.

FABRICATION OF NANO-POROUS ALUMINA TEMPLATE

STUDENT Li Yen Ng *Mechanical Engineering*

ADVISOR Sheng Shen *Mechanical Engineering*

ROOM/TIME Rangos 3 / 12-2:30 pm

This project involves a two-step anodization process to create nano-porous templates with changeable interpore distance. Successful fabrication of this template will allow it to be used to grow nanowires that can in turn be used in various applications

FINITE ELEMENT SIMULATION METHODOLOGIES FOR REFLOW AND MECHANICAL BEHAVIOR OF MAGNETIC NANOPARTICLE-BASED SOLDER COMPOSITES

STUDENT Andrea Pickel *Mechanical Engineering*

ADVISOR Michael McHenry *Materials Science Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:15 am

Sn-Ag-Cu (SAC) alloys are a promising alternative to traditional lead-tin solder, but their higher reflow temperature and longer reflow period leads to reliability concerns. Coupling RF fields to magnetic nanoparticles (MNPs) that have been added to lead-free solder enables localized (magnetic) reflow, which can alleviate these issues. Finite element simulations were used to model both magnetic reflow and thermal stress effects. The magnetic reflow process was simulated using SolidWorks™ software and spatio-thermal profiles were generated for different concentrations of MNP additives. The predicted temperature profiles agreed well with experimentally derived data and demonstrate the ability of localized reflow to enable low-temperature flip chip package assembly. To investigate thermomechanical effects, a two-dimensional model was developed using

ANSYS Mechanical™. The system was subjected to cyclic thermal loading conditions and stress profiles were generated. The solder material was considered to be viscoplastic, allowing for solder joint lifetime predictions. Finally, a three-dimensional model was created using ANSYS Workbench™ in which the reflow stress acts as an initial condition for subsequent thermal cycling. The resulting stress profiles suggest that stress generated during magnetic reflow will not significantly increase the final stress after thermal cycling. The model also contains an algorithm that runs a refined analysis on the "worst-case" (i.e. most highly stressed) solder bump. This allows the full model to be run with a coarser mesh, thus reducing computational cost, while ensuring that the integrity of the final results will not be compromised.

IMPLEMENTATION OF VIRTUAL REALITY IN MARKET RESEARCH

STUDENT Bic Yan Lee *Mechanical Engineering*
ADVISOR Jonathan Cagan *Mechanical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Understanding the consumer market is crucial for product development, because the product has to be functional and aesthetically desirable to satisfy consumer preferences. Traditional market research tools involve survey and prototype testing. However, modern technology has opened doors for the possibility of more accurate and cost effective market research methods. The focus of this research is one of these modern technologies – Virtual Reality, a computer-simulated environment. The aim is to develop Virtual Reality into a tool for ascertaining consumer preference for different features of a product. In order to incorporate users' feedback obtained from market research into the product design process, we will utilize and manipulate different mathematical models, such as utility functions, to optimize a system for quantifying and summarizing the consumer preferences. Ultimately, these quantified preferences can be effectively translated into a product form and used as a direction or basis for product modification.

IMPROVEMENT OF DESIGN OF FLAPPING WING MICRO AERIAL VEHICLE

STUDENT Kok Wei Lee *Mechanical Engineering*
ADVISOR Metin Sitti *Mechanical Engineering*
ROOM/TIME Rangos 3 / 12-2:30 pm

Based on a current prototype of a Flapping Wing Micro Aerial Vehicle, this project improves upon it with the goal of increasing the lift the vehicle is capable of achieving and ease of manufacturing. This is done by: 1. sourcing for suitable commercial micro-motors by running dynamic simulations to predict lift-performance, 2. Custom design and fabrication of springs to achieve dimensional constraints and spring constants required for resonance 3. redesign and fabrication of vehicle structural parts for easier and more accurate assembly,

INVESTIGATING LOCATION DECISIONS OF MANUFACTURING FACILITIES RELATED TO SHALE GAS

STUDENT Zachary Furman *Mechanical Engineering*
ADVISOR Deborah Stine *Engineering and Public Policy*
ROOM/TIME Rangos 3 / 12-2:30 pm

The shale gas revolution has spurred a new industry within the United States and has dramatically affected the economy as a whole. The industry currently produces approximately $100 billion in revenue and is projected to grow rapidly for at least the next 25 years. In 2015, shale gas production and related activity is expected to support 870000 and contribute $118.2B to the GDP as a conservative estimate.

This rapid growth is requiring investment from a large number of different companies of different type and scale. Companies investing in the shale gas revolution can be considered as either international companies, headquartered outside the United States with multinational operations including operations in the US, national companies, headquartered in the United States as established companies, and startup companies, those companies that are beginning due to the shale gas revolution. Shale gas supports a number of industries including chemicals, fertilizers, steel, aluminum, tires and rubber, plastics, power plants, glass, transportation, and packaging as well as primary energy production. A large number of plants and facilities have been emerging across the United States as across the world. This study focuses on investments within the United States in these new investments and utilizes research into individual investments compiled through databases and news articles to find specified reasons for a location decision. From this data, correlations were made on a state and regional basis to various location reasons. Along with this statistical component, interviews with decisionmakers regarding location decisions were conducted.

MECHANICAL DESIGN OF SKYLIGHT SURVEY INSTRUMENT

STUDENTS Ashrith Balakumar *Mechanical Engineering* | Richard Shanor *Mechanical Engineering*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The overall research problem is to conceive, develop, and test a sensor package capable of surveying lunar craters and skylights upon approach of a lander to the lunar surface. Specifically, the mechanical team will investigate the necessary requirements to validate such a device on earth. Skylights (Fig. 1), gateways to underground caves and lava tubes, have recently been observed on planetary surfaces. They have never been detailed due to viewing limitations of orbital survey equipment. It is hypothesized that an extensive network of interconnected caves lies beneath the lunar surface. A cave network might shelter humans against harsh moon elements, and minimize the impacts of long lunar nights. These caves can reveal a planet's geology, climate, and even biology. Our mission is to build and test a survey instrument capable of mapping skylights, to be carried by the Carnegie Mellon Lunar X spacecraft in 2015.

PET THATCH – PLASTIC FUSING

STUDENTS Alexander Lucci *Materials Science Engineering* | Deepak Ravi *Mechanical Engineering* | Annette Ritchie *Materials Science Engineering* | Julia Tucker *Mechanical Engineering* | Tangrui Zuo *Mechanical Engineering*

ADVISOR Robert Heard *Materials Science Engineering*

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

There are many Ecuadorian communities with a roofing problem: their current metal roofs are hot, noisy, and don't allow in any natural light. Roofs made of plastic thatch would solve all three of these problems, but these roofs are not being made yet. Our research investigates how regular, recycled plastic bottles can be cut up and fused together to form the thatching necessary for these roofs. One fusing method, friction fusing, is particularly promising. This method involves using a power-sander-like machine to vibrate two strips of plastic, while different amounts of heat and pressure are applied to help the fusing process. The combined friction, heat, and pressure should all be enough to create a strong bond between the strips of plastic. Our research will experiment with different oscillation patterns, applied heats & pressures, and different solvents that can also ease along the process. In order for us to further research this method, however, we need funding so that we can buy the necessary equipment. A power sander and several different solvents are needed, and this SURG grant would provide us the appropriate funding to keep our research going strong.

PHOTOBIOREACTOR DESIGN FOR ECONOMICALLY-VIABLE ALGAE BIODIESEL PRODUCTION

STUDENTS Nia Christian *Mechanical Engineering* | Korey Haug *Mechanical Engineering* | Shannon Horgan *Mechanical Engineering* | Allen Miller *Mechanical Engineering* | Ian Rosado *Mechanical Engineering* | Megan Tienjaroonkul *Mechanical Engineering*

ADVISOR Philip LeDuc *Mechanical Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:45 am

The present SURG application proposes to design, build, and operate an optimized photobioreactor (PBR) in Hamerschlag Hall as a research project sponsored by the LeDuc Laboratory at CMU. A PBR allows the gross production of algae which can be used to create biodiesel, an alternative energy source to fossil fuels. The coupling of globally increasing energy demands and the finite nature of fossil fuels emphasizes the need for a restructuring of the energy economy to use clean, renewable energy sources like algae-sourced biodiesel. A PBR permits a deeper investigation into the complex process of meeting global energy demands via algae biodiesel. With the successful application of a SURG grant, the present team will have its existing budget increased by 67%. Currently, a simple, unoptimized PBR is being built during the Fall 2013 semester. The increase in funding will provide the team the necessary resources to conduct experiments to design and create a more efficient, larger-scale PBR to produce algae for the team's research in renewable energy in the Spring 2014 semester.

RHINO UNFOLDER: A POLYHEDRON EDGE-UNFOLDER FOR FABRICATION

STUDENT Joshua Lopez-Binder *Mechanical Engineering*

ADVISOR Ali Momeni *Art*

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

Edge unfolding is the process of marking seams on a three-dimension- al polyhedron or 'mesh' and laying it out flat into a 'net.' Meshes are the most common type of 3D model, commonly used in animation, finite-element analysis and 3D printing. A few software packages, notably Pepaku- ra (created by Tama Software Ltd.),

facilitate edge unfolding of 3D meshes. However, the existing programs are tailored specifically for paper-crafting and are not open-source. The goal of this project is to make edge unfold- ing software that is more versatile and accessible. To achieve this the software is open-source, and runs as a script in a commonly used com- puter-aided drafting program called Rhinoceros.

SIMULATIONS OF VEHICLE INDUCED TURBULENCE, FOR USE IN NEAR-ROADWAY POLLUTANT DISPERSION MODELS

STUDENT Alexander Fry *Mechanical Engineering*
ADVISOR Satbir Singh *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:30 am

Understanding dispersion of traffic-related pollutants in the near roadway environment is important to assess human exposure and potential health effects. Concentration of pollutants near roadways is governed by local meteorology, local topography, and traffic-related parameters. Among these, vehicle generated turbulence on the roadway plays an important role. On-road mixing, caused by moving vehicles, can lead to a faster decay of pollutants away from the roadway. However, the current exposure assessment models, used by epidemiologists, do not account for vehicle generated turbulence, partly because the models are simple and do not incorporate flow physics. In this project, vehicle induced turbulence on the roadway was predicted using three dimensional computational fluid dynamics (CFD) simulations for different vehicle types. The CFD simulations were completed, using a commercially available CFD code and CAD models, which were created by the author. Results from the CFD models were compared to experimental data. The gathered information will later be incorporated into exposure assessment models, as part of a bigger research activity that involves development of computer models to simulate physiochemical evolution of traffic-related pollutants.

SUBSURFACE EXPLORATION OF LUNAR AND MARTIAN CAVES

STUDENT Richard Shanor *Mechanical Engineering*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Planetary skylights are gateways to underground voids, caves, and lava tubes. However, they have never been explored due to difficulty of access with current technologies. It is hypothesized that there exists an extensive network of interconnected caves beneath the lunar surface. A cave network might shelter humans against harsh moon elements and minimize the impacts of long lunar nights. Subsurface caverns may be the best place on Mars to find life. They can reveal a planet's geology, climate, and even biology. The research problem is to conceive, develop, and test a compact, reliable robotic system for accessing and exploring these caves, modeling their physical parameters, and communicating those findings to scientists on Earth. Last summer I successfully developed Tyrobot, a robotic pit descender that traverses cables and lowers exploration devices into pits and caves. Performance was validated in local Pennsylvania coal mines.

TABLET BASED TOCODYNAMOMETER

STUDENTS Whitney Aaronson *Human Computer Interaction Inst.* | Dale Best *Electrical & Computer Engineering* | Arnob Mallick *Electrical & Computer Engineering* | Sara Saheb Kashaf *Chemical Engineering* | Matthew Sarett *Electrical & Computer Engineering* | Eric Wise *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

A tocodynamometer is a medical device used to measure the frequency and duration of uterine contractions. It is used quite often in hospitals to monitor the condition of a woman's pregnancy. Typically, a tocodynamometer is used at around 39 weeks into a woman's pregnancy. It uses a pressure sensing button that must be strapped tightly to the patient by the nurse or other assistant. This button sends a signal to a box that processes the stimulus. It can output plots and analyses of the contractions.

Another component of pregnancy care is a fetal heart rate monitor. This is another device that is generally confined to hospitals. Specialized equipment must be used due to the inherent challenges of filtering the relatively small fetal heart rate signal from the more prominent electrical signals present in a pregnant woman. Consideration of this device is important because the fetal heart rate monitor is often used in conjunction with a toco to help doctors understand the state of the pregnancy and make important decisions.

Both tocodynamometers and the fetal heart rate monitors suffer from usability issues. For the toco, the patient is dependent on a nurse to strap on the button sensor in exactly the correct position. The patients must remain still to ensure that the reading is based on contractions and not on any shifting of position that may occur while the patient is in pain. Both devices are bulky (~1' x 1' x 0.5'), expensive (~$10,000), and difficult to use, meaning that both are confined to specialized hospitals. Many low resource hospitals do not have tocos and, in general, the toco device is not portable or convenient.

Our goal is to create an Android application and small embedded system to take the place of both of these devices. We will use electrodes to read an electrical signal that may represent heart rate or muscle contractions. The Muscle Sensor v3 takes in an analog value (voltage) from the electrodes, amplifies it, and passes it via a wire to the Arduino Uno. The Arduino Uno converts the analog signal to a digital value that it packages and sends over a serial connection to the Google Nexus 7 tablet via a USB Adapter. The Google Nexus 7 tablet filters the input signal, plots the data, and calculates useful metrics.

THE CHARACTERIZATION OF UV ABSORPTION IN PHOTOACTIVE COMPOSITES.

STUDENTS David DePoi *Computer Science* | Andrew Garibaldi *Mechanical Engineering* | Theodore Houlis *Biomedical Engineering* | Robert Isopi *Materials Science Engineering* | Gabriel Rodriguez *Materials Science Engineering* | Mariana Rodriguez *Materials Science Engineering*

ADVISOR Michael Bockstaller *Materials Science Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:00 am

This intention of this projection is to study the effects of different photo-active composites. We will begin this project by constructing our own x,y,z gantry from basic materials. Once it is constructed, we begin to mix metals with photoactive composites and attempt to curate the composite. Different combinations of certain composites will be mixed to see which outcome has the most effecient results.

UNDECIDED

METAL CLAY PROPERTIES AND PERFORMANCE IN CLAY EXTRUSION ADDITIVE MANUFACTURING

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

ADVISOR Eric Brockmeyer *Architecture*

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

When a part needs to be fabricated in forms unsuitable for traditional subtractive manufacturing companies and individuals have increasingly turned to additive manufacturing (3D printing) to fill their design needs. Additive manufacturing in metal has traditionally been a bulky, expensive, industrial level process only suitable for high price applications. Most metal printers are based on either printing a part in weaker materials such as sand and wax for casting, or sintering metal powders using electrons and lasers which all require very specialized equipment. In order to bring the price of 3D printing in metal down to consumer grade materials we built a 3D printer using existing printer and paste extruder designs to print in metal clay, a mixture of metal particles in a binder which can be sintered using household tools. Our aim is to obtain data on what properties metal clay has when printed and further our understanding of where this technology falls on the spectrum of commercially available technologies. Our findings advance the understanding of how viable metal clay is as a method of additively manufacturing parts on a lower budget.

COLLEGE OF FINE ARTS

ARCHITECTURE

EFFECTS OF SEATING LOCATION AND SURROUNDING CONDITIONS ON PARTICIPATION IN A LEARNING ENVIRONMENT

STUDENT Seo Hyun Stephanie Par *Architecture*
ADVISOR Azizan Abdul-Aziz *Architecture*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

In a learning environment, the physical conditions can affect the performance of learning activities, such as participation. The objective of this research project is to understand and explore the optimal design for a learning environment, specifically its effect on participation in a classroom. The study consists of analyses including data collection through case studies, observation, and survey, which examine the physical conditions of the environment, such as lighting, temperature, noise, and seating location, and their effects on participation rate. The key results have shown that there is an active seating zone that demonstrated the highest participation rate. Also, students in cooler temperature and dimmer lighting demonstrated higher participation rate than others. These studies of the physical conditions in a classroom and their effects on performance, including participation, can be useful when applied in architectural design of learning spaces.

LA FRONTERA: THE US/MEXICO BORDER FENCE AS LINEAR URBANISM

STUDENT Paulina Reyes *Architecture*
ADVISOR Christine Mondor *Architecture*
ROOM/TIME Pake / 12:00 pm

The US/Mexico border fence is often perceived at best as a necessity of national security, and at worst, a vessel for political deceit and cultural burden. Beyond these definitions, the fence is also a profoundly symbolic spatial division between our two countries, one which defies the cultural, economic, and ecological continuity of the border region.

Ultimately, my aim with this research is to demonstrate the potential of a "responsive" barrier which accommodates and the complexity of flow along the border. Moreover, a barrier which facilitates everyday cultural contact, and in the longer term, lead to some form of integration. The wall raises the question of what kind of alternative urbanism can be envisioned, a system capable of providing for development, flow, and programmatic insertion, yet responding to the different characters of the existing edges and voids. A new strategy of the linear.

ART

STONEGHOST/THE THOUSAND-YARD STARE

STUDENT Adelaide Agyemang *Art* | Andrew Bueno *BCSA*
ADVISOR Andrew Johnson *Art*
ROOM/TIME Connan / 3-5 pm

"[20 years ago] you were private by default and public by effort. Nowadays, you are public by default and private by effort."

Recent insights into the scale of personal data mining by government and corporate entities have renewed public attention towards the dynamics of privacy and safety in the post-9/11 internet age. Increasingly, we are all becoming hyper aware that volumes of our personal data is quietly being siphoned without our consent. But are we facilitating the surveillance state when we upload media and habitually offer updates about our private lives through social networks? How do we reconcile our need to share with the disturbing realities of government spying, corporate surveillance, public scrutiny, and our own urges to stalk and spy on other people?

STONEGHOST/The Thousand-Yard Stare reassembles the data mining patterns of parallel, yet inadvertently colluding forces to make more tangible the overwhelming availability of intimate personal data and the psychologically numbing consequences of a pervasive culture of watching.

Our project's title references a data exchange network operated by the "Five Eyes" defense intelligence agencies, as well as the unfocused, PTSD-stricken gaze of battle weary soldiers. However, our show identifies personal data gathering and exchange as being broader than the government; we see it as a process undertaken on institutional, social, and individual levels, with varying degrees of sophistication. There are more entities watching us than we've fully processed, yet the digital nature of surveillance distances us from this fact in our day to day lives. Therefore, the various installations in STONEGHOST/The Thousand-Yard Stare sought to induce feelings of hypervigilance in our viewers, challenging them to contemplate their sense of safety, the power they think they hold, and their capacity for understanding the greater forces at play between themselves and others. The Thousand-Yard Stare is then used to describe a collective state of neurosis following the realization that intimate details about all of our lives will irrevocably become public.

DESIGN

A SPATIAL COLLABORATIVE INFORMATION ORGANIZATION INTERFACE

STUDENTS Michael Chiu *Computer Science* | Antonio Ono *Design*
ROOM/TIME McKenna / 12:20 pm

This is a project to design, develop, and evaluate a large-scale, platform-agnostic gestural interface that allows collaborative organization and exploration of information. Our objective is to marry the experiential benefits of tangible means of organizing information — spatial consistency, visual familiarity, and in-person collaboration — with the functional benefits of digital means of organizing information — data redundancy, volume, location

independence, sharability — such as email and tools like Dropbox and Pinterest. We intend to develop the application as a platform-agnostic web application that allows for collaborative simultaneous input from multiple users, be they on separate devices or using a single multi-user wall-based interface.

BINSPACE

STUDENTS Siddharth Dedhia *Electrical & Computer Engineering* | Min Kyung Kim *Design* Yong Joon Kwon *Electrical & Computer Engineering* | Junho Lee *Design* | Joseph Oak *Design* | Zachary Rousselle *Electrical & Computer Engineering*

ADVISOR Pei Zhang *Electrical & Computer Engineering*

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

Mobile application service system that provides real time feedback of available seats in libraries using sensor technology.

BURGH BEES EDUCATIONAL APIARY

STUDENTS Sonal Chakrasali *Design* | Kevin Kan *Design*

ADVISORS Dylan Vitone *Design*

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

We propose to transform the Burgh Bees Community Apiary from a member-oriented club space into an engaging public space. We hope to construct and install a permanent museum quality exhibit that will teach interested kids and adults about pollinators, beekeeping, and sustainable agriculture; the folks at Burgh Bees are good at keeping bees and are very knowledgeable but only cater to a small audience, how can we use design to connect them to the community at large?

HAPPY FEET - HEELS THAT CONVERT INTO FLATS

STUDENTS Alanna Fusaro *Design*

ADVISORS Amanda Fox *Business Administration*

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

My objective is to solve the problem of uncomfortable footwear. Women frequently wear painful shoes for the sake of fashion. I am proposing a redesign of the traditional high heel shoe, so that it is transformable based on the occasion and comfort of the wearer. I hope to accomplish a pair of shoes that have a removable heel and mechanism to change them from a high heel to a ballerina flat. I plan on conducting experiments for the mechanism and creating many prototype iterations to find the most structurally stable and aesthetically pleasing version of this shoe. This project will help improve the connection between my field, industrial design, and the fashion industry. I hope to use my knowledge of form and function (industrial design) to create a practical shoe that can compete with the trendy shoes on the market today. Received $400 Fall SURG grant to create this project.

HEAD TRACKING AUDIO SYSTEM

STUDENTS James Allen *Computer Science* | Kenneth Murphy *Computer Science* | Joshua Newby *Design*
ADVISOR Stephen Stadelmeier *Design*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

We propose to design and fabricate a functioning set of head-tracking loudspeaker stands that will greatly improve the the quality and accuracy of an audio environment as experienced by the listener. Loudspeakers are used in a multitude of different applications from monitoring, recording, and mixing music, to immersive 3D virtual environments. Both mixing and virtual environments rely on a high level of audio precision in order to be effective. Our system will track the position of the listener's head and move speakers along their x and z-axis to keep the speakers equidistant, symmetrical, and aligned with the listener's head. This will ensure that sounds generated from the left and right channels both arrive at the listener's ears simultaneously, so the user can move about the room without experiencing distorting in the speaker's audio image.

IDENTITY CREATION WITHIN ONLINE EATING DISORDER COMMUNITIES

STUDENTS Zachary Bergeron *Design* | Katherine Frazer *Design*
ADVISOR Charlee Brodsky *Design*
ROOM/TIME Connan / 3-5 pm

The purpose of this book is to explore online identity curation and creation among participants of online eating disorder communities. Through our research, we have discovered that online eating disorder communities are a prevalent, yet unknown facet of the internet, creating a safe-haven for youth to freely express themselves through images and text in an intimate and anonymous way. We aim to showcase individual and collective identities within this community and showcase the content captured from individual blogs, giving a voice to this inaccessible niche online space.

INTERACTIVE FASHION

STUDENT Scott Alberstein *Design*
ADVISOR Aisling Kelliher *Design*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

As a designer, I am intrigued by the way in which people interact with things, each other, and the greater world around them. This interest, coupled with my love of fashion and apparel, has led me to wonder how I can augment clothing to express the way the body moves, the environment it is in, and the people around it. My goal is to explore novel wearable technology and digital fabrication processes to showcase how new technology could enhance and impact apparel. Furthermore, this project challenges the assumption that fashion and and technology research are relatively disparate fields. I plan to complete ten pieces of wearable clothing that draw attention to certain aspects of the human body through utilization of modern day fabrication techniques and technology. This project is an important step forward, to me as a designer, because it bridges the gap between the two fields of art and technology, in which I have experience and a continued interest.

MAKEUP TOOL FOR WOMEN WITH HAND TREMORS

STUDENTS Nigel Alcorn *Design* | Sijia Wang *Design*
ADVISOR Stephen Stadelmeier *Design*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

This project is to develop a tool that would help women with hand tremors apply makeup. By limiting the amount of shaking from the hand to the makeup product, the device enables users to apply cosmetics with more accuracy, based on their desires as opposed to body restrictions. This ability to choose returns independence to the user and frees them from relying on others to complete tasks that were once done individually. Our solution will be developed based on feedback provided from users during prototype testing sessions. A possible solution for the device will be a tool that would hold makeup steady and have a flexible, tremor-absorbing handle for the user to maneuver the device.

SOLAR STERILIZATION AND DISTILLATION UNIT FOR WATER FOR RESOURCE-POOR SETTINGS

STUDENTS Anshul Dhankher *Biomedical Engineering* | Gryphon Drake *Materials Science Engineering* | Jinie Haytko *Chemical Engineering* | Yatindra Patel *Biomedical Engineering* | Christine Sidoti *Biomedical Engineering* | Gihoon Song *Design*
ADVISOR Conrad Zapanta *Biomedical Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

In many resource-poor settings, there is not an effective way for hospitals to sterilize surgical equipment, leading to a higher prevalence of healthcare associated infections in developing countries as opposed to developed countries. In order to address this issue, we have designed a solar sterilization and distillation unit for local clinics and hospitals in resource-poor settings with the goals of sterilizing surgical equipment and producing potable water. In designing the device, cost of materials and operations was the biggest constraint, as we wanted to keep costs as low as possible, taking advantage of cheap materials, simple operations, and existing local infrastructure or resources. The design uses a system of mylar and solar pressure cookers as an autoclave to accomplish our goals.

DRAMA

WE WORE THE MASKS

STUDENT Nathan Bertone *Drama*
ADVISOR Susan Tsu *Drama*
ROOM/TIME Connan / 12-2:30 pm

Take a moment. Look around. What do you see? In front of and all around you is a crowd of people whose faces are covered by neutral expressionless masks. On a daily basis, thousands of people pass us by and wear "masks" that shield who they truly are. Eventually, these masks become covered by layers of protection that ultimately make it difficult to peel them back to reveal the true face beneath.

Underneath these masks are the emotions and characteristics of ourselves that we keep deeply routed inside, underneath the Surface, and hidden from society. We Wore The Masks is a photo-journalistic exploration that dares you to remove that mask, and show the world something that you have yet to share. This project asks

the question, "If you could give five words that you feel you keep hidden from the world; either because you are afraid to share them, or because the world does not allow you to; what would those words be and why?" In asking this question, participants have dared to peel back individual layers of their mask to release the thoughts and feelings hidden beneath.

What will it take to discover your inner most thoughts and feelings?"

MUSIC

EXAMINING STRAINED POLYCRYSTALS WITH HIGH ENERGY DIFFRACTION MICROSCOPY

STUDENT Noah Baum *Music*
ADVISOR Robert Suter *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Most common metals are polycrystalline meaning that they are made up of many grains which may have the same crystal structure but have different orientations and sizes. The boundaries between these grains can have a profound effect on the mechanical, electromagnetic, and thermal properties of the material.

In the technique of High Energy Diffraction Microscopy (HEDM), images are taken at short range of diffraction from planar monochromatic X-Rays (50 -100 KeV) through a polycrystalline sample as it is rotated. These images can be used to determine the boundaries and orientations of the different grains in a cross section of the sample. Since this technique is nondestructive, we are able to examine how the grain boundaries and orientations change as the material is strained. This poster will overview HEDM and explore how high angular resolution HEDM measurements from the Advanced Photon Source can be used to probe how strains affect the crystal lattice within a single grain.

ORBIT SLAM

STUDENT Corinne Vassallo *Music*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:00 am

Autonomous navigation is pivotal to planetary missions. Performing navigation during cruise stage and orbit determination using only optical measurements avoids the need for Earth-based position estimation. Cruise stage and lunar orbits can be determined optically and without external input sources, and algorithms have been adapted for use with Kalman filtering to achieve real-time processing. Simultaneous localization and mapping (SLAM) is the task of incrementally building a map of the surrounding environment with a mobile robot while simultaneously localizing the robot in the map. This project brings the problem of SLAM in orbit; an orbiting spacecraft localizes and simultaneously builds a map of the body being orbited. Since no prior reference map is used, orbit SLAM enables true spacecraft autonomy.

CROSS COLLEGE

BCSA

BXA CAPSTONE: A STUDY IN VIDEOGAME NARRATIVE AND MECHANICS

STUDENTS Andrew Bueno *BCSA* | Kyna McIntosh *BCSA* | Mark Strelow *BCSA*
ADVISOR Paolo Pedercini *Art*
ROOM/TIME Connan / 12-2:30 pm

Our Capstone project is a story-driven game. The setting is an ambiguously present-day utopia, in which people harbor foreign lifeforms in their brains in order to correct certain abnormalities such as blindness, immobility, and mental illnesses.

The player controls a character who is normally blind, but can see with the aid of the aforementioned lifeforms. The character learns she can transfer her sight to other people, effectively looking through their eyes. The main mechanic of the game involves using this ability to alter perspective and solve problems by seeing them from different points of view.

CONSTRUCT: PROGRAMMING WITH GEOMETRY

STUDENT Samuel Gruber *BCSA*
ADVISORS M. Stephanie Murray *BHA* | Brad Myers *Human Computer Interaction Inst.*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Computer programming translates the intentions of the human programmer to the reality of machine execution. Commonly, this is done through sequences of text symbols which resemble algebraic formulas. Programming in this way encourages logical reasoning, straight-line solutions, and abstract processes. Construct presents a design for programming with examples using a geometric syntax. By engaging the spatial reasoning of programmers, this new method can broaden the field of computer programming to accept more contributions from visual and spatial thinkers.

GETTING A KICKSTART: INVESTIGATING BEST PRACTICES FOR CROWD-FUNDED VIDEO GAME STUDIOS

STUDENT Andrew Biar *BCSA*
ADVISOR Jesse Schell *Machine Learning*
ROOM/TIME Dowd / 3:00 pm

In this presentation I will present synthesized research regarding video game studios who have attempted to use crowd-funding to finance their games. This will include a review of literature available online, as well as in-depth case studies of three Pittsburgh studios: Schell Games, Mojo Game Studios, and Completely Fair Games. How can you predict whether you will be successfully funded? What should be done before you reach out to the online community for funding? How can you prevent project delays and ensure timely delivery of backer rewards?

Crowd-funding is a powerful and growing means of project finance, and by learning from the mistakes and successes of others we can make better decisions when our project is on the line.

LUMIVERSE: LIGHTING CONTROL FOR EVERYONE

STUDENT Evan Shimizu *BCSA*
ADVISORS Kayvon Fatahalian *Computer Science* | M. Stephanie Murray *BHA*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Lumiverse is an open software architecture that allows applications to control lighting systems without the use of proprietary, specialized lighting consoles. Removing the lighting consoles from the control network opens up these systems to the full power of software application control. Most notably, it will enable far more complex interactive lighting setups. As interactive lighting becomes more prevalent in both theatre and everyday environments (e.g., offices, living rooms, cars), the proposed system will allow control of large numbers of sources with high precision and flexibility. This project will develop the initial Lumiverse prototype and will demonstrate the platform's use in both a traditional theatrical lighting environment and in an interactive setting through the creation of a color theory game. More generally, it will demonstrate the platform's viability as a catalyst for new creative uses of lighting.

STONEGHOST/THE THOUSAND-YARD STARE

STUDENTS Adelaide Agyemang *Art* | Andrew Bueno *BCSA*
ADVISOR Andrew Johnson *Art*
ROOM/TIME Connan / 3-5 pm

"[20 years ago] you were private by default and public by effort. Nowadays, you are public by default and private by effort."

Recent insights into the scale of personal data mining by government and corporate entities have renewed public attention towards the dynamics of privacy and safety in the post-9/11 internet age. Increasingly, we are all becoming hyper aware that volumes of our personal data is quietly being siphoned without our consent. But are we facilitating the surveillance state when we upload media and habitually offer updates about our private lives through social networks? How do we reconcile our need to share with the disturbing realities of government spying, corporate surveillance, public scrutiny, and our own urges to stalk and spy on other people?

STONEGHOST/The Thousand-Yard Stare reassembles the data mining patterns of parallel, yet inadvertently colluding forces to make more tangible the overwhelming availability of intimate personal data and the psychologically numbing consequences of a pervasive culture of watching.

Our project's title references a data exchange network operated by the "Five Eyes" defense intelligence agencies, as well as the unfocused, PTSD-stricken gaze of battle weary soldiers. However, our show identifies personal data gathering and exchange as being broader than the government; we see it as a process undertaken on institutional, social, and individual levels, with varying degrees of sophistication. There are more entities watching us than we've fully processed, yet the digital nature of surveillance distances us from this fact in our day to day lives. Therefore, the various installations in STONEGHOST/The Thousand-Yard Stare sought to induce feelings of hypervigilance in our viewers, challenging them to contemplate their sense of safety, the power they think they hold, and their capacity for understanding the greater forces at play between themselves and others. The Thousand-Yard Stare is then used to describe a collective state of neurosis following the realization that intimate details about all of our lives will irrevocably become public.

THINK ABOUT SOMETHING ELSE

STUDENTS Kevin Karol *BCSA* | Brian Pettitt-Schieber *BHA*
ADVISOR Lawrence Shea *Drama*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

As the evidence in support of an accelerating global warming mounts, the near-certainty of future climatic catastrophes takes root in our collective consciousness, causing disruption and displacement. A conversation moves through communities, passing from person to person as knowledge is shared and concern is expressed. Each person develops a different understanding of the information at hand, and the issues are complex. Over the course of three months, a broad spectrum of Pittsburgh citizens was interviewed and surveyed on issues of environmental justice, including scientists, government officials, businessmen, activists, and others. Utilizing the server-based dynamic narrative delivery system as developed by sophomore Kevin Karol (BCSA '16), symposium guests can listen to their city speak freely and offer up their own views in solidarity throughout the day.

BHA

14 STORIES: AN ELEVATOR SONNET

STUDENT Cole Heiner *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 12-2:30 pm

Through the lens of word-game-play, this project looks at aspects of recombination and mechanization in language. Drawing from the historic work of poets Georg Philipp Harsdörffer and Raymond Queneau, this language game explores the techniques of constraint and deformance. Working within the conceptual realms of digital poetics and new media writing, the poem is envisioned more as event than object, and more as process than performance. From a framework of disruption and reorganization, the game repeats and deforms, seeking to shift the player's attention to otherwise unseen meanings.

BORDERS OF BODY AND NATION: THE CYBORG IN BORDER ART

STUDENT Anna Nelson *BHA*
ADVISOR Candice Amich *English*
ROOM/TIME Peter / 12:20 pm

The term 'cyborg' occupies a conceptual space on the border of the human and the machine. The cyborg as a being made up of parts from different origins makes it a powerful metaphor for identity construction that has been used by artists working in a similar conceptual space - the border between nations as a site rather than a divide. These artists revel in the unique cultures created at junctures, not just geopolitical, but also metaphorical. And by proposing alternate visions of the future, they open our minds to myriad cacophonous projections which change the way we think about and create our future.

BRIDGING ARCHITECTURE & PSYCHOLOGY

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

Have you ever wondered whether an environment can effect your mood, productivity, or focus? As a BXA student studying the integration of architecture and psychology, the focus of my senior Capstone project was to explore the relationship between simple spatial and environmental cues and how one internalizes them on an emotional and cognitive level.

This inquiry manifested itself in two projects: an installation and a research paper. The goal for the installation was to create a momentary experience that instilled an awareness of one's self in the space, both physically and mentally. The research paper focused on the role of communal spaces and lounges in the learning experience; how the aesthetics of the space can increase relaxation and productivity and minimize stress and anxiety.

Thus, my overarching question is what spatial factors are valued over others and how can we incorporate these aesthetics into the built environment to better the experience of the user? My goal was to explore this question while also expressing the importance of establishing a relationship between the ideals of architecture and psychology.

BUILDING BEYOND VALUE AND PERCEPTION: HOW ARCHITECTURE CAN ACTIVELY AFFECT URBAN CHANGE PROCESSES

STUDENT Danielle Dong *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 12:40 pm

Exploring past and current academic perspectives of urban architecture as a largely passive physical quality of areas that does not actively influence change within a city until after these transformations have already begun, my research recognizes architecture as a major factor that affects the way urban change develops. Whether creating an image for certain districts, acting as a focal points around which people form a community, producing economic opportunities for people and businesses, the architecture of the urban environment plays an important multidimensional role in shaping the changes occurring in cities such as Pittsburgh.

BXA CAPSTONE PROJECT: UPGRADES TO CAMPUS LIGHTING THROUGH OCCUPANCY SENSORS AND DAYLIGHTING

STUDENT Catherine Paquette *BHA*
ADVISORS Vivian Loftness *Architecture* | M. Stephanie Murray *BHA*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

In a typical academic building, lighting comprises 30 percent of its total energy use. Lighting is also often considered the "low-hanging fruit" of energy efficiency plans because improvements can often be easily made and also have quick payback periods. My BXA senior capstone project demonstrates how lighting energy efficiency can be improved in Carnegie Mellon academic buildings with occupancy/vacancy sensors and daylighting. These strategies are simple to implement and relatively inexpensive. Occupancy sensors and daylighting reduce a building's energy consumption without affecting students, faculty or staff and can also

improve light quality. Going forward, I intend for this project to serve as support for the implementation of widespread occupancy based lighting controls for the university.

DIARY OF A CHAIR: A METHODOLOGY FOR DEFINING ABSENCE, SPACE, AND SELF.

STUDENTS Kayla Heglas *BHA*
ADVISORS Patricia Maurides *Art*
ROOM/TIME Connan / 12-2:30 pm

My project will be a conclusion to my interests in inhabited space and family dynamics. The body of work will be an exploration of space through inhabitance and absence. These aspects will be reviewed through research done in Gestalt Theory, through interviews, and self-exploration. Research on terms like space, historical value, sentimental value, identity, self-narrative, portrait, absence, and longing dictated the growth of the project in whole.

The signature piece utilizes both photography and writing, and results in an artist book and hand-built chair. The handmade chair was placed in spaces that are relevant to the growth of myself over time, my house and my grandmother's house. Each day 'the chair' reflected upon itself and its surroundings in a diary entry, expressing its feelings of the inhabited and abandoned space around it, as well as, take a self-portrait. Through this somewhat comical exploration of the chair, I hope to create a methodology for defining absence, space, and self-narrative.

DIY CARBON FIBER

STUDENT Daniel Campos Zamora *BHA*
ADVISOR Ali Momeni *Art*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The project is an alternative resource encouraging artists, hobbyist, and builders to experiment with carbon fiber. Instead of focusing on topics like chemical makeup, stress analysis, or tensile strength the site highlights practical applications and unorthodox ways of working with the material like weaving your own cloth, knitting it, or laser etching.

EFFECTS OF MUSICALITY ON THE SHORT-TERM MEMORY OF AUDITORY PERCEPTUAL OBJECTS

STUDENT Monica Ly *BHA*
ADVISOR Richard Randall *Music*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Auditory scene analysis (ASA) is the cognitive process in which low-level acoustic cues such as timbre and amplitude are used to group and localize sounds. These cues allow the formation of what has been called an "auditory perceptual object" out of a sequence of pitched sounds. To perceive something as musical, we must first identify it as a high-level "auditory perceptual object". Musicality is difficult to define, but tends to be characterized by gradual rather than sudden changes in contour, timbre, and amplitude. Analogous to memorizing a phone number, musical melodies tend to be remembered in "motives", or chunks of notes. This study seeks to show that the presence of musicality facilitates the short-term memory of tone sequences. More musical sequences are expected to be more easily remembered than non-musical sequences. Participants heard pure tone sequences varying in musicality and were asked to respond to whether a second

sequence was the same or different. More accurate memory of musical sequences over nonmusical sequences would likely be due to the formation of stronger auditory perceptual objects through easier grouping/chunking of the tones. Connections between auditory perception and memory could be investigated further through studies in learning and long term memory.

EMPATHY AND THE ENVIRONMENT

STUDENT Janet Lorenz *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Dowd / 12:20 pm

Throughout my undergraduate career, I have researched what it means to be an environmentalist — or at least someone who is concerned about the environment. I have participated in protests and studied the science behind anthropogenic ecological change. I have met many people that have changed my view of what it means to be environmentally conscience. From the passionate activists to the sober engineers, what I have come to understand is what is crucial in having a relationship with our environment, or with anything at all, is empathy. In this presentation, I reflect on my journey in understanding what an environmentalist is through oral presentation and visual arts. This project is part of my BXA Spring Capstone.

IN CELEBRATION OF MARGO LOVELACE

STUDENT Nicolas Marlton *BHA*
ADVISORS Bob Bingham *Art* | Carrie Hagan *BCSA* | M. Stephanie Murray *BHA*
ROOM/TIME Peter / 3:20 pm

In 1964 Margo Lovelace bought 58881/2 Ellsworth and renovated it to make the Margo Lovelace Marionette Theater. The focus of her work was what she referred to as the "Magic of Puppetry." Norman Beck, a former employee who regards her as a second mother, claims "If you grew up in the 70's, and went to a kids birthday party in Pittsburgh, you saw a Lovelace show." Experiencing her magic is a treasured memory for all who attended the Lovelace Marionette Theater. "In Celebration of Margo Lovelace" is a SURF funded BHA Capstone project intended to rediscover the magic of Margo's theater.

INCUBATOR & PIONEER: THE CARNEGIE TECH DEPARTMENT OF DRAMATIC ARTS

STUDENT Emily Gibson *BHA*
ADVISORS M. Stephanie Murray *BHA* | Steven Schlossman *History*
ROOM/TIME Connan / 12-2:30 pm

The Carnegie Tech Department of Dramatics Arts was the first degree-granting theatre program in the United States. Launched in the spring semester of 1914 by Thomas Wood Stevens, the program broke new ground in theatre education and the practice of theatre arts, both in Pittsburgh and beyond. Steven's model was intended to nurture well-rounded theatre artists in a hands-on environment. This project, which culminates in an essay and a digital exhibit, presents the early years of the Carnegie Tech Department of Dramatic Arts and creates the narrative of how a program and its founder not only pioneered a path to theatre education in American Universities, but inspired others to follow.

MODELING VENTURE DECISIONS: IMPROVING VENTURE CAPITAL INVESTMENT DECISIONS THROUGH MODELS, A PRACTICAL GUIDE

STUDENT Juddson Poeske *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 4:00 pm

Venture Capitalists make new investment decisions almost every day, but on average only report about 8-12 minutes vetting each startup through a business plan, and eventually possibly short interviews. Research has shown, however, that decision-makers of all kinds are rife with biases in their choices, are inconsistence across decisions, and are generally not good at integrating disparate variables into a cognitive model.

This presentation presents a review of evidence suggesting even experts fall prey to these biases, and that models outperform human decision-makers almost every time. Several Venture Capital (VC) decision-making studies are presented providing evidence that even VCs could improve their "hit-rate" of investing in successful startup companies by applying models. This presentation also presents the types of models and important information cues/variables employed in these models, as well as potential resistances towards model utilization in the VC investing field.

MORPHIC LITERATURE: TEXT WITH SPACE AND TIME

STUDENT Andrew Staiger *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 4:20 pm

Traditional literature is a set, linear form. Morphic literature attempts to add the properties of architecture into literature: space and time. These can be added by manipulating how and when the text is displayed, and how the reader interacts with it. Morphic literature thus moves reading from a passive to active engagement.

MUJERES CREANDO: ANARCHY AND AESTHETICS IN FEMINIST PROTEST

STUDENT Anna Shepperson *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 4:40 pm

This presentation will deconstruct the work of Mujeres Creando by contextualizing their aestheticized protest within the context of Bolivian politics and history, as well as considered within the realm of Latin American performance. Through an analysis of individual works, I will argue that their work serves as a more aestheticized demonstration, combining poetic inclinations with street demonstrations or political methods in order to inspire an accessible protest that enacts their ideals of non-western feminism and a reworking of the Bolivian state.

ON NATURAL CURIOSITIES: DISCOVERING THE ANIMAL WORLD THROUGH SELF MOTIVATION

STUDENT Sarah Gao *BHA*
ADVISORS M. Stephanie Murray *BHA* | Stephen Stadelmeier *Design*
ROOM/TIME Peter / 12:00 pm

On Natural Curiosities is a book dedicated to promoting curiosity, engagement, and motivation to discover the natural animal world. The book consists of perplexing individual animal stories told through detailed

illustrations and simple one-line captions. Each spread strives to challenge the reader's preconceived understandings, leaving them unsettled and seeking to fill the gaps in their knowledge and to better understand the story. By using such an approach, I hope to create a more self-directed and therefore more impactful and effective learning experience. My intention is to introduce autonomous discovery of animals in order to not only inspire further interest in the animal world but also to stimulate readers' senses of wonder, curiosity, and connection with the natural world.

POETRY IN MEMORY: AN ILLUSTRATED SERIES

STUDENT Hanbbit Chang *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 12-2:30 pm

This is a series of illustrated poems, or "poemed" illustrations, which reflect on my obsessions in how I deal with memory and how memory itself functions in the human mind. More specifically, the project features several pieces which draw off associations, phrases, and images that have recurred in my past or my attempts at remembering the past. I hope to imitate the way our minds process and recount such associations by fusing impressionistic poetry and fluid/collaged illustrations. None of the characters are anything more than avatars to explore a dream-like landscape and none of the memories take the form of concrete, chronological stories; instead, my project aims to become metaphor for memory, a process we all intuitively use and often take for granted.

PULSE: AN EXPERIMENT ON CONTEXT AND SETTING

STUDENT Laura Contero *BHA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME McConomy Auditorium / 11:30 am

"Set in an ordinary restaurant, a waitress, a professor, and a young man conduct their daily business. But behind the utensils, cash registers, and cookware, lies a manipulated story, and the spectator soon learns that these three individuals represent more than their visual personas suggest." Combining research done on cinema structuralism and the ideas based in re-purposed architecture, this film explores the denotation (literal meaning) and connotation (evaluative meaning) relationship between the environment and the characters on screen.

SPERM BUDDIES: MARKETING ORIGINAL DESIGNER TOYS INSPIRED BY THE LOWBROW MOVEMENT

STUDENT Vanessa Branch *BHA*
ADVISOR Bob Bingham *Art*
ROOM/TIME Connan / 12-2:30 pm

Sperm Buddies is an original series of designer toys; they are directly inspired by the amusing aesthetic of the growing lowbrow movement culture. The large network base and demand for lowbrow, urban art offers profitable professional experience in the areas of production and marketing. Working in the designer toy culture should be perceived as credible as working in neoclassic sculpture; technique, research, vision, and hard work are essential. Sperm Buddies' simple silhouette and dynamic design reflect the minimalistic qualities

that make designer toys so accessible and visually appealing despite their possible mature subject matter. These designer toys help perpetuate the evolving mentality that art's definition is changing and Art should embrace and value the urban artist's aesthetic.

STEEL TOWN SHORT FILM SCREENING

STUDENTS Nicolas Hurt *Business Administration* | Talia Levin *BHA* | Anna Nelson *BHA*
ADVISOR Jane Bernstein *English*
ROOM/TIME McConomy Auditorium / 12:00 pm

We will be screening our 18-minute historical drama film, "Steel Town," which displays the creative talents of the student filmmakers at Carnegie Mellon University while bringing to life a legendary event in Pittsburgh's history. A brief introduction and Q&A session will be led by the film's director, Nick Hurt.

THINK ABOUT SOMETHING ELSE

STUDENTS Kevin Karol *BCSA* | Brian Pettitt-Schieber *BHA*
ADVISOR Lawrence Shea *Drama*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

As the evidence in support of an accelerating global warming mounts, the near-certainty of future climatic catastrophes takes root in our collective consciousness, causing disruption and displacement. A conversation moves through communities, passing from person to person as knowledge is shared and concern is expressed. Each person develops a different understanding of the information at hand, and the issues are complex. Over the course of three months, a broad spectrum of Pittsburgh citizens was interviewed and surveyed on issues of environmental justice, including scientists, government officials, businessmen, activists, and others. Utilizing the server-based dynamic narrative delivery system as developed by sophomore Kevin Karol (BCSA '16), symposium guests can listen to their city speak freely and offer up their own views in solidarity throughout the day.

UPROOTING THE RAMAYANA

STUDENTS Collin Cherubim *Chemistry* | Nicolas Marlton *BHA*
ADVISOR Bob Bingham *Art*
ROOM/TIME Connan / 12-2:30 pm

Wayang has evolved with Indonesia. From its origins at the confluence of Javanese folklore, Sanskrit epics, Hinduism and Buddhism, wayang has been influenced by Islam, Dutch colonization, politics, and pop-culture. During the postcolonial era, western perspectives began to infiltrate an art form founded on a thousand years of traditional knowledge. Thus, wayang has been an element of Indonesian history, faithfully documented for posterity as well as a platform for contemporary artistic innovation. This SURG funded project attempts to bridge the cultural gap separating the contemporary American artist from this discourse.

WIREFRAME: BECOMING A USER EXPERIENCE DESIGNER

STUDENT Emma Young *BHA*
ADVISORS Catharine Fichtner *Computer Science* | M. Stephanie Murray *BHA*
ROOM/TIME Dowd / 4:00 pm

My exploration of design and business.

WOMEN IN WORK: A RHETORICAL ANALYSIS OF HOW MEDIA IMAGERY INFLUENCED A CHANGE IN GENDERED LABOR NORMS

STUDENT Kayla Heglas *BHA*
ADVISOR James Wynn *English*
ROOM/TIME McKenna / 3:40 pm

This research looks at the change in woman's identity from before WWII to during WWII. The project draws upon propaganda deployed under government appointment through the 'Womanpower' campaign and analyzes selected imagery using Burke's Pentadic Analysis. We see that there is a stark difference between woman in prewar imagery and war imagery due to the campaign's deployment, and it can be seen that imagery was used as an important rhetorical tool used to shape society both before and during wartime.

WONDERFUL EXPRESSION: ESSAYS ON THE DRAMATIC WORKS OF OSCAR WILDE

STUDENT Emily Gibson *BHA*
ADVISOR Megan Rivas *Drama*
ROOM/TIME McKenna / 4:20 pm

This collection of original essays delves into the topic of Oscar Wilde's plays from a dramaturgical perspective, reuniting the literary scholarship of Wilde studies with the plays' rightful home: the theatre. Essay topics include a case study on SALOME, Wilde's changes in writing style, contemporary and historical influences on Wilde's work, the difficulty in modernizing Wildean productions, and the intertextuality between the social comedies and THE PICTURE OF DORIAN GRAY.

BIOLOGY AND PSYCHOLOGY

EXPLORING TOUCH WITHIN STRESSOR DISCUSSIONS OF CLOSE RELATIONSHIPS

STUDENT Lindsay MacGillivray *Biology and Psychology*
ADVISORS Brooke Feeney *Psychology* | Brittany Jakubiak *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Touch is an important component to close relationships; it is used by many couples to indicate closeness and display affection, and touch has been shown to promote physical health by buffering stress (e.g., Ditzen et al., 2007). While touch has been researched in many day-to-day scenarios, little has been done to determine the predictors and effects of touch in a stressful discussion between members of a close relationship. One hundred newlywed couples were videotaped having a discussion about a life stressor, and we coded the types of touch

utilized by the wife during these discussions. The aims of this study were to investigate 1) the types of touch (e.g., affectionate, supportive, grooming, casual) used in stressor discussions, 2) whether attachment style (i.e., individual's orientations toward relationships) predicts the use of types of touch, and 3) whether types of touch used in the interaction is related to satisfaction one year later. This study provides an initial analysis of the types of interpersonal touch that is likely to occur during discussion of individual stressors and the factors that predict and result from interpersonal touch in this context.

LEISURE ACTIVITIES AND WELL-BEING: PART ONE

STUDENTS Luke Masa *Science and Humanities Scholars* | John Ra *Biology and Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The primary goals of this research study are to examine a causal 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 behind such a relation. The study is longitudinal, with the second part taking place 6-8 months after the first part. Fifty participants will be interviewed in-person primarily for their recent volunteer history and level of cognitive functioning in the Spring of 2014 and then again about 6-8 months later in the Fall of 2014. The participants (preferably over the age of 75) will be drawn from the Osher Lifelong Learning Institute (OLLI) at CMU and the University of Pittsburgh through advertisement. The independent variables will be the various aspects of recent volunteer history (e.g., hours spent volunteering in the past year, type of volunteering, motives for volunteering), and the dependent variables will be health, specifically cognitive functioning. The effects of different moderator variables, such as socioeconomic status (SES), on the relation between volunteering and cognitive functioning will also be examined. SES will be of particular interest because previous research has been divided on whether low SES people reap more health and well-being benefits from volunteering or high SES people reap more health and well-being benefits from volunteering. The results from this study could provide convincing evidence favoring one relation and initiate new discussion regarding whether low or high SES people experience less cognitive impairment from volunteering.

SOCIAL STIGMA OF VISIBLE AND NON-VISIBLE PHYSICAL ILLNESS

STUDENT Lazar Lalone *Biology and Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Culturally established social stigma is known to result in negative social and psychological consequences for the bearer and the perceiver of the condition. This laboratory study investigated the effect of visible and non-visible stigmatizing conditions on the perceiver's mood and impressions of the bearer. Sixty-one undergraduate participants were made to believe they would be interacting with another student whose condition's visibility had been manipulated. It was hypothesized that the perceiver would report more negative impressions when the bear's condition was visible versus non-visible and that both would be more negative than control. It was also believed that the perceiver would implement the norm to be kind to the stigmatized and would present a more favorable, positive mood than they were truly feeling in the stigmatized conditions compared to control. Results showed no difference in perceptions across any of the conditions. However, while non-significant, the expected mood change was observed for both anxiety and well-being measures. It is believed that the nature

of the questionnaire may have prevented meaningful results from being drawn in regard to the perceptions of the stigmatized individual, but the results of the less overt mood measure seemed promising for future work.

BSA

A GENETIC BLUEPRINT FOR THE FUTURE OF FASHION: A STUDY OF THE COMMODITIZATION OF HUMAN TRAITS AND ABNORMALITIES

STUDENT Jessica Waldman *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

I am interested in producing commercial-looking advertisements and magazine features with a direct focus on the commercialization of physical curiosities that perpetuate new standards of aesthetics. I plan to do so using what I have learned about portrait photography and styling, as well as by conducting research into genetic abnormalities, desirable physical values, and the history of the fashion industry's use of unique traits to sell a product or image. This field of research is important to me because it impacts me directly, as a follower of current fashion and aesthetic values. We live in a world where our genetic luck can be corrected for through medical procedures, human genetic engineering, and beyond, and I feel that this phenomenon deserves a further exploration in the smaller context of what this means for the appearance of humankind. As a final product, I plan to create a mock magazine featuring editorial and commercially styled photography that can serve as a prototype for the packaging and commoditization of extreme manipulation of the human form.

ART, SCIENCE, AND THE SUBLIME

STUDENT Anna Mohr *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 12-2:30 pm

This project deals with the concept of advertising science in a silly way, through posters and t-shirts. Additionally, there will be a written component, and a series of interviews will be done. The goals of my capstone will include educating and entertaining the audience with science, and provoking them to think differently about art and science. I want to enable scientists to see art for what is truly is, and to get artists to see what it truly is, to raise awareness of the absolute mindblowing quality of science.

CREATIVITY ACROSS DISCIPLINES

STUDENT Elena Peterson *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

The goal of this project is to examine the concept of creativity and how it manifests itself within different disciplines. While creativity has traditionally been thought of as a property of the arts, this project hopes to show the omnipresence of this quality throughout different fields. CMU professors from various departments

were interviewed, each giving their own perspective on what it means to be creative within their own area of study.

EXAMINING THE PSYCHOPHYSIOLOGICAL RESPONSE TO PITCH-RANGE MANIPULATIONS IN MUSIC

STUDENT Philip Zakko *BSA*
ADVISOR Richard Randall *Music*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Music serves a wide variety of functions, from the pleasure of listening to its therapeutic uses; however, an aspect of music that is not well understood is how music's frequency range can elicit various emotional responses. Through gathering self-reports and analyzing the skin conductance of human subjects who will listen to various generated musical excerpts, I will determine the correlation between frequency and valence and arousal; valence is defined as the attractiveness or averseness, positive or negative valence respectively, of an event while arousal is a measure of reactivity to stimuli. These results will be used to help people understand how music shapes human behavior and responses, and they will also be used to look further into music's therapeutic abilities, from relieving stress to depression. Ideally, this study will open the door for additional research on the mechanisms of the brain and body that respond to music.

LOOKING TO THE PAST FOR A FUTURE OF SUSTAINABILITY : AN EXPLORATION OF THE ENERGY BASED DESIGN SOLUTIONS OF THE VERNACULAR ARCHITECTURE OF THE SOUTHWEST

STUDENT Madeleine Robson *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Peter / 3:40 pm

I originally entered the BSA program (Math and Architecture) because of an interest in architecture, particularly in the area of sustainability.

I saw the program as a good way to be able to have a more self directed study, allowing for learning in areas outside of what I would traditionally have access. My project is intended to combine my two concentrations.

This project was inspired by two courses I took, American Regionalism and Environment I: Climate and Energy, and by a presentation I saw as part of a lecture series. At this presentation, the architects were lauded for their buildings envelope, which was inspired by features on local structures. It was considered an innovation to take in the historical built context of a site. However, in the American Regionalism course, I saw example after example from history of buildings and design strategies that were a result of climate. These responses are ways to improve a building's performance without mechanical systems, and could be solutions to problems of current projects, but it doesn't seem like it is common to look at them in such a way.

I hope to, through this project, bring to light to these. Specifically, I intend to locate design qualities within the pre-Industrial architectural history of a region within the United States and show the quantitative impact such traits have on a building's performance, specifically heating and cooling loads.

The importance of the historical research of this project is that with industrialization and the introduction of climate control mechanisms, the importance of designing for the environment a house was located in decreased. I anticipate that the most valuable elements will be pre-industrial because of this. The importance of the calculations of this project will be to prove that such strategies are actually of value, it does no good to

my argument if historical methods have no hope of competing against modern mechanical systems.

If I am successful, I hope to present an argument for using local historical types to inform the design process of a project. I intend to approach this as an exploratory challenge, starting with a "standardized" house, and see how much can I affect the building's load using only design methods from the area's history. I intend for this, in itself, to mirror how an architect or engineer on a project could explore such solutions within their own project. That is, given a location and the house that is currently proposed, how could a person then suggest improvements.

Secondary Objective: Additionally, it seems to be a trend in projects for sustainable design to be excluded, or involved late or intermittently, for fear of additional costs and labor. Sustainable design can be a luxury, expensive to implement with a long time to pay off. Because of this, it is often hard to persuade a client, or even the architect or builder themselves, that it is a worthwhile investment of money, labor, time, or education. I hope to show that sustainability need be neither expensive or esoteric; that it can be accessible and viable even within the limits of a student's education.

ONCOLYTIC VACCINIA VIRUS EXPRESSING ALDEHYDE DEHYDROGENASE AS A CANCER STEM CELL VACCINE

STUDENT Erica Moore *BSA*

ADVISORS Mary Braun *Biological Science*s | M. Stephanie Murray *BHA*

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

We are exploring the benefits of targeting selected, alternative antigens. One immunotherapeutic benefit of OV is that the immune response raised against the tumor as a result of viral replication automatically targets multiple and relevant tumor antigens (released after viral lysis of cells in the tumor) without the need for phenotyping of the tumor or processing of biopsy material ex vivo. However, these antigens will primarily be those expressed on bulk tumor cells. As a result, targeting of cell types found only as rare populations in the tumor may not be achieved. In particular, even though oncolytic vaccinia was shown to destroy cancer initiating cells (CIC), the limited number of these cells in the tumor means that it is unlikely any immune response targeting antigens specific to CIC will result. As a result, although it is believed that boosting the immune response against bulk tumor antigens (through their expression from IOV) will provide a significant therapeutic benefit (Aim 2), additional expression of CIC-specific antigens would provide the extra capacity to target this rare sub-population and so would limit the outgrowth of metastasis and tumor relapse.

Dr. Wang (Consultant) has recently described the use of CD8+ T-cells targeting the aldehyde dehydrogenase (ALDH) A1 isoform111 that is expressed on CIC from various cancers including head and neck, breast, melanoma, ovarian and pancreatic cancer111-113. We therefore hypothesize that the expression of ALDH1A1 antigen from UPCI-1812 would provide a further immunotherapeutic boost through induction of CTL specifically targeting this antigen. This additional vaccine effect will help destroy residual CIC, and so would be expected to reduce outgrowth of metastases and prevent relapse through clearance of micrometastases and immune surveillance.

REASSESSING THE DEBATE REGARDING MAURICE RAVEL'S LAST COMPOSITIONS AND HIS NEUROLOGICAL DEGENERATION

STUDENT Angela Lo *BSA*
ADVISOR M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5 pm

Maurice Ravel, a 20th century classical composer, was one of France's most notable musicians. He was known for the intensity of his melodies, and his masterful use of instrumental textures and orchestral effects. By the time Ravel was in his early fifties, those closest to him noticed incidents where Ravel lost fine as well as general motor control. Before his death, Ravel could not even write down the letters of the alphabet, let alone notate music. Because of such neurological deterioration, musical historians and neurologists have hypothesized his diagnosis and how such deterioration may have impacted his last works. This research paper tries to evaluate this debate and discusses how some of the arguments presented may not be completely valid. Due to the subtleties of neurological disorders, evidence provided by one side of the debate can also be explained differently in support the opposing side. Because the neurological advancement was limited during Ravel's time, there is not enough evidence to determine what Ravel suffered from. And without such definitive answer, it is difficult to prove that Ravel's disease did in fact affect his last compositions.

SYNTHESIS OF INHERENTLY CHIRAL TETRAHEXAHEDRAL GOLD NANOPARTICLES

STUDENT Alexander Petti *BSA*
ADVISOR Nisha Shukla *ICES*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

The observation of gold chiral nanoparticles has always been of interest to the pharmaceutical industry as proper separation of R and S enantiomers is crucial to the successful preparation of certain drugs. In a further observation of the separating effects of probe molecules on chiral gold nanoparticles, the researchers attempted to synthesize gold nanoparticles with L- and D-cysteine already attached to the ligands of the particles.

UNCERTAINTY IN MEDICINE: A CASE STUDY IN AUTOIMMUNITY

STUDENT Erica Moore *BSA*
ADVISORS Caroline Acker *History* | M. Stephanie Murray *BHA*
ROOM/TIME Dowd / 3:40 pm

Autoimmunity is defined as the body producing antibodies that attack the body's cells and tissues. This process can sometimes be beneficial, as when it removes cancerous cells. In other cases, the antibodies can attack healthy cells, resulting in a range of diseases and disorders. These disorders have been continuously encased with uncertainty. While physicians first proposed the idea of autoimmunity around 1900, scientific consensus on the existence of autoimmune diseases did not form until the 1960s. Even today, uncertainty surrounds autoimmunity and its diseases. This project explores the historical emergence of autoimmunity and debates over its existence while considering how autoimmunity is addressed in medical practice. This thesis will analyze the events leading towards the universal acceptance of autoimmunity and discuss today's models for addressing autoimmunity, informed by interviews with practicing physicians.

From this analysis, the thesis will draw implications on how researchers and clinicians meet the challenges posed by poorly understood or complex disease conditions.

COMPUTATIONAL BIOLOGY

CATEGORIZATION OF HORIZONTALLY TRANSFERRED GENES

STUDENT Charlotte Darby *Computational Biology*
ADVISOR Dannie Durand *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Xenologs are defined as genes related through a horizontal transfer event as opposed to through vertical decent. However, this definition encompasses a wide variety of evolutionary histories and relationships among genes in families where a horizontal transfer occurred. A subdivision of the term "xenolog" based on tree topology could potentially shed light on gene function or transfer event history. This project seeks to characterize a relationship between a specific method of xenolog categorization and gene function in order to determine if this particular subdivision is biologically informative. Using phylogenetic software developed in the Durand lab, I categorized xenologous relationships in examples from the literature which posited horizontal gene transfer from prokaryotes to fungi. I investigated whether the distribution of xenolog subtypes in a gene family where a horizontal transfer occurred is correlated to the gene's function.

CHARACTERIZATION OF THE SV40 MICROGLIAL CELL LINE USING QUANTITATIVE PCR

STUDENT Victor Hsue *Computational Biology*
ADVISOR Jason D'Antonio *Computational Biology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Primary cell lines come from patients and are the highest quality cells available for experimentation in the lab. The downsides of primary cells are that they are in very low supply, cost a great deal, and take very long to prepare. Due to these issues, immortal cell lines are preferred for use in the laboratory. Immortal cell lines arise from mutations in oncogenes that cause indefinite division. These mutations can either occur naturally or be induced artificially in the lab. Immortal cell lines come with their own risks though, as the oncogenes used to create them may have unintended effects on the cell. Before a newly discovered or synthesized immortal cell line can be used, it must be characterized by ensuring that it behaves in the same manner as the primary cell line it models. SV40 is a new artificially created immortal microglial cell line, and has not yet been characterized. In this experiment, I will be characterizing SV40 to determine whether respond to LPS in the same way as a primary microglial cell line. I will be using quantitative PCR to calculate the up and down-regulation of different genes under various drug treatments for both SV40 and a primary microglial control cell line. I will then compare the two results to determine the usefulness of SV40 as a lab substitute for primary microglial cells.

GENERATIVE MODELS OF THE SPATIAL ORGANIZATION OF NEURONS

STUDENT Rebecca Elyanow *Computational Biology*
ADVISOR Robert Murphy *Computational Biology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:00 am

The ability to understand and predict the behavior of cells is a major goal of systems biology. To accomplish this goal it is necessary to understand the complex network of interactions within cells and how these are

spatially organized. CellOrganizer is open source software that can be used to create conditional generative models of cellular organization for numerous cell types from microscopy images. These models capture important characteristics, such as nuclear shape, cell shape, vesicular size, frequency and location, and microtubule distribution, and can be used to synthesize new images that are statistically similar to experimental training data. However, some cells, such as neurons, have highly complex shapes that require specialized models. In this work we extend CellOrganizer to generatively model the spatial organization of neurons. To create the model, the number of neurites and the relative positions of the each neurite on the soma are drawn from distributions learned from image data. The neurites are then 'grown' using a stick-breaking process. Previous software has been published to generatively model neuron structure including TREES, L-Neuron, Netmorph, and NeuGen, Unlike previous approaches however, our models leverage the conditional structure of CellOrganizer to learn the relationships between neurite shape, number, length and distribution, soma shape, and subcellular protein distributions. These models can be used to describe the differences between various neuron types and changes in neuronal organization under various conditions.

DIETRICH COLLEGE OF HUMANITIES & SOCIAL SCIENCES

ECONOMICS

CONSUMER BEHAVIOR IN UPGRADING TECHNOLOGICAL GOODS

STUDENTS Akwasi Brefo *Economics* | Maya Geleroff *Economics* | Zaneta Grant *English* | Michelle Lin *Social & Decision Sciences*

ADVISOR Rebecca Lessem *Economics*

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

We have taken usual behavioral economic theories applied to generalized consumer behavior and applied them specifically to technological good purchasing choice. Factors such as normative versus informational decision making, anchoring bias, and income effects have been proven to be significant influencers in consumer choice of technological goods.

DATA SWAPPING OF CENSUS RECORDS

STUDENT Peter Sadosky *Economics*

ADVISOR Rebecca Steorts *Statistics*

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

Protecting the privacy and confidentiality of its respondents is a critical part of the U.S. Census Bureau's work. To this end, it has turned to data swapping. Data swapping is a statistical measure of disclosure protection for a database. Prior to a public release of a Census database, data swapping is performed to impute/redistribute individual records to ensure the privacy of each respondent's personal information. In this project, three forms of data swapping (randomized, targeted, and high-match) are evaluated for their privacy protection as well as their data utility. We find that targeted swapping (proposed by Shlomo, Tudor, and Groom 2010), which assigns a risk value to each record and swaps proportionally to the level of risk, produces a database of records with the highest balance of data utility and privacy control.

FACULTY COURSE EVALUATION

STUDENTS Shivika Dhar *Statistics* | Shannon Ho *Business Administration* | Hyo Na Lee *Economics* | Yuxuan Li *Statistics* | Kristina Schiffhauer *Statistics*

ADVISOR Grant Weller *Statistics*

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

Explore the different methods of FCEs and their effectiveness. Look for ways to have higher response rates that is to have more students fill out the FCEs. Through FCEs, give students more information about courses and corresponding instructors. Use FCEs to help students make wiser choices in choosing courses.

PUBLIC HEALTH AND TUBERCULOSIS MORTALITY DURING THE FRAMINGHAM TUBERCULOSIS DEMONSTRATION

STUDENT Avery Calkins *Economics*
ADVISOR Karen Clay *Economics*
ROOM/TIME Dowd / 12:40 pm

Between 1900 and 1940, tuberculosis declined rapidly in the United States, even though there was no effective medical treatment or vaccine for tuberculosis until after the Second World War. Public health improvements are often used to explain the decline in tuberculosis, and studying what public health improvements helped in the United States can help combat tuberculosis in the developing world today.

Little quantitative research has been done on the decline of tuberculosis in the United States. My project investigates the little-known Framingham Community Health and Tuberculosis Demonstration, during which several public health improvements were made on the small town of Framingham, Massachusetts to reduce tuberculosis incidence and mortality, to find which public health improvements were effective in reducing tuberculosis.

SALARY EXPECTATIONS FOR CARNEGIE MELLON UNIVERSITY STUDENTS

STUDENTS Rachel Cohen *English* | Marko Hudak *Economics and Statistics* | William Sanders *Economics* | Stephanie Stern *Social & Decision Sciences* | Olga Zubashko *Economics and Statistics*
ADVISOR Grant Weller *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The significance of formal educational attainment on achieving future employment and high wages incentivizes many high school students to attend college. These students often take out numerous loans and exit college indebted to the government and other private sources.

This begs the question: are students expecting higher education to pay off in a large capacity? Are students overestimating how much money they will be earning in the future and graduate college not being able to pay off their accumulated loans? Within this study, we hope to understand the difference between students beliefs of how much they will be making and their true salaries. Our possible client is the Career Center at Carnegie Mellon University, aiming to educate students better on their prospects.

TEPPER STUDENTS' ATTITUDE TOWARDS CURRENT GRADING SYSTEM

STUDENTS Karthik Annaamalai *Business Administration* | Andres Anzola *Economics* | April Jianto *Business Administration* | Dixon Liang *Business Administration* | Jisoo Park *Statistics*
ADVISOR Trent Gaugler *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Grades are not only an indication of how well a student is performing, but also a hiring criterion for employers and graduate schools.

Recently, controversy over Harvard's grading system has gained national media attention. Some schools, most notably Harvard, are known for grade inflation, while others, such as MIT, are known for grade deflation. As Tepper attempts to move forward in national rankings, it's important for university officials to understand a range of grading alternatives.

Recently, the undergraduate Tepper administration has been implementing grading policy changes including introducing a grade cap on the maximum number of students who receive an A grade in a particular class at 30% of the class size. The administration is also evaluating additional alternatives. Thus, our findings can have a substantial impact on the future policies that Tepper may introduce. This survey needs to be conducted now because of the immediate consequences for the future of students. Unlike the leniency of some employers in other fields, business employers arguably view GPA as the most important factor for consideration. For example, employers often have a set GPA requirement for most jobs in business, with 3.3/4.0 being the most common. The requirement isn't school specific, but is standard across all schools and thus, does not take into consideration the distribution of grades at any particular school.

University officials, from career center employees to school deans, can use this research to better understand, adjust grading systems, or inform employers or graduate institutions to put students in competitive positions relative to their peers.

The main question we hope to answer in this project is "Do undergraduate Tepper students prefer the hybrid grading system that is currently used, which combines both absolute grading scales and relative curved grading scales? If not, what alternatives are most popular?"

Tepper's undergraduate business program currently employs a hybrid grading system where some classes use an absolute grading method while others a relative one. Given that students understand the current system, it is possible that students prefer an absolute grading system because it can lend itself to a more collaborative environment in which students are less likely to compete with one another. Because of this synergistic climate, students may feel more comfortable to share their ideas and unique perspectives and in turn create a better learning experience.

THE FEASIBILITY OF AN ALTERNATIVE BUS PLAN FOR CMU

STUDENTS Steven Chang *Economics* | Sung Jin Hong *Economics and Statistics* | Daniel In *Economics and Statistics* | Hyejin Lee *Economics and Statistics* | Hyun Suh Lee *Statistics*

ADVISORS Trent Gaugler *Statistics* | Grant Weller *Statistics*

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

CMU undergraduate students were charged $60 transportation fee this semester. Clearly, this is an expenditure that cannot satisfy every student in CMU, especially if one feels he or she is not riding enough buses over the years they study here. CMU's original intention to benefit students through a convenient and defaulted bus system is viewed differently by the students. We would like to investigate CMU students' attitudes towards this system and the CMU free shuttle services. Now that the PAT smart-card system works with CMU IDs, studying the feasibility of an alternative bus plan (where students have the option of purchasing a bus pass or not) by exploring the students' "utility functions" towards the two respective transportation means could help university leaders perform their cost-benefit analysis of potentially implementing a new transportation system.

The Port Authority has seen a fair share of financial problems, so the university and its students should plan for future transportation contracts accordingly. Back in the fall of 2009, Carnegie Mellon students were charged $40.00 per semester, a rate that has risen to $60.00 today, and $120 for the coming fall. In addition, the number and frequency of bus routes have been continuously decreasing. In other words, every year, students are paying more for lesser service. Today, the university may find it financially beneficial and ethically appropriate to establish alternative means of transportation or expand its own free shuttle services for students.

USING SURVEYS TO IMPROVE COMPUTING@CARNEGIEMELLON

STUDENTS Noah Cohon *Economics* | Maya Geleroff *Economics* | Matthew Greenberg *Economics* | Maksim Horowitz *Statistics* | Jana Motie *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

Through a randomized distribution of surveys given to undergraduate students, our research team gathered opinions regarding new content for the Computing@CarnegieMellon course. With a goal of revolutionizing the course to make it more applicable to all students on campus, our research question was "What content should be included in the Computing @ Carnegie Mellon course in order to help students succeed, overall, at Carnegie Mellon?". After surveying 245 students, a majority felt negatively toward the course before they took it and thought it had not truly helped them succeed at Carnegie Mellon. However, the proposed course changes brought up by an undergraduate faculty review board were received positively by a slight majority of students we sampled.

ECONOMICS AND STATISTICS

A METHOD FOR DISTINGUISHING BETWEEN HOMOPHILY AND CONTAGION IN SOCIAL NETWORKS

STUDENT Hannah Worrall *Economics and Statistics*

ADVISOR Cosma Shalizi *Statistics*

ROOM/TIME Wright / 12:00 pm

It has been shown that it is impossible to distinguish between homophily and contagion in social networks without strong assumptions.

However, I show that it is possible to control for homophily by controlling for network community in circumstances where community detection is consistent. This method provides a way to determine if contagion is present in a network.

CMU DINING SURVEY

STUDENT Marcus Anthony *Statistics* | Asad Meghani *Statistics* | Charles Primbas *Self-defined* | Sam Waters *Economics and Statistics*

ADVISOR Trent Gaugler *Statistics*

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

Our research group conducted a survey, taken from a simple random sample of all CMU undergrads, to determine their dining preferences, priorities, and evaluations of current CMU dining options in order to maximize student utility gained from on-campus dining.

COMPARING PROPENSITY SCORE METHODOLOGIES FOR ANALYZING HIGH SCHOOL CLASS ASSIGNMENT

STUDENT Zachary Branson *Economics and Statistics*
ADVISOR Howard Seltman *Statistics*
ROOM/TIME Wright / 1:20 pm

Students' class assignment is extremely relevant to their academic achievement, but the problem of assigning a student to the correct class is difficult to assess. It may not be clear whether a student should be placed in remedial, regular, or advanced math classes, but it could greatly affect how a student does in school. All school districts face this problem, but the solution is not readily apparent. This project assesses several methodologies – focusing on propensity scores – to analyze this problem, and determines which one is most effective for analyzing school data.

One can view class assignment as a causal inference problem, where class assignment is a treatment. In reality a student is assigned to only one class difficulty, and we want to determine how their academic achievement would be affected if they were, counterfactually, assigned to a different class. Thus, we want to determine the treatment effect of class assignment. Propensity scores are a common way to analyze observational data to assess treatment effects when the treatment is nonrandom. Class assignment is nonrandom because school districts likely use students' test scores, grades, and other information for their class assignment.

There are several methodologies for utilizing propensity scores, but it isn't clear which one is the most useful for analysis. This project compared methodologies such as (1) including hierarchy in modeling propensity scores, (2) matching, and (3) stratifying propensity scores to determine which was the most effective with the purpose of analyzing real-world data from Pittsburgh Public Schools.

DE-DUPLICATION OF CIVIL WAR KILLINGS IN EL SALVADOR

STUDENTS Daniel In *Economics and Statistics* | Karn Mishra *Statistics* | Joseph Pane *Statistics*
ADVISOR Cosma Shalizi *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Several people were killed during the civil war between the Salvadoran Government and the left-wing guerrilla Farabundo Marti National Liberation Front (FMLN) in El Salvador from 1980 to 1991. Our primary focus is the reporting of these deaths. In some instances, the same death was recorded multiple times. De-duplication removes duplicate records from one list or database without unique identifiers but the purpose of this project is to come up with a methodology to determine who is who. The El Salvador database contains name, date of death, and location from 4 different sources. We will use this data to develop a methodology that will establish a hand matched dataset to train on in order to identify duplicate records. Ultimately, we want to be able to estimate the number of unique deaths.

DIETRICH COLLEGE FRESHMAN SEMINAR EVALUATION

STUDENTS Megan Garvey *Business Administration* | Anas Hoque *Economics and Statistics* | Bryan Ketterer *Statistics* | Anton Razanav *Economics* | Christopher Wysocki *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

An evaluation of the Faculty and Student perspectives on the Freshman Seminar Program. The evaluation includes perspectives on whether or not the goals of the program are achieved as well as analysis of downstream effects generated from the FS.

SALARY EXPECTATIONS FOR CARNEGIE MELLON UNIVERSITY STUDENTS

STUDENTS Rachel Cohen *English* | Marko Hudak *Economics and Statistics* | William Sanders *Economics* | Stephanie Stern *Social & Decision Sciences* | Olga Zubashko *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

The significance of formal educational attainment on achieving future employment and high wages incentivizes many high school students to attend college. These students often take out numerous loans and exit college indebted to the government and other private sources.

This begs the question: are students expecting higher education to pay off in a large capacity? Are students overestimating how much money they will be earning in the future and graduate college not being able to pay off their accumulated loans? Within this study, we hope to understand the difference between students beliefs of how much they will be making and their true salaries. Our possible client is the Career Center at Carnegie Mellon University, aiming to educate students better on their prospects.

STRESS LEVEL AT CMU AND SOLUTIONS

STUDENTS Aashna Singh *Economics and Statistics* | Hannah Worrall *Economics and Statistics* | Tony Zhang *Mathematics* | Ruiqi Zhao *Business Administration*

ADVISOR Grant Weller *Statistics*

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

There are many surveys that have been done at CMU asking about students' stress level and their health condition related to stress.

However, few surveys digged into the real sources of stress and possible solutions to cope with stress. As students who work under the stressful environment, we are more interested in learning about what we can do or what can be done by the school to solve the stress problem.

Our research question for the survey is to find out the real sources that contribute to the stress culture at CMU and what can the university or professors do about it. There are mainly 6 sources of stress that have been targeted in this study: Coursework, Extracurricular activity, Sports, Job Search, Employment, and Stress Culture (Peer Competition). We want to find out if any of the sources specifically has a significant impact on students' stress level or it is a combination of several sources. We also proposed some solutions in our survey and attempted to find students' opinion on each of the solutions proposed and tried to figure out the most effective solution. Some solutions we proposed in the survey included workshops for professors to deal with students, stress support groups and mandatory campus wide events to deal with stress. We plan to suggest our findings to CMU administration and Academic Development Staff for implementation to benefit all CMU students.

THE FEASIBILITY OF AN ALTERNATIVE BUS PLAN FOR CMU

STUDENTS Steven Chang *Economics* | Sung Jin Hong *Economics and Statistics* | Daniel In *Economics and Statistics* | Hyejin Lee *Economics and Statistics* | Hyun Suh Lee *Statistics* | Trent Gaugler *Statistics*

ADVISOR Grant Weller *Statistics*

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

CMU undergraduate students were charged $60 transportation fee this semester. Clearly, this is an expenditure that cannot satisfy every student in CMU, especially if one feels he or she is not riding enough buses over the years they study here. CMU's original intention to benefit students through a convenient and defaulted bus system is viewed differently by the students. We would like to investigate CMU students' attitudes towards this system and the CMU free shuttle services. Now that the PAT smart-card system works with CMU IDs, studying the feasibility of an alternative bus plan (where students have the option of purchasing a bus pass or not) by exploring the students' "utility functions" towards the two respective transportation means could help university leaders perform their cost-benefit analysis of potentially implementing a new transportation system.

The Port Authority has seen a fair share of financial problems, so the university and its students should plan for future transportation contracts accordingly. Back in the fall of 2009, Carnegie Mellon students were charged $40.00 per semester, a rate that has risen to $60.00 today, and $120 for the coming fall. In addition, the number and frequency of bus routes have been continuously decreasing. In other words, every year, students are paying more for lesser service. Today, the university may find it financially beneficial and ethically appropriate to establish alternative means of transportation or expand its own free shuttle services for students.

USING SURVEYS TO IMPROVE COMPUTING@CARNEGIEMELLON

STUDENTS Noah Cohon *Economics* | Maya Geleroff *Economics* | Matthew Greenberg *Economics* | Maksim Horowitz *Statistics* | Jana Motie *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

Through a randomized distribution of surveys given to undergraduate students, our research team gathered opinions regarding new content for the Computing@CarnegieMellon course. With a goal of revolutionizing the course to make it more applicable to all students on campus, our research question was "What content should be included in the Computing @ Carnegie Mellon course in order to help students succeed, overall, at Carnegie Mellon?". After surveying 245 students, a majority felt negatively toward the course before they took it and thought it had not truly helped them succeed at Carnegie Mellon. However, the proposed course changes brought up by an undergraduate faculty review board were received positively by a slight majority of students we sampled.

ENGLISH

A HISTORICAL AND RHETORICAL ANALYSIS OF TWO GENETIC SCREENING PROGRAMS

STUDENT Michael Setzer *English*
ADVISOR James Wynn *English*
ROOM/TIME Dowd / 12:00 pm

With increasing technological advancements, never has the field of genetics had the potential to affect such a large portion of the population. While scientific and medical professionals have emphasized the importance of genetics and genomics in clinical settings, little research has been done on how to best develop and communicate implementation of these technologies. This paper looks at the historical context and rhetorical frames of two genetic screening programs that caused considerable public outcry - sickle cell anemia screening in the 1970's and screening recommendations for chromosomal abnormalities in 2007. I find that poor social awareness and a strict focus on scientific risk assessment in frames are some of the primary causes for each program's respective controversies. Moving forward, healthcare leaders will need to have greater cultural and rhetorical awareness; frames must be developed from both scientific and social considerations with substantial public input.

A NARRATIVE APPROACH TO UNDERSTANDING STRESS CULTURE

STUDENT Haley Bryant *English*
ADVISOR Linda Flower *English*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

The so-called "stress culture" at Carnegie Mellon continually threatens to diminish the physical, mental, and emotional health of students.

The University is currently combatting the negative effects of stress by launching new initiatives and providing additional resources to students for identifying and dealing with stress. However, there is a more deeply rooted aspect of CMU stress culture that stems from the inter/intrapersonal relationships students have with the CMU community and with each other. My project aims to break down the Carnegie Mellon community's constructions and definitions of stress through storytelling. The project will culminate in a performance of a series of dialogues and monologues inspired by the results of critical incident interviews conducted through the class 76-355: Leadership, Dialogue, and Change.

ARGUMENTATION AND REPRESENTATION: A CASE STUDY OF HOW POLITICAL ARGUMENTS ARE REPRESENTED IN PRINT NEWS

STUDENT Allison Cosby *English*
ADVISOR Chris Neuwirth *English*
ROOM/TIME McKenna / 12:00 pm

This thesis is an in-depth case study that examines how major policy speeches containing extended arguments are condensed and reported in written news sources, specifically looking at what claims and evidence are omitted and how such omissions might affect media consumers. Kathleen Jamieson's seminal study, Eloquence in an Electronic Age: The Transformation of Political Speechmaking, documented how radio and TV "shrink"

political discourse, but less is known about this process for newspapers. Although newspapers and digital publishing platforms typically have more extended coverage than radio or TV, they nevertheless engage in accommodations that require omitting key components of more extended political arguments.

This study focuses on two instances of political argumentation and their subsequent news media representations: President Obama's ABC News interview in which he came out in support of same-sex marriage in May 2012 and Obama's address to Congress on the need for health care reform from September 2009. In each case, the argument is broken down into its major claims, then traced through a variety of liberal and conservative mainstream and independent news sources, selected because of their large readerships. The analysis shows that news outlets excluded major claims from these political arguments, instead choosing to highlight simply the overall position or focusing solely on the anecdotal evidence provided with the argument. For example, of the six major claims in Obama's same-sex marriage interview, news outlets tended to directly report an average of 1.8 main claims (30.5% of the claims), while sometimes indirectly including one or two of the others. Many media outlets also chose to exclude claims that individuals on both sides of the political spectrum might agree on, therefore contributing — and perhaps escalating — the controversy surrounding these issues.

CONSUMER BEHAVIOR IN UPGRADING TECHNOLOGICAL GOODS

STUDENTS Akwasi Brefo *Economics* | Maya Geleroff *Economics* | Zaneta Grant *English* | Michelle Lin *Social & Decision Sciences*

ADVISOR Rebecca Lessem *Economics*

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

We have taken usual behavioral economic theories applied to generalized consumer behavior and applied them specifically to technological good purchasing choice. Factors such as normative versus informational decision making, anchoring bias, and income effects have been proven to be significant influencers in consumer choice of technological goods.

EXPLORING LINGUISTIC STRUCTURE IN SHORT FICTION: BUILDING THE CASE FOR COLLABORATION BETWEEN LITERARY AND TECHNICAL ANALYSIS

STUDENT Colleen Eagan *English*

ADVISOR Peggy Knapp *English*

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

This project serves as an exploratory glimpse at possible future of literary study. It takes a research experiment approach to a typically humanistic field with the intent of demonstrating a need for linguistic and literary collaboration. I argue the usefulness of technical analysis in performing literary research, to show the value in using objective measures in a traditionally subjective approach. In order to illustrate this, I pose the following research questions to be explored: does the genre classification of a fiction text have a structural element? If so, to what can the structural differences be attributed? Are the differences related in any way to the content of the stories themselves? I attempt to answer these questions by analyzing short stories from the 1940's-1960's in a series of three case studies, examining three linguistic features of short fiction: narrative mode, information-status of the pivot nominal, and subordinate clausal structure. I conclude with a discussion of what this type of collaborative research adds to literary study and the potential growth of the digital humanities field.

GIRLS AT THE LAKE AND OTHER STORIES

STUDENT Laura Stiles *English*
ADVISOR Jane McCafferty *English*
ROOM/TIME Peter / 2:00 pm

"Girls at the Lake and Other Stories" is a collection of fiction and creative non-fiction that aims to accomplish three main goals: to explore childhood and memory, invite readers to consider and empathize with the world in a new or forgotten light, and raise awareness of social issues, all through the power of storytelling. Strongly influenced by the socially-minded work of authors Ruth L. Ozeki and Gene Weingarten, this collection considers a broad range of themes including grief, violence, sexuality, discrimination, and love through both fictional and non-fictional lenses. It is in essence an exploration of how I grapple with personal tragedy, how I attempt to fight for what matters to me, and how I struggle to balance these realizations with an outlook that remembers and appreciates the beauty in the world.

HUBRIS AND OTHER SANITIES

STUDENT Ivy Krislov *English*
ADVISOR Jane McCafferty *English*
ROOM/TIME Peter / 3:00 pm

"Hubris and Other Sanities" is a collection of short non-fiction stories about health and wellness. They aim of the thesis is to reveal the human struggle behind illness.

JENNINGS SCHOLARSHIP MEETING OF THE MINDS PROJECT

STUDENTS Gabrielle West *English*
ADVISORS Kevin Gonzalez *English*
ROOM/TIME Dowd / 4:20 pm

I will be reading a collection of poetry inspired by the time I spent in Buenos Aires, Argentina last summer.

MORAL MOTIVATIONS AND STEREOTYPE CONTENT

STUDENTS Louis Lamanna *English*
ADVISORS Mina Cikara *Social & Decision Sciences*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Two experiments explore the relationship between stereotype content and norm breaking behaviors in conscious moral reasoning. Stereotype content has been shown to affect empathic and emotional response to transgression, both of which are instrumental in formulating and explicating moral judgments. By manipulating moral dilemmas presented to subjects, the study seeks to uncover if the agent of an action affects our moral judgments and motivations as a function of stereotypes.

OPEN HEART

STUDENT Joshua Claudio *English*
ADVISOR Jane Bernstein *English*
ROOM/TIME McKenna / 12:40 pm

Open Heart is a feature-length screenplay that tells the story of Xui Li, a shy girl adopted by a conservative Christian family in Wilkes-Barre, PA, and her journey in becoming a cardiac surgeon. As Li prepares to attend her brother Jared's wedding, she recalls her traumatic upbringing and the uncouth relationship she shared with her brother.

PITTSBURGH BUCKET LIST

STUDENT Roxanne Hiatt *English*
ADVISOR Andreea Deciu Ritivoi *English*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Many college students do not often leave campus, missing enriching opportunities to explore Pittsburgh and all it has to offer. This travel blog highlights historic places, parks, and cultural icons that should be on every student's Pittsburgh bucket list. The blog combines my personal experiences and photos with intriguing facts and anecdotes to inspire and entice others to visit, along with suggested bus routes and directions.

PRETTY SAD GIRL

STUDENT Hannah Dellabella *English*
ADVISOR James Daniels *English*
ROOM/TIME McKenna / 1:00 pm

Pretty Sad Girl is a collection of poems in two sections that explores my experience with mental illness. The first section deals with clinical depression by examining the treatment process, stigma, symptoms, and the effects of mental illness on relationships. While the poems in the second section are not about depression explicitly, they reflect how the characteristics can linger. These poems deal with heartbreak, grief, and self-esteem. Together, these two parts create a cohesive picture of how clinical depression can affect an individual life, both during depressive episodes and periods of remission.

SALARY EXPECTATIONS FOR CARNEGIE MELLON UNIVERSITY STUDENTS

STUDENTS Rachel Cohen *English* | Marko Hudak *Economics and Statistics* | William Sanders *Economics* | Stephanie Stern *Social & Decision Sciences* | Olga Zubashko *Economics and Statistics*
ADVISOR Grant Weller *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The significance of formal educational attainment on achieving future employment and high wages incentivizes many high school students to attend college. These students often take out numerous loans and exit college indebted to the government and other private sources.

This begs the question: are students expecting higher education to pay off in a large capacity? Are students overestimating how much money they will be earning in the future and graduate college not being able to pay off their accumulated loans? Within this study, we hope to understand the difference between students beliefs of how much they will be making and their true salaries. Our possible client is the Career Center at Carnegie Mellon University, aiming to educate students better on their prospects.

SIGMA TAU DELTA INTERNATIONAL CONFERENCE PRESENTATION

STUDENT Von Wise *English*
ADVISOR James Daniels *English*
ROOM/TIME Pake / 3:00 pm

I presented a collection of poems titled "Lack of Coherence" at the 2014 Sigma Tau Delta International Conference in Savannah, GA. The poems explore the inconsistent and incoherent nature of human thoughts and emotional response, probing the issue, but ultimately succumbing to its reality.

SUBLIMINAL LIMNOLOGY

STUDENT Samantha Dickinson *English*
ADVISOR James Daniels *English*
ROOM/TIME McKenna / 2:00 pm

In June 2011, NASA-funded researcher Felisa Wolfe-Simon and her research group published a highly controversial article, "A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus" in the prestigious journal Science. This article claimed that the bacterium found in Mono Lake in Lee Vining, California was able to substitute phosphorus for arsenic to sustain its growth. Ironically, just 150 earlier, Mono Lake was deemed "lifeless" by Mark Twain in his 1872 novel, Roughing It. The vitality of the lake is still questioned as its restoration is only in the beginning stages. This restoration is counteracting the severe damage (toxic alkali dust storms on windy days and decimation of 99% of ducks and geese) caused by the redirection of its tributaries to meet demands of the Los Angeles water supply in 1941. Overall, not only is Mono Lake a rich site for considering life in a "lifeless" place, but it serves as a microcosm of broader issues in contemporary society concerning uncertain vitality and embodiment of information. Tinted periwinkle and incorporating voices that now haunt me, "if you blink, you'll miss it" and "yo, no," this presentation is a poetic meditation and regeneration of my travels and imagination focused in Mono Lake.

THE CYRUS OF WACO - AN EXPLORATION OF THE LIFE OF DAVID KORESH IN CONCRETE POETRY

STUDENT Matthew Finlay *English*
ADVISOR Gerald Costanzo *English*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This project is what I am calling a "concrete poetry biography" — a synthesis of history, design, and poetry. My goal has been to produce a manuscript of visual poems profiling the life of a historical figure in a compelling and engaging way. The project deviates from traditional applications of concrete poetry in that I am seeking a middle ground between the literal and the abstract; allowing the concrete poems to generate a coherent biographical narrative. The figure I have chosen to profile is the late 20th century religious leader Vernon Wayne Howell, better known as David Koresh, who quickly rose to power in a mystical, prophetic sect of American Protestant Christianity called "the Branch" or "the Branch Davidians." On the strength of his charisma and his sincere belief in his own prophethood, Koresh began to teach a compelling and complex eschatology — or endtimes philosophy — based on the Seven Seals of Revelation and reinforced by other biblical passages. By the early 1990s, Koresh had caught the attention of the U.S. government, both for his implementation of controversial sexual policies within his group, and for his illegal modification and stockpiling

of firearms. In 1993, the ATF (Bureau of Alcohol Tobacco and Firearms) failed in an attempt to raid the Waco, TX compound where Koresh's group was headquartered. A two-month siege ensued. This siege ended in an infamous and catastrophic loss of life that catapulted Koresh into the unique dual status in American consciousness as both a tragic hero and deranged villain.

THE MIGRATION OF MARCY FREEMAN: A NOVEL

STUDENT Colleen Casey *English*
ADVISOR Sharon Dilworth *English*
ROOM/TIME Wright / 4:20 pm

For my honors project, I have drafted a young adult novel about Marcy Freeman, a girl who is uprooted from her home and must adapt to life with a new family. While this new home is much more stable from the reader's perspective, Marcy struggles to appreciate the security and complexity of her new life. I wanted to explore how this character would react to a major life change, and how she would ultimately develop a new understanding of home and family.

TIGER LILY MOM

STUDENT Connie Chan *English*
ADVISOR Jane McCafferty *English*
ROOM/TIME McKenna / 3:20 pm

This memoir is a series of novellas about my relationship with my mother who is a first generation immigrant from China. Our relationship has been shaped by unique cultural challenges as well as universal issues, such as bridging the generation gap to find common ground. My thesis focuses on the poignant moments in both my childhood and adulthood when I felt the intersection of our personalities reached its peaks and valleys. Simply, it is a story that explores the complexities of maternal love and growing with one another.

ETHICS, HISTORY & PUBLIC POLICY

OBJECTION!: AN ANALYSIS OF THE MODERN AMERICAN LEGAL EDUCATION SYSTEM

STUDENT Hannah Loo *Ethics, History & Public Policy*
ADVISOR Joseph Devine *History*
ROOM/TIME Pake / 1:40 pm

This paper presents a review of the current American legal education system and how the system came to be, with an analysis of the history and development of American law schools. This paper attempts to piece together the different parts of the American legal system that have contributed to the development of law schools throughout the history of the United States of America, before moving on to the current controversies of law school. Finally, by drawing from a variety of published sources and various interviews, this paper presents responses to the criticisms and offers a few predictions regarding the future of the American law school.

HISTORY

16TH CENTURY SPANISH BANKRUPTCIES AND LONG TERM EFFECTS OF FISCAL MISMANAGEMENT

STUDENT Sangwook Jeon *History*
ADVISOR Allyson Creasman *History*
ROOM/TIME Dowd / 1:00 pm

The numerous bankruptcies in 16th century Spain under Philip II have been a puzzling mystery to historians for quite literally centuries. The high amount of metallic inflows from American territories to the Habsburg Spanish Empire during the 16th century, combined with its bankruptcies, led many to believe that fiscal management by the Crown was conducted poorly. My research demonstrates how Spain had a much healthier debt-to-equity ratio than both France and England; furthermore, that these defaults by the crown were not necessarily due to fiscal mismanagement, but were demonstrative of the vulnerability of the 16th century Spanish Empire to price shocks. The long run data analysis will clearly demonstrate that even though debt was sustainable, high short-term debt loads can have devastating effects on a sovereign government, especially in conjunction with higher than normal inflationary pressures. This paper aims to correct many misconceptions regarding the Spanish bankruptcies, particularly that of 1575, and to show how the analysis can correlate to even current day debt management by governments.

BEACON - GESTURE SENSITIVE BICYCLE GLOVES

STUDENTS Connor Brem *Computer Science* | Jessica Phoa *History*
ADVISOR Steve Collins *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:45 am

Many bikers use hand signals to inform cars of their intention to turn. However, these hand signals are difficult to see at night, and motorists often misinterpret them. We developed cycling gloves which illuminate LED turn signals when the wearer makes a hand signal. These gloves address two needs: intersections and night-riding are hazardous for cyclists. According to a 2013 study by the National Highway Traffic Safety Administration, 51% of fatal bicycle accidents occurred in the evening, after 4:00pm, and 31% occurred at intersections. The gloves increase a cyclist's visibility at night and allow the rider to better communicate with surrounding motorists.

The gloves also make use of a novel user interface: they track hand orientation and illuminate the appropriate signals automatically, so users do not have to change their behavior in order to use the gloves. Over the course of our research, we have conducted several studies that test the effectiveness of Beacon's interface compared to standard hand signals. Our main objective was to create a product that complemented existing technologies and safety practices.

EVALUATING DEVELOPMENT PROGRAMS THROUGH A PARTICIPATORY FRAMEWORK: BIOGAS TECHNOLOGY AND THE KAMALNAYAN JAMNALAL BAJAJ FOUNDATION

STUDENT Richard Stuver *History*
ADVISOR Nico Slate *History*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

It is not always clear who is included and who has ownership of the international development process. The issue of "participation" has intensified over the last fifteen years following a renewed emphasis on improving health, education, and gender rights. Debates over participation have complicated these targets, set forth in the UN Millennium Development Goals in 2000. The 20th century witnessed significant challenges to the equitable participation of developing regions in engaging with their own development. Additionally, this period gave rise to attempts to redress these issues at both the local and international scale. "Participation" has garnered criticism from some sectors of the development community due to the proliferation of the term in reference to a wide range of theories and practices of varying credibility. Nevertheless, the fundamental concept of participation, i.e. who is included and who has ownership in the process, is a useful framework with which to judge the quality of development enterprises at any scale. Chapter I of this thesis offers a historical analysis of international development that explains both the importance of participation in development and the landscape within which it finds itself today. Chapter II follows with an examination of biogas technology, widely used in developing regions, both as an effective tool in expanding the number of individuals who benefit from and can participate in development programs. Chapter III is a case study of the Kamalnayan Jamnalal Bajaj Foundation, based in Wardha, Maharashtra, India, that identifies the challenges facing NGOs and local groups in carrying out equitable development programs centered on community participation.

EXTREME BEAUTY: BODY IMAGE IN GERMAN AND AMERICAN POPULAR MEDIA

STUDENT Rachel Kuhn *History*
ADVISOR Gabriele Eichmanns *Modern Languages*
ROOM/TIME Dowd / 2:00 pm

Popular media has long been a prominent provider of information about beauty ideals, especially for women and girls. However, the push to achieve these beauty ideals may be becoming increasingly extreme. In both Germany and the United States, genres that promote taking extreme measures to enhance attractiveness have crept into popular media alongside the longstanding genres of chick lit. The latter genre, while often obsessed with a certain concept of female attractiveness, typically provides little more than a reflection of mainstream body image conceptions. In contrast, recent reality series suggest that desire for beauty should warrant plastic surgery or self-harming behavior. This paper is a cross-cultural study that analyzes representations of beauty in Germany and the United States. It will examine German and American chick lit novels and reality television series and utilize studies and documentaries in order to make conclusions about the beauty ideals projected by popular media in each country and to draw comparisons between these representations of beauty.

ON THE COVER OF ROLLING STONE: PHOTOGRAPHS, POLITICS, AND THE PUBLIC

STUDENT Marcy Held *History*
ADVISOR Nico Slate *History*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Photographic communication is inextricably linked with expressions of politics and power. Using Rolling Stone's August 2013 cover image of Dzhokhar Tsarnaev and the ensuing outrage as a case study, I will explore how and why this controversy arose. What happens when an image is used in a context that is interpreted as being a "violation" of either the purposes that image can fill or the content a certain publication can (or should) display? Why was this particular use of Tsarnaev's photograph seen as being a "violation"? How do the prescribed cues of visual culture contribute to this interpretation of the photograph as it was used in this context? How does Rolling Stone's positioning within the current media landscape contribute to this situation? By analyzing this event, an evaluation can be made of how the public perceives what are "appropriate" uses for certain images, the role of print and social media in today's society, and what line divides concepts of "fame" and "notoriety." By understanding instances when visual codes are interpreted as being broken, a clearer view can be gained of what those codes actually are and how they are used and navigated on a daily basis.

RESOLVING THE KASHMIR CONFLICT: THE ROLE OF THE UNITED STATES

STUDENT Kate Fisch *History*
ADVISOR Nico Slate *History*
ROOM/TIME McKenna / 1:20 pm

The conflict in the region of Jammu and Kashmir (here, simply "Kashmir") in South Asia has been described as one of the most militarized conflicts in the world. Initially the subject of a territorial dispute between newly independent India and Pakistan, Kashmir has been at the center of three Indo-Pakistani wars since 1947, the Sino-Indian war of 1962, and countless reported acts of terrorism. Conflict and violence in the region is ongoing, and citizens of Kashmir have increasingly participated in pro-separatist groups, domestically driven insurgency movements, and allegedly, in international terrorist organizations. The intensity of the Kashmir conflict coupled with the international stakes surrounding its resolution call for a distinct change of pace in the peace process. While current U.S. relationships with India and Pakistan are somewhat strained, the presently unsuccessful peace process in South Asia might call for U.S. intervention in order to keep talks moving forward. In addition to illustrating the multifaceted nature of the Kashmir problem, this research project will attempt to design a role for the U.S. going forward, and address both the foreign policy interests at stake and the challenges that would accompany American involvement.

RTD-1 M: A MODIFIED NATURAL ANTIMICROBIAL PEPTIDE

STUDENTS Julia Atwood *Chemistry* | Kevin Long *Chemistry* | Cat Mao *History* | Alexander Orenstein *Biological Sciences*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

RTD-1 is a cyclic antimicrobial peptide in the theta defensin family present in Rhesus macaque, which has been found to be effective against viruses, fungi and both gram-negative and gram-positive bacteria. The mechanism of action works by incorporating itself into the cell membrane using arginine side chains, causing

leakage. Though effective by itself as an antimicrobial agent, the peptide as it occurs naturally is difficult to synthesize due to the three disulfide cross linkages necessary for the tertiary structure of the peptide. This obstacle has been overcome by the incorporation of PNA monomers during solid phase synthesis which replace the functionality of the disulfide cross linkages. Initial tests against gram-positive and gram-negative bacteria displayed similar antibiotic properties to RTD-1 while hemolysis assays indicate that it is nonlytic to human red blood cells. Incorporation of D-amino acid monomers in synthesis decreases chances of pathogens developing resistance. Providing additional mechanisms that target the cell membrane also decrease the likelihood of pathogens developing antibiotic resistance. This is due to the difficulty for pathogens in developing survivable mutations that could effectively change phospholipid bilayer chemistry. In addition, using unnatural PNA molecules reduces the chance of proteases adapting to cleave the peptide. Antibiotic activity could be improved by attaching a hydrophobic tail much like those of Telavancin and Daptomycin, increasing membrane perturbation as well as cellular anchoring. The work builds upon these principles, which will hopefully result in the emergence of a new class of antibiotics with a low chance of obsolescence.

INFORMATION SYSTEMS

ASSISTIVE NAVIGATION TECHNOLOGY FOR VISUALLY IMPAIRED TRAVELERS

STUDENTS Alekhya Jonnalagedda *Mathematics* | Lucy Pei *Business Administration* | Ming Y. Wu *Information Systems*
ADVISOR Mary Bernardine Dias *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

We explored different avenues through which computing technology can enhance the safety and independence of visually impaired people as they navigate transit stations such as airports, train stations, bus depots, etc. First, we studied the related work in the literature. Having established this foundation, we gathered information from a variety of relevant stakeholders through observation, interviews, and surveys.

The goal of this needs assessment was to understand the specific challenges, needs, existing solutions, governing policies, and ideas for future technology tools that would enhance the experience of visually impaired travelers using transit stations. Based on the findings from our needs assessment, we generated recommendations and guidelines for how technology can address some of the challenges faced by visually impaired travelers.

BEHAVIORAL TRACES IN WEB BROWSING

STUDENT Michael Bove *Information Systems*
ADVISOR Aniket Kittur Human *Computer Interaction Inst.*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

When trying to discover information on the web, people will often visit a page with a particular goal in mind. While these goals vary from visitor to visitor, content on the web will often not adjust to accommodate these needs. Eye-tracking has been used in the past to determine where people focus when visiting a web page, but the application of these sorts of tools would prove to be impractical on a large scale. The goal of this project is to explore how subtle behaviors while browsing can indicate or even predict a user's focus or intent.

GREENLIGHT

STUDENTS Michael Ferraco *Information Systems* | Dillon Grove *Information Systems* | Nathan Hahn *Information Systems* | Jonathan Miller *Information Systems*

ADVISOR Larry Heimann *Information Systems*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:00 am

Artificial light and natural light have cohabitated in spaces for many years. What if these two light sources could be combined to brighten a room and provide a comfortable setting that would save energy? When a large amount of sunlight is entering a room, artificial lighting can be decreased while still maintaining the same level of comfort for room occupants. Electricity costs would decrease for large organizations as the idea of artificial light and natural light working together would allow for less power to be transferred to lighting fixtures. In an attempt to find this less expensive lighting alternative, our team has researched and developed a system that can alter the brightness of artificial lighting depending on the amount of total ambient light in a room.

HIRING THE "PERFECT" SOFTWARE ENGINEER USING CONJOINT ANALYSIS, MARKET DESIGN, AND AUCTION ANALYSIS TO DESCRIBE THE HIRING MARKET FOR SOFTWARE ENGINEERS

STUDENTS Alice Borie *Self-defined* | Anthony Corletti *Information Systems* | Alexander Egan *Information Systems* | Ryan Flood *Self-defined* | Shaun Ford *Information Systems* | Varun Murali *Self-defined* | Dmitriy Yurkanskiy *Self-defined*

ADVISOR Larry Heimann *Information Systems*

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

The purpose of this research is to determine the strategies companies in the software industry use to evaluate potential software engineers during the recruiting and hiring process. We collect data through online job postings and surveying hiring managers in the field of software development. We look for patterns and trends by using conjoint analysis and the logic of markets and auctions. After collecting this information we will determine overall trends as well as differences in hiring patterns based on company size, age, and market to find out what companies use to distinguish applicants.

SIX DEGREES OF FRANCIS BACON

STUDENTS Adetunji Olojede *Information Systems* | Katarina Shaw *Self-defined* | Amiti Uttarwar *Information Systems*

ADVISOR Raja Sooriamurthi *Information Systems*

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

This poster describes our senior-level capstone team's experience towards building a novel system for social network analysis. The Six Degrees of Francis Bacon (SDFB) project aims to facilitate the study of relationships between individuals in the 16th and 17th centuries. Decentralized sources of information, the lack of a convenient medium for collaboration amongst scholars, and the lack of a visual form of the data inhibited advanced analysis. Our team developed an interactive visualization that resolves many of these challenges by allowing for analysis on the macro scale, user-generated content, and automatically-updated quantitative models.

SIX DEGREES OF FRANCIS BACON: EXPLORING THE SPREAD OF INFLUENCE

STUDENTS Ivy Chung *Self-defined* | Sama Kanbour *Information Systems* | Angela Qiu *Self-defined* | Chanamon Ratanalert *Self-defined*

ADVISOR Raja Sooriamurthi *Information Systems*

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

Facilitating the exploration of the spread of influence in the Early Modern Era
Six Degrees of Francis Bacon (SDFB) is a digital reconstruction of the Early Modern social network under the direction of Christopher Warren, Assistant Professor of English at Carnegie Mellon University. SDFB is an on-going project worked on in phases by different teams. In the Spring 2014 semester, beginning with mined biographical data on over 6000 luminaries of the Early Modern Era, SDFB was developed as a web-based interactive application that allows its users to explore the relationships between these historical figures. This phase of the project focuses on how a user might be able to link the spread of influence between people and works from this time period. A user can view who an individual figure knew, the mutual connections two individuals had, and the relationships between members of categorized groups (e.g. Puritans, Virginia Company, King's Men). The application also allows for crowd-sourcing contributions in which scholars and students can add to the network of people, relationships, and group. These features allow for anyone using Six Degrees of Francis Bacon to collaboratively examine, expand, and curate the knowledge of figures from the Early Modern Era and further understand their works.

THE RIGHT TOOL FOR A BIG JOB: AN EXPERIMENTAL STUDY OF BIG DATA TOOLS

STUDENT Patrick Dustmann *Information Systems*

ADVISOR Raja Sooriamurthi *Information Systems*

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

In a world that produces data in massive quantities (the world is estimated to have 5 zettabytes of data) and at high rates, big data analysis is paramount to finding meaningful answers in these large sets of data. This emerging field has created a new set of technologies such as MapReduce, Pig, Hive, and Spark that are making significant advances. Determining which tool to use for analysis is not always clear. This research is ongoing work to comparatively analyze big data tools.

LINGUISTICS

THE OTHER ROMANCE LANGUAGE: A BRIEF HISTORY AND LINGUISTIC ANALYSIS OF ROMANIAN

STUDENT Brian Farruggia *Linguistics*

ADVISOR Thomas Werner *Philosophy*

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

Often overshadowed by its more well known cousins of Western Europe, the Romanian Language nevertheless stands as a testament to the linguistic breadth of Latin, the tongue spoken by the ancient Romans. Though it is surrounded by Slavic and Turkic languages, Romanian shows a clear Latin pedigree unprecedented in other Romance Languages such as Spanish, Italian, or French. Indeed, Romanian, thanks to its isolation from the

turmoil that plagued Western Europe after the fall of the Roman Empire, underwent more conservative, gradual alterations to its morphology and phonology. Grammatical structures that were present in Latin reappear with greater vitality in Romanian than in other Romance Languages, such as nominal declension and the inclusion of the "neuter" gender. I will explore the history of the Romanian Language from the Latin to the present, provide a linguistic analysis detailing the differences between it and other Romance Languages, and finally reveal Romanian's development from Latin.

MODERN LANGUAGES

BREAKING THE NORM: NEGOTIATING INDIVIDUAL VS. GROUP IDENTITY IN FOOD CULTURE IN FRANCE AND SPAIN

STUDENT Catharine Youngs *Modern Languages*
ADVISOR Susan Polansky *Modern Languages*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

"Food identity", a term created by the author of this study, was formed through Phillip Smith's (2001) definition of the term culture, which includes the customs and way of life of a people, and identity as posited in social identity theory. In social identity theory, a person has several selves and is a member of several groups as a result creating in-group and out-group categorizations. From these two ideas, theorizing one identity at a national level (food culture) and one identity on an individual level (social identity), the idea of "food identity" was formed.

The concept for this project was a result of the author's experiences as a gluten free American living in France and Spain. These two countries have distinct cultural and food identities. Problematically, when an individual who identifies with these cultures chooses or requires a dietary difference outside the normative cultural framework, in this case not eating gluten, the group can react negatively. Subsequently, the thesis focuses on researching these two cultures' reactions to gluten free diets in relation to their historical identities of food and culture.

Through the historical background of each country with an emphasis on bread, an examination of the personal blogs of seven food bloggers from both countries, and an analysis of five survey results, new information has been uncovered about the role of bread in France and Spain. This new information includes the food identity of average individuals in these countries and how gluten free nationals have to negotiate their personal food identity in relation to their culture's identity. The differences and similarities between the experiences of the nationals in these two countries further highlight the fascinating negotiation required when an individual is identified as outside of a culture's normative food identity.

LOCALIZING THE JAPANESE LIGHT NOVEL

STUDENT Stephanie Chiu *Modern Languages*
ADVISOR Yasufumi Iwasaki *Modern Languages*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Localization is by nature an intercultural project, requiring knowledge of both the original language and culture and also the target language and culture. Depending on the item undergoing localization, the process is also an interdisciplinary one; for example, localization of a creative work also requires knowledge on how to structure prose and analyze characterization to write convincing dialogue. I found this combination suitable for me given my abilities in Japanese Studies and Creative Writing, and for my Senior Honors Project, translated and edited 81 pages of a Japanese light novel. During the process, I also identified and addressed language, cultural, and content discrepancies in translating between the two languages. Combined, these experiences allowed me a view into the work of those who bridge the communication gap in our increasingly intercultural world.

THE DISCURSIVE REPRESENTATIONS OF SPAIN'S ECONOMIC CRISIS (2008-PRESENT)

STUDENT Maximilian Edmonds *Modern Languages*
ADVISOR Mariana Achugar *Modern Languages*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

In 2008, the Spanish economy experienced the beginning of a profound economic crisis that continues to the present. This thesis conducts a discursive analysis of the representations of the Spanish economic crisis by three distinct social actors: the Government of Spain, Spanish news media, and the Spanish protest movement, los indignados. This work examines discourse produced by the three aforementioned social actors during two specific historical moments: the 2011 Spanish general election and the 2013 Spanish economic "improvement." The investigation analyzes textual and visual media produced by each of the social actors through an assessment of their respective use of discursive strategies (e.g., transitivity, evaluation, intertextuality) and multimodal properties. Moreover, this thesis also investigates how the absence of particular discourses in a nation's dominant media (i.e., State and newspaper publications) may contribute to the rise of a social movement that practices alternative forms of democratic debate and civic engagement.

PHILOSOPHY

FRENCH ONLINE LEARNING: HOW DO STUDENTS BEHAVE AND PERFORM?

STUDENTS Kairavi Chahal *Statistics* | Jaclyn Wolf *Philosophy* | Julian Zhou *Statistics*
ADVISOR Cosma Shalizi *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Online learning has become increasingly popular, an area of which Carnegie Mellon's Online Learning Initiative (OLI) is a pioneer. Between 2006 and 2010, around 100 students from Carnegie Mellon and the University of Pittsburgh took an online version of French Languages I via OLI. Their activities throughout the online course generated large-scale learning-related data that were captured by DataShop of the Pittsburgh Science of

Learning Center (PSLC). This project aims to address several hypotheses proposed by the faculty behind the French online course, regarding students' online learning behaviors. Questions asked vary from 'Do students navigate through the course linearly?', 'Do students who complete fewer activities on a certain language skill later perform worse in assessment on that skill?', to 'Do students form distinct clusters based on their online learning behaviors?'. A range of statistical analyses, descriptive and inferential, exploratory and advanced, are utilized to provide reasonable answers.

ON BIOGENOUS SYSTEMS

STUDENT Kelvin Rojas *Philosophy*
ROOM/TIME Pake / 12:40 pm

A biogenous system is a complex adaptive ecosystem where living organisms provide for other living organisms. The focus of this paper is a biogenous system currently being developed for urban/suburban built environments. Described is an extension to the low-cost process for architecturally integrating microbial ecosystems originally outlined in [En]coding Architecture : The Book - Algal Architecture: Incorporating Biological Symbiosis.

Implementing this process has the potential to close open energy loops by the onsite production of refined biogas - using algae photobioreactors and anaerobic digestion - and to foster a symbiotic relationship between humans and microorganisms. Furthermore, the paper presents a point of view regarding issues of implementing biological systems in the built environment and on the larger notion of a change in the physicality of human habitats. This point of view is developed through inquiry into the foundations of complex systems culture in design and how complexity theory can help identify sustainable systems.

With these foundations laid out, the paper analyzes the current biogenous system. The analysis focuses on the biological elements, speculating about the interactions between elements at different levels, from microbe to city, and their sustainable characteristics. The aim of the analysis is a better understanding of issues with implementing complex adaptive ecosystems like the biogenous system described, the sustainability of such systems, and the impact implementation could have on the human habitat.

PSYCHOLOGY

ATTACHMENT DIFFERENCES IN SUPPORT PROVIDERS' PHYSIOLOGICAL REACTIVITY IN SUPPORT DISCUSSIONS

STUDENT James Colmar *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

This experiment explores the effects of attachment orientation on physiological reactivity during discussions of the partner's greatest fear and the partners most important goal. We theorize that anxious people will show greater physiological reactivity when providing goal support, avoidant people will demonstrate higher reactivity in fear support, and secure people will remain stable across both kinds of support. We also predict lower quality support in situations where high reactivity is present. To examine this, we studied 100 couples where

one member had recently retired, we assessed attachment orientation, and collected biometric data during two types of support discussion. If the results are as predicted, this study will shed new light on the mechanisms underlying long term attachment-related health problems, as well as offer new understanding of how well people give support to their partners.

COMMUNAL COPING AMONG COUPLES IN STRESSFUL SITUATIONS

STUDENT Emma Bright *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Wright / 2:00 pm

When faced with a stressor, partners often cope together. Communal coping, defined as a reappraisal of a stressor as "our issue" as opposed to "my issue," is a construct that reflects one possible way for couples to cope. In this study, we examined manipulated communal coping as a strategy for dealing with stressful situations in a randomized controlled experiment. Couples (n= 39) were randomly assigned to one of two conditions: communal coping condition or non-communal coping condition. The communal coping condition instructions characterized the presentation as the responsibility of both members of the couple. The non-communal coping condition instructions indicated that the presentation was the responsibility of one member of the couple. There were no significant effects of the communal coping manipulation on communal appraisal, but there was a marginally significant effect on collaboration, $t(37) = -1.75$, $p = .09$.

Participants in the communal coping condition reported greater collaboration ($M = 4.30$, $SD = .66$) than participants in the non-communal coping condition ($M = 3.84$; $SD = .96$). Communal appraisal was related to relationship duration, $r = 0.38$, $p < 0.05$. The longer the duration of the relationship, the more likely participants were to respond that the presentation was our responsibility. The communal coping condition lead to increased relationship satisfaction over time for the partners, $F(1, 36) = 8.42$, $p < .01$. Partners in the communal coping condition showed increases in relationship satisfaction ($M = .10$, $SD = .05$) compared to partners in the non-communal condition ($M = -.10$, $SD = .05$). However, the communal coping condition was not as beneficial for perceived stress. There was a significant effect of condition on the partner's perceptions of stress, $t(37) = 2.72$, $p < .05$. Partners in the non-communal coping condition reported less stress ($M = 4.58$, $SD = .69$) than partners in the communal coping condition ($M = 3.90$; $SD = .85$). There was also a significant effect of condition on how discussing the presentation made partners feel about the task, $t(37) = 2.15$, $p < .05$. Partners in the non-communal coping condition reported feeling better and more confident about the task ($M = 4.42$, $SD = .61$) than partners in the communal coping condition ($M = 3.89$; $SD = .88$). Communal coping may be beneficial for relationship satisfaction but it does place a burden on the partners coping communally.

COMMUNAL COPING AMONG COUPLES WITH TYPE 2 DIABETES

STUDENT Emma Bright *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:00 am

When faced with a chronic illness, such as type 2 diabetes, partners often cope together. Communal coping, defined as a reappraisal of a stressor as "our issue" as opposed to "my issue," is a construct that reflects one possible way for couples to cope. In this study, we examined the links of communal coping to relationship variables and health outcomes among couples (n=50) in which one partner was diagnosed with type 2 diabetes in the last 2 years. Participants were married or living with someone in a marital-type relationship.

Both members of the couple were asked to respond to a questionnaire that measured communal coping, relationship variables, and psychological distress. Couples were also asked to provide answers to an audio prompt, which was subsequently transcribed and analyzed for pronoun usage using the LIWC program, and to participate in a videotaped discussion. Results showed a positive relation between patient and partner self-reports of communal coping ($r = 0.37$, $p < .01$). The various measures of communal coping showed some correspondence. Patient and partner self-reports of communal coping were marginally associated with independent raters' codes of communal coping in videotaped interactions ($p < .10$). Communal coping during videotaped interactions was correlated with greater use of the "we" pronoun from the audio prompt ($p < .05$). Both patient and partner self- reports of communal coping were related to higher levels of emotional intimacy, higher relationship quality, and greater perceived emotional and instrumental support from partner to patient (p's $< .05$). However, the links of communal coping to health outcomes were mixed. Patient self-reports of communal coping were unrelated to patient perceived stress but were related to greater partner perceived stress ($p < .05$). Both partner self-reports of communal coping and partner videotape communal coping were related to greater patient self-efficacy ($p < .05$). Taken collectively, it appears that communal coping is associated with positive relationship outcomes but may have different implications for patients' and spouses' health. The extent to which age and sex moderate these relations will be discussed.

COUPLES' COMMUNAL COPING IN PATIENTS WITH NEWLY DIAGNOSED TYPE 2 DIABETES: A FOCUS ON SEX AND RACE

STUDENT Shaquille Charles *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:30 am

Type 2 diabetes (T2D) is the 7th leading cause of death in the United States and is associated with an array of health problems, including heart and kidney disease, neuropathy, and lower limb amputation. Prevention of these problems largely depends on effective disease self-management. Persons with T2D need to alter their diet, exercise, and typically take medication to control blood glucose levels. As social environment is an important determinant of diabetes self-management, we enrolled 50 couples (52% male; 68% white; mean age 55; mean A1c 6.83) that included one person with newly diagnosed T2D (mean diagnosis 1.33 years ago) in a study to examine partner influence on patients' management of diabetes. Race and sex differences were examined. Evidence that communal coping (i.e., perception of diabetes as a joint problem rather than an individual problem) was more common for males than females with T2D. Males chose greater overlap among two concentric circles to represent the couples' approach to diabetes and reported more daily communication about diabetes than females (p's $< .05$). Using audiotaped recordings of coping interviews to analyze pronoun usage, females were marginally more likely than males ($p < .10$) and blacks were more likely than whites to use "I" pronouns ($p < .05$). In videotaped couple conversations about coping with diabetes, trained observers rated the lowest level of communal coping among couples in which the patient was female and black ($p < .05$). When asked how involved they would like partners to be in diabetes, females were more likely than males and blacks were more likely than whites to report that they desired greater involvement of the partner in their diabetes care (p's $< .05$). In summary, this study suggests that women and blacks are less likely to receive partner support regarding diabetes management. These findings are important because partner involvement in diabetes care was related to better diabetes self-management.

DISCLOSURE OF DIABETES IN THE CONTEXT OF ROMANTIC RELATIONSHIPS

STUDENTS Stephanie Chen *Psychology* | Priscilla Kim *Psychology* | Seth Schlisserman *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The goal of this study was to explore the evolution of romantic relationships in persons with type 1 diabetes. We enrolled 68 young adults (ages 18 to 36) with type 1 diabetes into this study. Participants had to be in a romantic relationship in order to participate: they were married (21%), engaged (6%), living together (26%), or dating (48%). Participants were recruited from an ongoing study (n = 14) or from online advertising (n = 54). The focus of the study was on how participants disclosed their diabetes to their romantic partners and how their partners reacted to this disclosure specifically and to diabetes more generally. We examine how demographic variables, such as participant sex and relationship length, were related to diabetes disclosure and partners' reaction to disclosure, how disclosure and partner reactions are related to relationship satisfaction, and compare disclosure to romantic partners to disclosure to friends.

EFFECTS OF BRIEF MINDFULNESS MEDITATION TRAINING ON BIOLOGICAL RESPONSE TO SOCIAL EVALUATIVE STRESS

STUDENT Hayley Rahl *Psychology*
ADVISOR John Creswell *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:15 am

Previous research suggests that mindfulness improves stress response and health outcomes in stress-related diseases. However, little is known about the mechanisms facilitating this effect or the roles of monitoring and acceptance in mindfulness. This study explores the mechanism of attentional control and separates the components of mindfulness. Participants (N=102) completed three days of brief mindfulness training or control training, followed by an emotional Stroop task and a Go/No-go task. Participants then completed their fourth training session followed by the Trier Social Stress Test (TSST), during which their systolic blood pressure was measured at two-minute intervals. Differences between study conditions in sustained attention target discrimination and omission errors were observed during a Go/No-go task. Significant differences between study conditions in accuracy of response to threat stimuli during an emotional Stroop task were also observed. We discuss the implications of these findings for the role of attention in mindfulness.

EFFECTS OF SYNONYMOUS CONTEXT CLUES AND EXAMPLE CONTEXT CLUES ON VOCABULARY ACQUISITION

STUDENT Matthew Mastricova *Psychology*
ADVISOR Anna Fisher *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

This study focuses on contextual language learning in young children. The importance of context clues in language learning in older children is heavily documented (Buikema & Graves, 1993; Kuhn & Stahl, 1998), however there is little available research on these benefits in young children. This study will assess young children's ability to learn novel vocabulary solely through synonym contextual clues and assess if children who learn solely through synonym context clues can explain new words and identify when they are being used incorrectly. In addition, this study will examine the differences in language acquisition and application between 3, 4, and 5 year old children.

FEELING STORIES: ENRICHING STORY LISTENING EXPERIENCE FOR CHILDREN WITH HAPTIC FEEDBACK

STUDENT Siyan Zhao *Psychology*
ADVISOR Roberta Klatzky *Psychology*
ROOM/TIME Peter / 1:40 pm

Story listening contributes greatly to children's development, and much research has explored different modalities of story listening in children. However, few studies have utilized haptic sensory input. In the present 2-session study, we implemented a haptic vest that generates haptic sensations on a child's back as he or she listens to stories. In the first session, child participants rated how realistic a sensation was in comparison to a language phrase. In the second session, the same child participants listened to two stories with the vest on. At the end of each story, the child participants retold the story and then answered 9 comprehension questions. At the end of the session, the child participants indicated which one of the two stories they liked better. Our study showed that children of 6 years old had the ability to associate haptic sensations with semantic meanings. They could also distinguish between sensations with congruent semantic meanings and those with incongruent semantic meanings. From the second session of the study, we observed an increase in children's comprehension of the stories when they felt story-relevant sensations from the vest. However, this was only true for the 5- and 6-year olds. We did not find a similar effect in child participants' retelling task. These results confirmed that 6-year olds had developed an association between haptics and semantics. In addition, sensations that were story-related improved children's performance on story comprehension. We showed that haptic sensory input could improve story processing for children.

HEARING TONES: HOW PREVIOUS LINGUISTIC EXPERIENCE INFLUENCES LEXICAL PROCESSING

STUDENT Amritha Mallikarjun *Psychology*
ADVISOR Erik Thiessen *Psychology*
ROOM/TIME Wright / 3:00 pm

Studies indicate that the input people receive in their native language shapes their perceptual understanding of unfamiliar speech. As infants, people tend to under-generalize their speech input; when given words in a certain affect or pitch, they cannot recall the word if it is presented in a different affect or pitch to them (Houston & Jusczyk, 2000, Singh et al., 2004). As they get older they focus only on the aspects of speech that provide important lexical information to them. For example, Japanese speakers cannot perceive the difference between /r/ and /l/ because their language groups these two sounds together in one phoneme, and as such they have difficulty learning words in English that require an r/l distinction to use properly, like [rip] and [lip]. This study will explore the differences in perceptual understanding between Mandarin speakers and English speakers in a statistical learning paradigm. The participants will listen to words that either have a consistent Mandarin tone associated with them or a random tone. We would expect that the Mandarin speakers, who store tone contour as an important aspect of words, would have trouble with an inconsistent tone cue, while English speakers would disregard the tone cue entirely and perform similarly in both conditions.

IMPROVING INSTRUCTION IN EDUCATIONAL CONTEXTS USING VISUAL REPRESENTATIONS

STUDENTS Jae-Won Kim *Psychology* | Jennifer Shin *Psychology*
ADVISOR Anna Fisher *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The purpose of this study was to evaluate the learning benefits of two different approaches to combining "concrete", real-world visual representations, and "abstract", symbolic visual representations of novel concepts, in educational instruction materials. In the "concreteness fading" approach, concrete representations are followed by abstract representations, whereas in the "simultaneous presentation" approach, both types of representation were presented at the same time. Each approach has been shown to yield better learning outcomes than approaches that use either concrete or abstract materials only. The effectiveness of each approach has been attributed to different underlying cognitive learning mechanisms. However, these approaches have never been compared to each other. This study performed this comparison using a paradigm in which participants learned a novel electrical engineering calculation procedure from instruction materials that either: 1) combined concrete and abstract representations according to the concreteness fading approach, 2) combined concrete and abstract representations according to the simultaneous presentation approach, 3) used entirely concrete representations, or 4) used entirely abstract representations. Participants' performance on learning tests were then used to evaluate the efficacy of these approaches and illuminate the nature of the cognitive mechanisms that underpin learning.

INCREASING DEPRESSION RECOGNITION IN STUDENTS THROUGH EDUCATIONAL INTERVENTION

STUDENT Joshua Swanson *Psychology*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Wright / 3:20 pm

Prior research has shown that only 49% of Carnegie Mellon students were able to correctly recognize depression in a depressed vignette.

In that study it was also found that a belief in masculine norms predicted an inability to correctly recognize depression in a depressed vignette

($p = .03$), and overall disregard for their distress. By contrast, there was a trend between Feminist Attitudes and recognition of depression such that the higher participants rated on Feminist Attitudes the more likely they were to correctly identify depression in the depressed vignette ($p = .11$). Openness and Neuroticism were also both positive predictors of depression recognition ($p = .001$ and $p = .001$, respectively). In attempts to increase students' ability to recognize depression and depressive symptoms, we had 39 students randomly assigned to receive a short 15 minute lecture, either on depression (experimental condition) or memory (control condition). After the educational intervention, two follow-ups were sent out to compare their ability to recognize depression in a depressed vignette.

INVESTIGATION INTO FORESTRY CAMPS IN LOS ANGELES

STUDENT Arielle Cohen *Psychology*
ADVISOR Steven Schlossman *History*
ROOM/TIME Dowd / 3:20 pm

I am studying the use of state- and county-operated forestry camps introduced in the 1930s, commonly used to treat juvenile delinquents. I have been examining the Los Angeles Juvenile Court in the year 1940, using files obtained from Dr. Steven Schlossman. My focus has been 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 send many of these children to forestry camps in the hopes of setting them on a better path. I am investigating the forestry camps' structure, which is largely unexplored, to better understand Tenette's enthusiasm towards the camps, as well as to provide insight into the use of public resources on minority youth in this era. This research illuminates largely unexplored scholarly terrain regarding relationships between African American youth (and families) and the public welfare, judicial, and correctional systems.

MINDFULNESS AND ITS EMOTIONAL EFFECTS TO A STRESS REACTIVITY

STUDENT Jae-Won Kim *Psychology*
ADVISOR John Creswell *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

It has been proposed that mindfulness training helps individuals become more attentive and aware of their inner processes and behavior (Levitt et al., 2004) and fosters problem solving abilities allowing them to make better decisions (Ostafin and Kassman, 2012).Despite these evidences, we know very little about how mindfulness training reduces stress, and the underlying mechanisms for these stress effects are still unclear. The present study investigated several purported mechanisms of mindfulness and stress reduction by conducting secondary data analyses on the Creswell et al. (2014) mindfulness training stress reactivity study. First, we hypothesized that mindfulness meditation training would reduce both emotional reactivity and emotional suppression. Second, it was hypothesized that the emotion effects mediates the psychological and stress reactivity effects of mindfulness.

NON-EVOLUTIONARY THREAT PERCEPTION AND AUDITORY THREAT PERCEPTION CUES WITH INFANTS

STUDENT Elyse Mylan *Psychology*
ADVISOR David Rakison *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Previous research suggests that 5-month old infants may have a perceptual template for detecting evolutionary threats, such as spiders and snakes, which aid in rapid detection of threatening stimuli (LoBue, Rakison, and DeLoache 2010). Similarly, a study by Rakison (2009) suggests that 11-month-old female infants are more easily able to learn associative pairings between fear-relevant stimuli and facial cues than between fear-irrelevant stimuli and facial cues. In the current experiments, I will expand on these previous findings in two ways: first, I will further expand the findings of the 2010 experiment by using a similar study design to test whether or not non-evolutionary threatening stimuli, such as schematic figures of sharks and guns, result in more rapid detection than do non-threatening stimuli, such as scrambled versions of the schematic shark and gun images,

with 5-month old infants. Second, I will apply the design of Rakison's 2009 study to an experiment which will examine whether or not 11-month old infants are able to learn associative pairings between fear-relevant stimuli and auditory cues. This dual-approach study will address whether or not human infants are better at fear learning as a result of evolutionary mechanisms via potential threat template-attenuation and associative auditory cue pairing. The results of this study will give us insight regarding the mechanisms with which infants learn about fear and potential threats.

RESOURCES AT HUNT LIBRARY

STUDENT Zhuling Li *Psychology* | Ahnsik Shin *Business Administration* | Abigail Volynsky *Statistics* |Sungkyu Yang *Statistics*
ADVISOR Trent Gaugler *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

For the benefit of the CMU community, we have decided to conduct a survey about the use of Hunt Library and its various resources. Through this survey, we hope to achieve a better understanding of the resources that are being used (i.e. CAMEO, eJournals, Online databases, etc) and the resources that many students fail to utilize properly. Additionally, we aim to understand why these resources are not being properly exploited. We hope the university will consider these results regarding future improvements in Hunt Library.

SENSITIVITY TO PURELY TAXONOMIC ASSOCIATIONS AMONG YOUNG CHILDREN

STUDENT Wyatt D'Emilia *Psychology*
ADVISORS Anna Fisher *Psychology* | Layla Unger *Psychology*
ROOM/TIME Wright / 3:40 pm

The goal of the present study was to examine an aspect of semantic development. Previous research investigated whether different types of relations between entities influence the degree to which children perceive them as similar. The purpose of the present study was to compliment this research by investigating whether the number of relations between entities influences their perceived similarity. The results showed that preschool-aged children perceive entities related along both single and multiple dimensions as more similar than unrelated entities, and entities related along multiple dimensions as more similar than those related along a single dimension. Therefore, by four years of age children are sensitive to the number of relations linking entities.

SOCIAL SUPPORT AND STRESS IN NEWLY-WED COUPLES

STUDENT Hsinlien Tsou *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

This study investigates the relationship between social support and stress in newly-wed couples. The main purpose of this study is to compare two models of social support- 1) the stress-buffering model and 2) the main effects model in close relationships. The stress-buffering model states that social support interacts with stress such that the effects of social support will be seen only when a person is under high stress. The main effects model indicates that social support will keep people healthy and feeling good in all life circumstances, not only when under high stress. Participants were gathered through various methods into CMU's relationships lab and were asked to complete questionnaires, work on activities, and perform discussions. After gathering data for

a total of 229 couples, data analysis using SPSS was conducted to find significant effects. Future research can look more closely into matching the most optimal form of social support with a certain type of behavior from the recipient.

THE DIRECTIONALITY OF THE RELATIONSHIP BETWEEN LEFT HEMISPHERE SPECIALIZATION FOR WORD READING AND HIGH SPATIAL FREQUENCY VISUAL INFORMATION

STUDENT Alexandra Ossowski *Psychology*
ADVISOR Marlene Behrmann *Psychology*
ROOM/TIME McKenna / 4:00 pm

Studies show that emerging left hemisphere lateralization for word reading is correlated with emerging left hemisphere lateralization for high spatial frequency (HSF) information. However, it is currently unclear whether left lateralization is partially caused by a pre-existing left hemisphere bias for high spatial frequency visual information (such as that found in words), or if the left hemisphere tuning for HSF is a consequence of reading experience. This study seeks to determine whether lateralization for HSF information exists prior to left lateralization for reading. We use a divided visual field task to examine left hemisphere bias for words and for high spatial frequency Gabor patches in pre-readers, early readers, and adults. If left hemisphere specialization for reading occurs due to pre-existing HSF bias in the left hemisphere, than LH specialization for HSF information will be present before children have word-reading ability, i.e., in the pre-readers. In addition, children who demonstrate greater left than right lateralization for HSF may exhibit better word recognition ability.

THE EFFECT OF RECEIVED TOUCH ON EXPLORATION BEHAVIOR

STUDENTS Amber Hekler *Psychology* | Nisha Singh *Psychology*
ADVISOR Brooke Feeney *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Our study examines how physical touch from a close relationship partner influences feelings of security (which we refer to as the establishment of a secure base), and as a result enables subsequent exploration behavior (i.e., the embracing of opportunities that could lead to self-growth). Romantic couples will be recruited using the Undergraduate Research Participant Pool from which one partner will receive research credit and the other partner monetary compensation for their participation. Study participants will be randomly assigned to receive touch from their romantic partner (or to receive no touch) while watching a neutral video. Further, we will vary the instructions during this period so that the partner's touch behavior is viewed as either volitional or non-volitional. We hypothesize that receiving touch will enable individuals to feel that they have a secure home base from which to explore and will subsequently result in them embracing exploration opportunities that could lead to self-growth (e.g., opportunities for career exploration, self-discovery, etc.). We also predict that a partner's volitional touch will lead to greater exploration behaviors than a partner's non-volitional touch. This study has implications for relationship interventions that may increase the well-being of individuals and relationships.

THE ROOTS AND IMPLICATION OF INTERNET CENSORSHIP IN CHINA

STUDENT Winnie Leung *Psychology*
ADVISOR Yueming Yu *Modern Languages*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Stories about China's policy of internet censorship often appear in the news, but these stories tend to offer a shallow view. This thesis examines the relevant events leading from Deng Xiaoping's opening of China to present time, as well as the inherent cultural views that have accommodated this system of internet surveillance. After covering the historical and cultural background, this thesis then covers the implications of this internet policy on future business ventures and relations with other countries.

TOWARD A PATHOPHYSIOLOGY OF RUMINATION: DORSAL NEXUS RESTING-STATE FUNCTIONAL CONNECTIVITY IN DEPRESSION BEFORE AND AFTER SEROTONERGIC OR BEHAVIORAL INTERVENTIONS

STUDENT Kevin Alastair Tan *Psychology*
ADVISOR Timothy Verstynen *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:15 am

Rumination is characterized as the tendency to engage in sustained, repetitive thinking about negative topics. Rumination is a symptom of several psychiatric disorders, particularly depression. Rumination usually occurs during periods of wakeful rest, taking place of normal mind-wandering (daydreaming). Resting-state functional connectivity measures neural activity during wakeful rest, and is thought to indicate the propensity of communication between different areas of the brain. A landmark study by Sheline et al. (2010) found an area of the dorsomedial prefrontal cortex—the dorsal nexus—that features anomalously high connectivity to the default-mode, affective and cognitive control networks in depressed individuals. Dysfunction of these networks is thought to underlie rumination and depression overall. To elucidate the role of the dorsal nexus in rumination, we've formulated a hypothetical model using dorsal nexus connectivities and their putative contributions to rumination. This model is to be tested by regressing dorsal nexus connectivities with various psychological self-report scores, both before and after treatment with cognitive behavioral therapy or selective serotonin reuptake inhibitors. However, we are unable to replicate Sheline et al.'s findings using current preprocessing techniques. We found that some aspects of Sheline et al.'s preprocessing stream have since been deemed unsuitable. This takes away the framework by which we were to proceed with our research objectives. These results highlight the importance of sound preprocessing methodology in resting-state functional magnetic resonance imaging.

SELF-DEFINED

CMU DINING SURVEY

STUDENTS Marcus Anthony *Statistics* | Asad Meghani *Statistics* | Charles Primbas *Self-defined* | Sam Waters *Economics and Statistics*

ADVISOR Trent Gaugler Statistics

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

Our research group conducted a survey, taken from a simple random sample of all CMU undergrads, to determine their dining preferences, priorities, and evaluations of current CMU dining options in order to maximize student utility gained from on-campus dining.

HIRING THE "PERFECT" SOFTWARE ENGINEER USING CONJOINT ANALYSIS, MARKET DESIGN, AND AUCTION ANALYSIS TO DESCRIBE THE HIRING MARKET FOR SOFTWARE ENGINEERS

STUDENTS Alice Borie *Self-defined* | Anthony Corletti *Information Systems* | Alexander Egan *Information Systems* | Ryan Flood *Self-defined* | Shaun Ford *Information Systems* | Varun Murali *Self-defined* | Dmitriy Yurkanskiy *Self-defined*

ADVISOR Larry Heimann *Information Systems*

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

The purpose of this research is to determine the strategies companies in the software industry use to evaluate potential software engineers during the recruiting and hiring process. We collect data through online job postings and surveying hiring managers in the field of software development. We look for patterns and trends by using conjoint analysis and the logic of markets and auctions. After collecting this information we will determine overall trends as well as differences in hiring patterns based on company size, age, and market to find out what companies use to distinguish applicants.

SIX DEGREES OF FRANCIS BACON

STUDENTS Adetunji Olojede *Information Systems* | Katarina Shaw *Self-defined* | Amiti Uttarwar *Information Systems*

ADVISOR Raja Sooriamurthi *Information Systems*

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

This poster describes our senior-level capstone team's experience towards building a novel system for social network analysis. The Six Degrees of Francis Bacon (SDFB) project aims to facilitate the study of relationships between individuals in the 16th and 17th centuries. Decentralized sources of information, the lack of a convenient medium for collaboration amongst scholars, and the lack of a visual form of the data inhibited advanced analysis. Our team developed an interactive visualization that resolves many of these challenges by allowing for analysis on the macro scale, user-generated content, and automatically-updated quantitative models.

SIX DEGREES OF FRANCIS BACON: EXPLORING THE SPREAD OF INFLUENCE

STUDENTS Ivy Chung *Self-defined* | Sama Kanbour *Information Systems* | Angela Qiu *Self-defined* | Chanamon Ratanalert *Self-defined*

ADVISOR Raja Sooriamurthi *Information Systems*

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

Facilitating the exploration of the spread of influence in the Early Modern Era
Six Degrees of Francis Bacon (SDFB) is a digital reconstruction of the Early Modern social network under the direction of Christopher Warren, Assistant Professor of English at Carnegie Mellon University. SDFB is an on-going project worked on in phases by different teams. In the Spring 2014 semester, beginning with mined biographical data on over 6000 luminaries of the Early Modern Era, SDFB was developed as a web-based interactive application that allows its users to explore the relationships between these historical figures. This phase of the project focuses on how a user might be able to link the spread of influence between people and works from this time period. A user can view who an individual figure knew, the mutual connections two individuals had, and the relationships between members of categorized groups (e.g. Puritans, Virginia Company, King's Men). The application also allows for crowd-sourcing contributions in which scholars and students can add to the network of people, relationships, and group. These features allow for anyone using Six Degrees of Francis Bacon to collaboratively examine, expand, and curate the knowledge of figures from the Early Modern Era and further understand their works.

SOCIAL & DECISION SCIENCES

A CORRECTIVE META ANALYSIS OF PERSONALIZED NORMATIVE FEEDBACK

STUDENT David Zimmerman *Social & Decision Sciences*

ADVISOR Baruch Fischhoff *Social & Decision Sciences*

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

Personalized Normative Feedback (PNF) has been proposed as an inexpensive and scalable intervention to reduce problematic consumption of alcohol, particularly among college students. Many individual studies, as well as meta-analyses, have tested the efficacy of PNF. The findings have been generally positive, demonstrating that it decreases alcohol consumption and associated problems with excessive consumption. Unfortunately, many of these studies have less than ideal methodologies, which potentially introduce bias to the results. We use a quantitative adjustment procedure on the findings of each study to account for these biases. Results were divided by a factor of 1.61 on average to account for biases. While many of the results remain significant after correction, they have relatively small effects. The effect sizes for every outcome were less than 0.2, post adjustment. Additional methods will need to be developed in order to achieve dramatic progress towards reducing drinking with PNF. Insufficient evidence exists on the long-term impacts of PNF, particularly as college students transition out of school.

CASE STUDIES IN SELECTORATE THEORY: SUCCESSES, FAILURES, AND ALTERNATE EXPLANATIONS

STUDENT Corinne Rockoff *Social & Decision Sciences*
ADVISOR Kiron Skinner *Social & Decision Sciences*
ROOM/TIME Dowd / 1:20 pm

As the influence of mathematical analysis in the field of international relations grows, a new theory has gained ground. A newcomer to the field, Selectorate Theory builds a model for assessing the behavior of leaders based on the assumption that leaders are motivated solely by a desire to obtain and retain power within their nation. While it may seem appealing for its clarity and simplicity, Selectorate Theory still bears examination on many fronts. This analysis investigates Churchill both before and after WWII and the Obama administration's current policy on drones through a Selectorate lens, to gain insight into aspects of Selectorate Theory that have been left unaddressed.

CONSUMER BEHAVIOR IN UPGRADING TECHNOLOGICAL GOODS

STUDENTS Akwasi Brefo *Economics* | Maya Geleroff *Economics* | Zaneta Grant *English* | Michelle Lin *Social & Decision Sciences*
ADVISOR Rebecca Lessem *Economics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

We have taken usual behavioral economic theories applied to generalized consumer behavior and applied them specifically to technological good purchasing choice. Factors such as normative versus informational decision making, anchoring bias, and income effects have been proven to be significant influencers in consumer choice of technological goods.

CONSUMER DECISION MAKING AND PRICE PARTITIONING

STUDENT Tamar Feigenbaum *Social & Decision Sciences*
ADVISOR Stephen Broomell *Social & Decision Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Previous research has indicated that partitioned prices generate higher consumer demand than the equivalent complete price options. Partitioned prices refer to price formats in which costs are presented with a base price and mandatory surcharges; complete formats include all cost components in one, overall price. In the current paper, we attempt to reconcile these findings with judgment and decision making research through the addition of a reference frame for hypothetical consumer choices. While the reference frame did not have an effect on participants' choices in our experimental purchasing environment, we failed to replicate previous results when a majority of our participants elected for the complete priced option. We conclude by outlining competing hypotheses that can potentially account for our failure to replicate preferences for partitioned pricing. Our use of joint (rather than isolated) evaluation in the form of a choice response (as opposed to scale ratings) may have caused a preference reversal in this context. These results demonstrate the limitations to previous results concerning price partitioning and underscore the importance for future research to also analyze preferences using choice.

CUBAN FOREIGN POLICY: SMALL ISLAND, BIG FOOT PRINT

STUDENT Angel Nonye-John *Social & Decision Sciences*
ADVISOR Afeworki Paulos *Univesity Libraries*
ROOM/TIME Peter / 1:20 pm

In 1978, Cuba had approximately 35,000 soldiers on the ground fighting in African revolutionary movements. The United States and NATO feared that Cuba was using its revolutionary prowess to influence post-independence political ideology on the continent. While there was some truth to this sentiment, other experts believed la preservación de la revolución was the nation's key objective. Decades after the fall of the Soviet Union, the heart of Cuban foreign policy is still disputed.

The region of Sub-Saharan Africa, in particular, has been a partner to the often isolated island. Wishing to make big impact with small resources, Cuba has created relations with the continent, first, through military support of revolutions and now, through medical assistance. This paper analyzes Cuba's military and medical assistance programs in order to obtain a deeper understanding of Cuban Foreign Policy.

IDENTIFYING SOCIAL CONTAGIONS USING NETWORK MOTIFS AND MACHINE LEARNING

STUDENT Manojit Nandi *Social & Decision Sciences*
ADVISORS Russell Golman *Social & Decision Sciences* | Barnabas Poczos *Machine Learning*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The confounding effect of latent homophily and social contagions in observational social networks is an important problem in the field. In this thesis, I aim to show how network motifs can be used as a statistical test to determine the presence of latent homophily or social contagion. In addition, I develop a machine learning classifier to show that these networks have features that allow them to be distinguished from one another under the appropriate mathematical representation of the network.

MINORITY VOTING FACTORS

STUDENTS Jae-Eun Kim *Social & Decision Sciences*
ADVISOR Kiron Skinner *Social & Decision Sciences*
ROOM/TIME Pake / 1:00 pm

The year 2008 marked a striking change in electoral politics for the United States. It was a year when the nation took its first steps in electing its first non-white president as it galvanized enormous support from all types of people, including the multiracial community. Ever since, one of the striking features of the political spectrum and campaigns in the United States has been the growing importance of racial and ethnic minority voters. This research, rather than focusing the effect of a black man as the nation's first president, will examine the undergoing development in racial politics- the factors that influence minority voter turnouts. In a unique method to answer this question, I conceive of this research as a case study in U.S. presidential political elections that takes three particular ethnic groups as its object, African-Americans, Hispanics, and Asian-American voters. Specifically, it will look at three underlying factors of each group's socioeconomic status, cultural factors, and political participation factors. Thus, as the nation develops and continues to move forward into an era that is becoming ever more global, it will examine the role and factors that influence minority voters to vote the way they do in this context. The aforementioned variables will strive to explain what influences them to vote and why they vote the way they do, in most cases supporting the Democratic Party over the Republicans. By doing

so, these factors will show how they play an important role in racial politics and the minority voter. It can be seen that this question and hypothesis has acquired even more interest followed with urgency and uncertainty with the recent two elections of Obama in 2008 and 2012.

SALARY EXPECTATIONS FOR CARNEGIE MELLON UNIVERSITY STUDENTS

STUDENTS Rachel Cohen *English* | Marko Hudak *Economics and Statistics* | William Sanders *Economics* | Stephanie Stern *Social & Decision Sciences* | Olga Zubashko *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

The significance of formal educational attainment on achieving future employment and high wages incentivizes many high school students to attend college. These students often take out numerous loans and exit college indebted to the government and other private sources.

This begs the question: are students expecting higher education to pay off in a large capacity? Are students overestimating how much money they will be earning in the future and graduate college not being able to pay off their accumulated loans? Within this study, we hope to understand the difference between students beliefs of how much they will be making and their true salaries. Our possible client is the Career Center at Carnegie Mellon University, aiming to educate students better on their prospects.

SELF-IMMOLATION AND ITS CONSEQUENCES

STUDENT Seijean Gahng *Social & Decision Sciences*

ADVISOR Donald Sutton *History*

ROOM/TIME McKenna / 1:40 pm

For the past couple of decades, Tibetan monks and an array of individuals have partaken in an act of setting themselves on fire, or self-immolation. Such acts have taken place in front of UN headquarters, village streets, and even monasteries, and the purpose behind self-immolation typically takes places as political protest. A number of Buddhist monks immolated themselves as a form of martyrdom in protest against discriminatory Chinese policies and attempt to equate their slow and painful death as a sacrifice for Tibetan freedom.
The consequences, however, are questionable as these self-immolators are sometimes viewed as selfish individuals who ultimately harm the Tibetan cause, while other times they are labeled as heroes and martyrs. The vast discrepancy between how self-immolation is perceived creates an amorphous reflection on self-immolation and its effectiveness. This study will examine the different self-immolations that occurred in the past few decades and analyze responses from significant parties, such as the Dalai Lama, in order to determine the positive and negative implications self-immolation have on the Tibetan cause.

THE ISRAEL LOBBY AND US POLICY IN THE MIDDLE EAST: THE IRAQ WAR, EGYPT AFTER THE ARAB SPRING, AND IRAN'S NUCLEAR PROGRAM

STUDENT Nina Mast *Social & Decision Sciences*
ADVISOR Kiron Skinner *Social & Decision Sciences*
ROOM/TIME McKenna / 3:00 pm

The influence of the so-called 'Israel Lobby', a diverse coalition of American organizations that aim to affect pro-Israel policy, has been hotly-debated for several decades, and descriptions of the lobby's importance to US foreign policy range from 'irrelevant' to 'axiomatic'. In an effort to understand the current debate, this project examines the relationship between the Israel Lobby and US foreign policy in three cases: the decision to invade Iraq in 2003; the legacy of the Arab Spring in post-Mubarak Egypt; and US-Israeli efforts to prevent Iran from obtaining nuclear weapons. Throughout the paper, I draw on primary and secondary historical resources and international relations theory in order to explore the US-Israel relationship through changing domestic and international circumstances and to better understand the implications of this relationship for the prospects of a more peaceful dynamic in the Middle East. I conclude that, while still a significant factor in American foreign policy, the influence of the Israel Lobby is stagnating and, in some cases, declining as the United States moves toward a narrower, more pragmatic and therefore less ideological strategy in the Middle East.

WHAT ASPECT OF IMAGINED CONSUMPTION REDUCES SUBSEQUENT CONSUMPTION?

STUDENT Vivian Chang *Social & Decision Sciences*
ADVISOR Carey Morewedge *Social & Decision Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Past research has indicated that perception and mental visualization of a stimulus create similar physiological and behavioral responses. The effect of this phenomenon has been studied in food consumption. Experiments have shown that imagined food consumption, when limited to a small number of repetitions or "imaginings," increases the desire for the object, in this case food . However, when the number of "imaginings" is increased, imagined consumptions begin to reduce desire for the object due to the habituation of the participant to the stimulus . This study will seek to expand our understanding of this habituation phenomenon in food consumption by isolating which aspect of imagined consumption most strongly induces habituation.

STATISTICS

ARTIST MUSIC DISCOVERY: THE DIGITAL ROAD TO THE TOP OF RADIO

STUDENT Emily Wright *Statistics*
ADVISOR Rebecca Nugent *Statistics*
ROOM/TIME Wright / 1:00 pm

Radio is a powerful medium with a vast and all encompassing audience reaching about 244.5 million consumers a year (Nielsen, 2014). Consequently, a music artist's position on the top radio charts is a primary measure of success in the music industry. It is of particular interest to record labels to identify artists whom are most likely

to hit the top charts of radio. One way to do so is to monitor artists' activity on online streaming services and social media. It is believed artists with the highest activity are expected to reach radio's merit of success. This paper is a formal inquiry and analysis examining the relationship between an artist's online presence and their appearance on the top charts of radio. A Cox Proportional Hazards model was fit predicting an artist's presence on radio with usage on Facebook, Wikipedia, Twitter, Youtube, Vevo and Soundcloud as explanatory variables. The final findings can be used to inform artists how best to promote themselves and further can aid record labels in choosing which artists to sign and promote.

CHANGING TO A PLUS/MINUS GRADING SYSTEM AT CMU

STUDENTS Samuel Bailey *Statistics* | Karn Mishra *Statistics* | Arjun Vijayakumar *Statistics*
ADVISORS Trent Gaugler *Statistics* | Grant Weller *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Several universities across the have established or adopted a plus/minus grading scheme. Our purpose is to guage undergraduate students' attitudes towards this grading scheme and their opinions with regards to whether Carnegie Mellon should adopt this scheme.

CMU DINING SURVEY

STUDENTS Marcus Anthony *Statistics* | Asad Meghani *Statistics* | Charles Primbas *Self-defined* | Sam Waters *Economics and Statistics*
ADVISOR Trent Gaugler *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Our research group conducted a survey, taken from a simple random sample of all CMU undergrads, to determine their dining preferences, priorities, and evaluations of current CMU dining options in order to maximize student utility gained from on-campus dining.

COSMIC VARIANCE: SPATIAL BOOTSTRAPPING

STUDENT Noah Fatsi *Statistics*
ADVISORS Jessica Cisewski *Statistics* | Peter Freeman *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The variance in the distribution of matter in the Universe is known as cosmic variance. Estimating cosmic variance accurately is important, because it affects statistical interpretations of data collected by surveys that can sample only small spatial volumes. In my project, I estimate cosmic variance with a technique called spatial bootstrapping. This means that, using the Sloan Digital Sky Survey (SDSS) as my data source, I count data in randomly allocated cells which may or may not overlap due to the randomness. Spatial bootstrapping is useful, because randomly resampling the data among all possible spatial volumes within the SDSS allows for varying cell locations, whereas regular bootstrapping randomly resamples the data using fixed volumes.

DE-DUPLICATION OF CIVIL WAR KILLINGS IN EL SALVADOR

STUDENTS Daniel In *Economics and Statistics* | Karn Mishra *Statistics* | Joseph Pane *Statistics*
ADVISOR Cosma Shalizi *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

Several people were killed during the civil war between the Salvadoran Government and the left-wing guerrilla Farabundo Marti National Liberation Front (FMLN) in El Salvador from 1980 to 1991. Our primary focus is the reporting of these deaths. In some instances, the same death was recorded multiple times. De-duplication removes duplicate records from one list or database without unique identifiers but the purpose of this project is to come up with a methodology to determine who is who. The El Salvador database contains name, date of death, and location from 4 different sources. We will use this data to develop a methodology that will establish a hand matched dataset to train on in order to identify duplicate records. Ultimately, we want to be able to estimate the number of unique deaths.

DIETRICH COLLEGE FRESHMAN SEMINAR EVALUATION

STUDENTS Megan Garvey *Business Administration* | Anas Hoque *Economics and Statistics* | Bryan Ketterer *Statistics* | Anton Razanav *Economics* | Christopher Wysocki *Economics and Statistics*
ADVISOR Grant Weller *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

An evaluation of the Faculty and Student perspectives on the Freshman Seminar Program. The evaluation includes perspectives on whether or not the goals of the program are achieved as well as analysis of downstream effects generated from the FS.

ESTIMATING COSMIC VARIANCE

STUDENT Audrey Callahan *Statistics*
ADVISORS Jessica Cisewski *Statistics* | Peter Freeman *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

The term cosmic variance denotes the variance of the distribution of matter in the Universe. Estimating cosmic variance is an important aspect of statistical inference in cosmology; without taking cosmic variance into account, uncertainties in measurements are systematically underestimated. Using data from the Sloan Digital Sky Survey, I estimate the variance in the number of galaxies observed in different sections of the sky that have equal volumes. I test the precision of my results by applying the method of bootstrapping. I use my results to estimate the cosmic variance as a function of survey volume.

ESTIMATION OF NBA PLAYERS' OFFENSE/DEFENSE RATINGS FOR GAME OUTCOME PREDICTION

STUDENT Kyongche Kang *Statistics*
ADVISOR Andrew Thomas *Statistics*
ROOM/TIME Wright / 1:40 pm

The standard plus-minus model for rating NBA players combines the offensive and defensive capabilities of each player into a single metric. While this is convenient for the sake of summary, it makes it difficult to isolate

the particular contributions that a player makes to either effort. To correct for this, we construct a penalized regression model that identifies the specific offensive and defensive contributions of each player on each possession, and tune the model using L1- and L2-regularization methods to optimize its predictive power. With fully developed model, we can accurately predict the outcome of the next unseen match with each player's contribution on the court.

EVALUATING STATISTICS OF GALAXY CLUSTER DETECTION

STUDENT Kathryn McKeough *Statistics*
ADVISOR Peter Freeman *Statistics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:15 am

A galaxy cluster is a set of galaxies held together by gravity. Astronomers study clusters because they are the most massive gravitationally bound objects in the Universe. Counting them gives us the ability to constrain parameters of cosmological models. This project examines the statistical methodology of cluster detection. This is done by simulating galaxy counts in regions of the sky. Using the simulated data, we compare the maximum likelihood and minimum chi-square estimators to determine which performs better in a cluster detection setting. The statistics are quantitatively compared by completeness, the rate of true galaxy clusters detected, and purity, the fraction of cluster detections which are correct.

FACULTY COURSE EVALUATION

STUDENTS Shivika Dhar *Statistics* | Shannon Ho *Business Administration* | Hyo Na Lee *Economics* | Yuxuan Li *Statistics* | Kristina Schiffhauer *Statistics*
ADVISOR Grant Weller *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

Explore the different methods of FCEs and their effectiveness. Look for ways to have higher response rates that is to have more students fill out the FCEs. Through FCEs, give students more information about courses and corresponding instructors. Use FCEs to help students make wiser choices in choosing courses.

FRENCH ONLINE LEARNING: HOW DO STUDENTS BEHAVE AND PERFORM?

STUDENTS Kairavi Chahal *Statistics* | Jaclyn Wolf *Philosophy* | Julian Zhou *Statistics*
ADVISORS Cosma Shalizi *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Online learning has become increasingly popular, an area of which Carnegie Mellon's Online Learning Initiative (OLI) is a pioneer. Between 2006 and 2010, around 100 students from Carnegie Mellon and the University of Pittsburgh took an online version of French Languages I via OLI. Their activities throughout the online course generated large-scale learning-related data that were captured by DataShop of the Pittsburgh Science of Learning Center (PSLC). This project aims to address several hypotheses proposed by the faculty behind the French online course, regarding students' online learning behaviors. Questions asked vary from 'Do students navigate through the course linearly?', 'Do students who complete fewer activities on a certain language skill later perform worse in assessment on that skill?', to 'Do students form distinct clusters based on their online learning behaviors?'. A range of statistical analyses, descriptive and inferential, exploratory and advanced, are utilized to provide reasonable answers.

IMPACT OF ADVANCED PLACEMENT COURSES ON COLLEGE READINESS IN THE PITTSBURGH PUBLIC HIGH SCHOOLS

STUDENTS Aleksandra Arkhangelskaya *Statistics* | Cynthia Clement *Mathematics* | Kathryn McKeough *Statistics*
ADVISOR Cosma Shalizi *Statistics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:15 am

Pittsburgh public school students who take advanced placement (AP) courses, and do well in them, are more likely to enroll in and to finish college. We investigate how much of these differences are treatment effects (AP prepares students for college), and how much are selection (the college-ready are the ones who take AP classes). By comparing students who took AP classes with students with similar academic records but no AP courses, we determine the effect of finishing at least one AP course on college enrollment. We also examine the criteria used to admit students to AP classes. Finally, we assess if the beneficial effects of AP classes are reduced for high-performing students when more lower-tier students are allowed to enroll in AP classes.

MODELING COSMIC VARIANCE

STUDENT Andersen Chang *Statistics*
ADVISORS Jessica Cisewski *Statistics* | Peter Freeman *Statistics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The distribution of galaxies in the Universe has large variation. Surveys of the Universe show that some volumes have large clusters of galaxies, while others have very few galaxies, if any at all. This variance in the distribution of galaxies is called cosmic variance. My project focuses on modeling cosmic variance using data from the Sloan Digital Sky Survey, an extensive survey of a large contiguous area in the sky. I first consider a homogeneous Poisson point process and find that this model does not fit the data from the survey very well. I then consider different two-dimensional inhomogeneous point processes; some of them, such as the Thomas and MatClust distributions, do not fit the SDSS data well, while others, such as the Cauchy and the Log Gaussian Cox, are visually more consistent with the data. Using the results of the modeling, I estimate the distribution for the density of galaxies in the Universe and the cosmic variance.

MODELING NEURONS

STUDENT Jonathan Yu *Statistics*
ADVISOR Robert Kass *Statistics*
ROOM/TIME Pake / 3:40 pm

One way to analyze how our brains encode and decode outside information is to study spike count correlations. In many experimental data between two simultaneously recorded neurons, it has been observed that spike count correlations seem to increase with length of time observed and input firing rate. While there are have been models used to research spike train correlation, it has been observed from single-unit recordings of rhesus monkeys that electrophysiological data can also be modeled by a balanced random-walk integrate and fire model. For my project, I am studying spike train correlations as part of a year-long project in which the purpose of this research project is to be able provide a random-walk integrate and fire model for studying correlation of two neurons under varying conditions. Through simulations, I look at the relationship of spike count correlation, across two neurons, to firing rate when there is multiplicative trial-to-trial variability in the inputs to the two neurons. After this step, I will then look at the way synchrony i.e., synchronous firing of two

neurons in close temporal proximity, varies with the inputs. Professor Robert E. Kass in the Department of Statistics will serve as my primary thesis advisor as well as Pengcheng Zhou, a graduate student in the CNBC PhD program, will be a very important mentor as well.

RESOURCES AT HUNT LIBRARY

STUDENTS Zhuling Li *Psychology* | Ahnsik Shin *Business Administration* | Abigail Volynsky *Statistics* | Sungkyu Yang *Statistics*
ADVISOR Trent Gaugler *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

For the benefit of the CMU community, we have decided to conduct a survey about the use of Hunt Library and its various resources. Through this survey, we hope to achieve a better understanding of the resources that are being used (i.e. CAMEO, eJournals, Online databases, etc) and the resources that many students fail to utilize properly. Additionally, we aim to understand why these resources are not being properly exploited. We hope the university will consider these results regarding future improvements in Hunt Library.

TEPPER STUDENTS' ATTITUDE TOWARDS CURRENT GRADING SYSTEM

STUDENTS Karthik Annaamalai *Business Administration* | Andres Anzola *Economics* | April Jianto *Business Administration* | Dixon Liang *Business Administration* | Jisoo Park *Statistics*
ADVISOR Trent Gaugler *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Grades are not only an indication of how well a student is performing, but also a hiring criterion for employers and graduate schools.

Recently, controversy over Harvard's grading system has gained national media attention. Some schools, most notably Harvard, are known for grade inflation, while others, such as MIT, are known for grade deflation. As Tepper attempts to move forward in national rankings, it's important for university officials to understand a range of grading alternatives.

Recently, the undergraduate Tepper administration has been implementing grading policy changes including introducing a grade cap on the maximum number of students who receive an A grade in a particular class at 30% of the class size. The administration is also evaluating additional alternatives. Thus, our findings can have a substantial impact on the future policies that Tepper may introduce. This survey needs to be conducted now because of the immediate consequences for the future of students. Unlike the leniency of some employers in other fields, business employers arguably view GPA as the most important factor for consideration. For example, employers often have a set GPA requirement for most jobs in business, with 3.3/4.0 being the most common. The requirement isn't school specific, but is standard across all schools and thus, does not take into consideration the distribution of grades at any particular school.

University officials, from career center employees to school deans, can use this research to better understand, adjust grading systems, or inform employers or graduate institutions to put students in competitive positions relative to their peers.

The main question we hope to answer in this project is "Do undergraduate Tepper students prefer the hybrid grading system that is currently used, which combines both absolute grading scales and relative curved grading scales? If not, what alternatives are most popular?"

Tepper's undergraduate business program currently employs a hybrid grading system where some classes use an absolute grading method while others a relative one. Given that students understand the current system,

it is possible that students prefer an absolute grading system because it can lend itself to a more collaborative environment in which students are less likely to compete with one another. Because of this synergistic climate, students may feel more comfortable to share their ideas and unique perspectives and in turn create a better learning experience.

THE FEASIBILITY OF AN ALTERNATIVE BUS PLAN FOR CMU

STUDENTS Steven Chang *Economics* | Sung Jin Hong *Economics and Statistics* | Daniel In *Economics and Statistics* | Hyejin Lee *Economics and Statistics* | Hyun Suh Lee *Statistics*

ADVISORS Trent Gaugler *Statistics* | Grant Weller *Statistics*

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

CMU undergraduate students were charged $60 transportation fee this semester. Clearly, this is an expenditure that cannot satisfy every student in CMU, especially if one feels he or she is not riding enough buses over the years they study here. CMU's original intention to benefit students through a convenient and defaulted bus system is viewed differently by the students. We would like to investigate CMU students' attitudes towards this system and the CMU free shuttle services. Now that the PAT smart-card system works with CMU IDs, studying the feasibility of an alternative bus plan (where students have the option of purchasing a bus pass or not) by exploring the students' "utility functions" towards the two respective transportation means could help university leaders perform their cost-benefit analysis of potentially implementing a new transportation system.

The Port Authority has seen a fair share of financial problems, so the university and its students should plan for future transportation contracts accordingly. Back in the fall of 2009, Carnegie Mellon students were charged $40.00 per semester, a rate that has risen to $60.00 today, and $120 for the coming fall. In addition, the number and frequency of bus routes have been continuously decreasing. In other words, every year, students are paying more for lesser service. Today, the university may find it financially beneficial and ethically appropriate to establish alternative means of transportation or expand its own free shuttle services for students.

USING SURVEYS TO IMPROVE COMPUTING@CARNEGIEMELLON

STUDENTS Noah Cohon *Economics* | Maya Geleroff *Economics* | Matthew Greenberg *Economics* | Maksim Horowitz *Statistics* | Jana Motie *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

Through a randomized distribution of surveys given to undergraduate students, our research team gathered opinions regarding new content for the Computing@CarnegieMellon course. With a goal of revolutionizing the course to make it more applicable to all students on campus, our research question was "What content should be included in the Computing @ Carnegie Mellon course in order to help students succeed, overall, at Carnegie Mellon?". After surveying 245 students, a majority felt negatively toward the course before they took it and thought it had not truly helped them succeed at Carnegie Mellon. However, the proposed course changes brought up by an undergraduate faculty review board were received positively by a slight majority of students we sampled.

MELLON COLLEGE OF SCIENCE

BIOLOGICAL SCIENCES

A QUANTITATIVE ANALYSIS OF TRPM8 STIMULATION BY MENTHOL AND COLD VISUALIZED IN THE SPINAL CORD USING IMMUNOHISTOCHEMISTRY

STUDENT Katherine Cecil *Biological Sciences*
ADVISOR Alison Barth *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:30 am

This proposed project involves studying cold thermosensation in mice by stimulating a specific ion channel known to be involved in thermosensation, TRPM8, with menthol and cold water, then observing the signal in the spinal cord as it travels to the brain. The signals from stimulating the mouse forepaw or hind paw with either menthol or icilin will be compared in terms of intensity and localization within the spinal cord. The results of this project will provide valuable insight into the pathway of cold sensation as it travels from the paw to the brain, and may prove useful in a larger neuroscientific effort to map our experiences to certain regions of our brain. This semester long project will be accomplished by stimulating and extracting the spinal cords from laboratory mice, sectioning them, then using immunohistochemistry to label firing neurons, which can be viewed under a microscope. Obtained images can then be analyzed quantitatively.

CEREBROSPINAL FLUID LEVELS OF MITOCHONDRIAL DNA IN PEDIATRIC TRAUMATIC BRAIN INJURY

STUDENT John Hong *Biological Sciences*
ADVISOR Jonathan Minden *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

Recently, innate inflammatory responses following non-programmed cell death (necrosis) have been linked to danger-associated molecular pattern molecules (DAMPs). The immediate necrosis following traumatic brain injury (TBI) leads to the released of DAMPs, such as the release of mitochondrial DNA (mtDNA) and high mobility group-box 1 protein (HMGB1), a known inflammatory protein. The pathway in how mtDNA induces the inflammatory response is largely uninvestigated. In vitro studies of mtDNA can help elucidate the intricacies of this pathway. The knowledge of this pathway could lead to advances in diagnosis and treatment of those suffering from TBI.

CONFIRMING THE IDENTITIES OF CANCERS

STUDENTS Chrystal Thomas *Biological Sciences*
ADVISOR Mary Braun *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

With an estimated 1.3 million deaths per year, lung cancer is the leading cause of cancer-related death in both men and women worldwide.

The five-year survival rate of lung cancer is only 16.3%, which is significantly lower than that of many other cancers (e.g. colon cancer at 65.2% or breast cancer at 90.0%). An approach to mitigating this problem is to analyze the relationship between cancers and their protein markers. For instance, tumors of what seemed to be two types of lung cancer arose from the same source after the silent mutation, KRAS, were triggered

in a mouse model. By analyzing the protein markers in the tumors via western blot, it was confirmed that two distinct populations of lung cancers were indeed developing. Future application of this study includes converting an advancing cancer into a less aggressive one.
Funded by the Howard Hughes Medical Institute grant #52006940.

RTD-1 M: A MODIFIED NATURAL ANTIMICROBIAL PEPTIDE

STUDENTS Julia Atwood *Chemistry* | Kevin Long *Chemistry* | Cat Mao *History* | Alexander Orenstein *Biological Sciences*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

RTD-1 is a cyclic antimicrobial peptide in the theta defensin family present in Rhesus macaque, which has been found to be effective against viruses, fungi and both gram-negative and gram-positive bacteria. The mechanism of action works by incorporating itself into the cell membrane using arginine side chains, causing leakage. Though effective by itself as an antimicrobial agent, the peptide as it occurs naturally is difficult to synthesize due to the three disulfide cross linkages necessary for the tertiary structure of the peptide. This obstacle has been overcome by the incorporation of PNA monomers during solid phase synthesis which replace the functionality of the disulfide cross linkages. Initial tests against gram-positive and gram-negative bacteria displayed similar antibiotic properties to RTD-1 while hemolysis assays indicate that it is nonlytic to human red blood cells. Incorporation of D-amino acid monomers in synthesis decreases chances of pathogens developing resistance. Providing additional mechanisms that target the cell membrane also decrease the likelihood of pathogens developing antibiotic resistance. This is due to the difficulty for pathogens in developing survivable mutations that could effectively change phospholipid bilayer chemistry. In addition, using unnatural PNA molecules reduces the chance of proteases adapting to cleave the peptide. Antibiotic activity could be improved by attaching a hydrophobic tail much like those of Telavancin and Daptomycin, increasing membrane perturbation as well as cellular anchoring. The work builds upon these principles, which will hopefully result in the emergence of a new class of antibiotics with a low chance of obsolescence.

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

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.

CHEMISTRY

A "KNOCKDOWN" ASSAY OF BIOFILM FORMATION IN CANDIDA ALBICANS

STUDENT Sarah Horner *Chemistry*
ADVISOR Aaron Mitchell *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:15 am

I performed genetics research on Candida albicans (C. albicans), which is the predominant form of fungal infection in the United States, causing upwards of $2.6 billion in treatment costs each year. Infection is linked to the formation of biofilms on medically implanted devices, such as artificial joints and catheters. Furthermore, the increased resistance of C. albicans biofilms to current antifungal drugs complicates treatment. In order to disrupt biofilm formation, we must disrupt hyphal cell formation since hyphal cells are essential to biofilm formation. Previous research found that ALS1, which is a surface protein involved in cell-surface adhesion, promotes BRG1, which is a transcription factor essential to hyphal formation. In the absence of either ALS1 or BRG1, C. albicans is defective in biofilm formation, yielding biofilms with depths of 50m and 20m respectively compared to a wild type strain at 300m. This means that brg1/ shows a more severe biofilm defect. The goal of my experiments was to determine if by knocking down BRG1, as opposed to deleting it entirely, we would observe a phenotype similar to als1/.

A NEW OBJECT-ORIENTED FRAMEWORK FOR MODELING MEMBRANE PROTEINS IN ROSETTA

STUDENT Rebecca Alford *Chemistry*
ADVISORS Jeffrey Gray *Johns Hopkins University* | Julia Koehler *Johns Hopkins University*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:45 am

Membrane proteins comprise over 30% of the human proteome and 50% of known drug targets. However, structure determination is extremely difficult and existing prediction methods cannot model a membrane environment. Our goal is to develop an object-oriented framework for membrane proteins in the Rosetta software for biomolecular structure prediction and design. The flexible architecture represents membrane protein topology and embedding, and integrates into kinematic and energy layers to move and score a protein. Ultimately, this allows easy combination of docking, folding, and design in the membrane framework and will facilitate membrane protein structure determination, drug design, and understanding of disease.

COMPUTATIONAL INVESTIGATION OF BENZOTHIAPHOSPHOLES

STUDENT Samuel Amsterdam *Chemistry*
ADVISOR David Yaron *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The electronic properties of benzothiaphospholes and their derivatives are investigated using ab-initio density functional theory (DFT). The incorporation phosphorous into these compounds is shown to fundamentally alter the orbital structure in comparison to other analogous molecules, demonstrating the importance of benzothiaphospholes as a new class of conjugated materials. Insights into their bonding character with substituents are developed into a design strategy for conjugated systems to allow for control of electron delocalization, with an eye towards applications as an organic semiconductor.

IMPROVING SEQUENCE SPECIFICITY IN ANTISENSE TECHNOLOGY

STUDENT Allison Huang *Chemistry*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:00 am

Peptide nucleic acids (PNAs) are synthetic nucleic acids being studied for applications in antisense technology1. PNA, a chiral PNA similar to other chiral probes showing promise in vivo2, has been found to bind tightly to RNA3. However, a principal obstacle in antisense technology is the inability of probes to bind specifically to their targets. Inserting D-isomer amino acids instead of the naturally occurring

L-isomers into the PNA sequence causes the helical formation to be disrupted and decreases the binding affinity of PNA for RNA, increasing sequence specificity for its target. Such modified PNAs were hybridized with various RNAs and the melting temperatures (Tm) measured by UV-Vis spectroscopy to test for sequence specificity. The 15-mer modified PNAs were able to distinguish their target from shorter RNA fragments (39ºC between full-length and half-length; with unmodified PNA, 23ºC) and the 10-mer modified PNAs were able to distinguish between the target and mismatched RNAs (on average, Tm 26ºC with modified PNA and 17ºC with unmodified PNA) (Figure 1). Because the modified PNAs do have improved sequence specificity, it is likely that similarly designed molecules will eventually be used to regulate gene expression via antisense technology.

MODEL DEVELOPMENT TO TEST EFFICACY OF ENCAPSULATED CHEMOTHERAPEUTIC DRUGS IN SOFT TISSUE REPAIR

STUDENT Leela Chockalingam *Chemistry*
ADVISOR Kacey Marra *UPMC*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:15 am

Fat grafting is an emerging surgical option for breast reconstruction after mastectomies, and uses the patient's own adipose tissue.

Adipose tissue contains an abundance of adipose stem cells (ASCs), which increase tissue viability. However, the breast may contain remnant cancer cells around the resected tumors, and ASCs have been shown to have tumor-promoting effects. It is hypothesized that encapsulated chemotherapeutic agents could be incorporated into the breast reconstruction fat grafts following mastectomies to prevent cancer remission, while allowing ASCs to function and proliferate. The goals of this project were to develop an in vivo model that reliably grows breast cancer tumors in fat grafts, to test the relative toxicity of chemotherapeutic agents on ASCs and breast cancer cells in-vitro, and to test the ability of ASCs to differentiate after being exposed to chemotherapeutic agents. Nod-SCID gamma mice were injected with ASC-infused lipo tissue with various doses of MDA-MB-231 cells, along with appropriate positive and negative controls. After excision and processing samples were stained for Hemotoxylin and Eosin (H&E) and human-specific pancytokeratin (clone MNF116-Dako). ASCs isolates (n=3) and cancer cells BT-474s were exposed to various doses of paclitaxel (Biotang MA). ASCs isolates (n=2), MDA-MB 231s, and BT-474s were exposed to various doses of 4-OH tamoxifen (Sigma-Aldrich, MO). An MTT assay kit was used to measure metabolic activity (Millipore, MA). ASCs (n=3) were exposed to concentrations of paclitaxel, and then incubated with differentiation factors. Their differentiation was measured with AdipoRed™ Assays (Lonza, MD). The in vivo experiment demonstrated that our animal model could be used to produce MDA-MB 231 tumors in lipo. The MTT assays in vitro shows that the cancer cells are more sensitive to the drugs used than the ASCs at certain doses. The AdipoRed assay shows that ASCs continue to differentiate after drug exposure. These results mean the ASCs can continue to serve the lipo even in the presence of the encapsulated drugs, allowing for increased viability of the fat-graft itself.

OPTIMIZATION OF PNA PROBES FOR FLUORESCENT IMAGING

STUDENT Chris Hong *Chemistry* | Lauren Xu *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:30 am

Measuring the length of telomeres, the structures at the end of chromosomes, is a significant indicator of risk for genetic disorders and cancers1. Peptide nucleic acids (PNA) have the ability to bind to DNA and RNA and act as fluorescent probes to measure telomere length. Because of its neutral backbone, PNA's have been known to be advantageous for having a higher hybridization and selective properties than DNA molecules1. Additionally, they are more thermodynamically stable than DNA molecules and are not substrates to any degrading enzyme2. There previously have been 4 methods pursued to label RNA molecules: (1) method for labeling 3' and 5' ends of RNA, (2) method of utilizing T4 DNA ligase with a DNA oligonucleotide splint, and (3) method of utilizing twin ribozymes3. However, each of these methods had their limitations, and instead PNA probes have been used and were shown to have a higher binding affinity without any degradation from other enzymes, allowing the usage of a more efficient labeling to RNA molecules3. I will be testing (1) the stability of the PNA probes and (2) the effect of how the distances between two dyes in a PNA probe will affect Forster Resonance Energy Transfer (FRET).Results have shown that Nathaniel's linker may be relatively stable at a higher temperature when compared to Lisa's design.

Additionally, the ester group on the coumarin dye may be susceptible of being hydrolyzed by water, which may produce a degradation product at high temperatures that can absorb light. Second, the results have shown that NS PNA-67, which contains two coumarin dye in the 6th and 7th base pair from the C terminus end of the PNA, has the highest absorbance of the three PNA's that were tested before and after being heated, which may indicate that the distance between the dyes is inversely proportional to the absorbance, and the NS PNA-47 and NS PNA-67 both had relatively the similar highest emission before being and after being heated. Third, all three PNA's (NS PNA-47, NS PNA-57, and NS PNA-67) had relatively the same Tm. However, the testing of the effect of the distance of the dyes to the FRET properties is currently ongoing, and so no conclusion can be made.

ORDER FORMATION AND TOUGHENING IN POLYMER-GRAFTED NANOPARTICLE SOLIDS VIA HOMOPOLYMER ADDITION

STUDENT Zachary Urbach *Chemistry*
ADVISOR Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:30 am

Polymer-Grafted nanoparticles have unique self-assembly properties and structures. They provide unique applications for light emitting devices or bendable optoelectronic applications. There is a trade off however between ordering of particles and mechanical strength of the thin films that are formed. By introducing free chain polymers (homopolymer) into the empty interstitials of the monolayer structure, both properties should be retained. Experimental tests will vary the relative amounts and sizes of free polymer added to polymer-grafted nanoparticles to see what conditions form the most ordered and mechanically strengthened material. Transmission electron microscopy will be used to analyze structures of monolayers and nanoindentation will be used to measure mechanical strength of multilayers.

RECRUITING OF RIBOSOMAL PROTEINS BY RIBOSOMAL ASSEMBLY FACTORS

STUDENT Luke Diorio-Toth *Chemistry*
ADVISOR John Woolford *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:45 am

Ribosome biogenesis is a complex, multistep process that involves processing and folding of rRNA and binding of ribosomal proteins.

Previous research has shown that many different classes of trans-acting proteins are also required for assembly, with both enzymatic and structural functions. However, the precise functions of most of these assembly factors are not known. To begin to explore roles of assembly factors in ribosome biogenesis, we investigated their functional relationships with ribosomal proteins. Although a significant amount of information exists about roles of both ribosomal proteins and assembly factors in ribosome biogenesis, not much is known about the interplay between the two types of proteins. Previous research has shown order of assembly of ribosomal proteins into pre-ribosomes, as well as with which assembly factors they associate. However, most of these studies started with specific ribosomal proteins and then asked: with which assembly factors do they interact, and which assembly factors depend on them to associate with pre-ribosomes?

Specifically, we asked which ribosomal proteins depend upon the assembly factors Nog1, Nog2, Dbp10, and Spb4 to assemble. These assembly factors were selected because they are thought to have similar functions (as GTPases or ATPases). Ribosomal proteins were tagged in strains conditional for expression of these assembly factors, and association of ribosomal proteins with pre-ribosomes was explored upon depletion of each of these factors. This work is intended to complement the work that has already been done by providing a more complete picture of how these ribosomal proteins fit into the established recruitment pathway for assembly factors. Because there is much more structural information about position and conformation of ribosomal proteins on the pre-ribosome, this work will hopefully elucidate similar information about the assembly factors. This approach has benefitted us because we have reevaluated out the previously established assembly hierarchy. This work has also lead us to believe that it is not simply RNA processing that allows these ribosomal proteins to stably associate with the pre-ribosome, but the presence of these assembly factors is required prior to the processing of RNA.

RTD-1 M: A MODIFIED NATURAL ANTIMICROBIAL PEPTIDE

STUDENTS Julia Atwood *Chemistry* | Kevin Long *Chemistry* | Cat Mao *History* | Alexander Orenstein *Biological Sciences*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

RTD-1 is a cyclic antimicrobial peptide in the theta defensin family present in Rhesus macaque, which has been found to be effective against viruses, fungi and both gram-negative and gram-positive bacteria. The mechanism of action works by incorporating itself into the cell membrane using arginine side chains, causing leakage. Though effective by itself as an antimicrobial agent, the peptide as it occurs naturally is difficult to synthesize due to the three disulfide cross linkages necessary for the tertiary structure of the peptide. This obstacle has been overcome by the incorporation of PNA monomers during solid phase synthesis which replace the functionality of the disulfide cross linkages. Initial tests against gram-positive and gram-negative bacteria displayed similar antibiotic properties to RTD-1 while hemolysis assays indicate that it is nonlytic to human red blood cells. Incorporation of D-amino acid monomers in synthesis decreases chances of pathogens developing resistance. Providing additional mechanisms that target the cell membrane also decrease the

likelihood of pathogens developing antibiotic resistance. This is due to the difficulty for pathogens in developing survivable mutations that could effectively change phospholipid bilayer chemistry. In addition, using unnatural PNA molecules reduces the chance of proteases adapting to cleave the peptide. Antibiotic activity could be improved by attaching a hydrophobic tail much like those of Telavancin and Daptomycin, increasing membrane perturbation as well as cellular anchoring. The work builds upon these principles, which will hopefully result in the emergence of a new class of antibiotics with a low chance of obsolescence.

SYNTHESIS AND NATIVE CHEMICAL LIGATION OF MP-L-PNA MONOMERS.

STUDENT Yidan Cong *Chemistry*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

It has been dated that more than 20 genetic diseases are associated with unstable expansion repeat. Research works have been currently focusing on Myotonic Dystrophy (MD1), whose mechanism has been fairly known. It has been found that patients who are affected by MD1 have genome consists of RNA triplet CUG repeat. The number of this repeat exceeds normal phenotype by a large amount. RNA repeats form hairpin structures that bind with muscle-blind-like protein 1, and consequently, inhibit alternative splicing. To open up these hairpin structures, a mechanism was proposed that short complementary gamma peptide nucleic acid (PNA) triplets to be delivered into the cells and bind with repeats in a native chemical ligation fashion. To test this hypothesis, MP-L-PNA monomers were synthesized and PNA 3mers and 6mers GAC were made from monomers. Native chemical ligation (NL+CL) between PNA oligomers and RNA sequences with various lengths were performed. Matrix-assisted laser desorption/ionization (MALDI) was used to analyze and investigate the occurence of NCL.

SYNTHESIS OF TANDEM FRET ACTIVE DYES FOR BIO SENSOR

STUDENT Jeffery Kurish *Chemistry*
ADVISOR Marcel Bruchez *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:00 am

Malachite green (MG) fluorescent dye was covalently linked to cyanine three (Cy3) dye to create a fluorescent active tandem dye wherein excitation of the Cy3 dye can show emission in the MG spectrum. A synthetic pathway was described for the creation of MG linked to a reduced Cy3 dye with spectroscopic data supporting the claim. The reduced Cy3 dye does not absorb energy and therefore does not fluoresce in the MG region. This dye can be used as a sensor for singlet oxygen the reduced Cy3 is oxidized slowly increasing the fluorescent signal. MG has two separate excitation regions the larger of the two overlapping with the emission spectrum of Cy3. The other excitation spectrum however overlaps strongly with the emission spectrum of a coumarin. In order to create another FRET dye tandem pair MG dye was linked with coumarin. Initial data has shown that the coumarin MG dye has shown quenching of MG emission but not significant energy transfer. Different linkers between the coumarin and MG dye should be attempted in the future.

TAML-CATALYZED DEGRADATION OF PROPRANOLOL

STUDENT Abigail Burton *Chemistry*
ADVISOR Terrence Collins *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:00 am

Propranolol, a pharmaceutical present in water at concentrations that may be dangerous to sensitive species, is efficiently degraded by FeIII-TAML activators and hydrogen peroxide in aqueous solutions at pH 6-8. The rate equation for this reaction, neglecting reversibility of catalyst activation, is rate = kIkII[FeIII][HOOH][propranolol]/(kI¬¬[HOOH] + kII[propranolol]), where FeIII represents the catalyst. The rate constant kI equals 29 ± 3, 150 ± 10, and 810 ± 80 M-1 s-1 at 25o C at pH 6, 7, and 8, respectively. The rate constant kII equals (4.4 ± 0.2) x 103, (2.9 ± 0.2) x 104, and (5.7 ± 0.2) x 104 M-1 s-1 under the same conditions. The products for this reaction have not all been identified; one has been identified as 1,4-naphthoquinone but at least one other colored intermediate is produced.

TARGETING THE POLY-U SEQUENCE OF THE HEPATITIS C GENOME WITH 2,6-DIAMINOPURINE PNA OLIGOMERS

STUDENT Rajeev Chorghade *Chemistry*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

The Hepatitis C virus affects over 200 million people, and inflammatory response can lead to cirrhosis and hepatocellular cancer. A kissing loop tertiary structure exists between two stem loops, 5BSL3.2 in the open reading frame, and SL2 within the 3' X domain of the genome. This kissing loop and a poly-U sequence are essential for replication. Altering the length of or adding cytosine to the poly-U sequence hinders replication. This sequence acts as an unstructured spacer to allow the kissing loop. A modified nucleobase, 2,6-diaminopurine, was studied due to its ability to form three hydrogen bonds to thymine. This nucleobase was bound to various PNA monomers, which were strung together to form oligomers of 4-5 units. These oligomers showed strong binding to the poly-U sequence in vitro. Binding to this poly-U sequence has the potential to alter its conformation and rigidity, disrupt the kissing loop structure, and prevent viral replication.

THE ATTAINMENT OF LOW-CHARGE STATE HK97 BACTERIOPHAGE CAPSID AT 13 MTH USING STJ CRYODETECTION MALDI TIME-OF-FLIGHT MASS SPECTROMETRY

STUDENT Jonathan Feldman *Chemistry*
ADVISOR Mark Bier *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:15 am

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. For example, in our previous work from 2007, the HEAD II capsid of HK97, MW 12.9 MDa, was observed with multiple charge states from +3 to +52 by MALDI. Observation of HK97 capsid charge states of +2 at 6.45 MTh (Thomson (Th)=m/z) and the +1 at 12.9 MTh have further extended this high m/z boundary and pushed beyond the previously known limit.

THE EFFECTS ON PEPTIDE BINDING AFFINITY FOR TNF BY CONJUGATION TO POLYMERS

STUDENT Sophia Wu *Chemistry*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:15 am

The human body responds quickly to injury, infection, and disease through the immune system's inflammatory response, governed by a group of cytokines - the tumor necrosis factor superfamily. Specifically, tumor necrosis factor alpha (TNF) is one of the most notable transmembrane proteins involved in this inflammatory response. Although TNF is a necessary protein for the body's healing process, its overexpression can cause chronic inflammation and has been known to be involved with syndromes such as rheumatoid arthritis, Chrohn's disease, and psoriasis. In order to overcome some of the symptoms connected to TNF, it is vital to focus on the development of anti-TNF therapy through the use of TNF inhibitors. These TNF inhibitors need to carry certain properties such as good solubility, high binding affinity, and high circulation time. The conjugation of poly(ethylene glycol) (PEGylation) has become a novel strategy for increasing the circulation time of therapeutics while at the same time not impacting the binding affinity negatively. In our previous studies, we have utilized the WP9QY peptide, which is known to be a TNF antagonist. We specifically determined that conjugation of this WP9QY peptide to PEG resulted in improved binding affinity of the peptide to TNF. In this study, we performed comparison studies in which the WP9QY peptide was conjugated to two other polymers through site-specific conjugation: poly(acrylic acid) (PAA) and poly(2-hydroxyethylacrylate) (pHEA). Different molecular weights of the polymers were also utilized to analyze whether or not a change in polymer length affects the binding affinity. The obtained binding affinities were compared to the binding affinity of the PEG-WP9QY conjugate to directly determine the capabilities of other WP9QY peptide-polymer conjugates as anti-TNF agents. Measurements of kinetic parameters such as kon, koff, and KD will be presented and correlated with polymer chemistry.

THE SYNTHESIS AND CHARACTERIZATION OF SELF-ASSEMBLING BIS-INTERCALATING THIAZOLE ORANGE DIMERS

STUDENT Peter Ronner *Chemistry*
ADVISOR Bruce Armitage *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:30 am

The purpose of this study was to design single chromophore intercalator molecules functionalized to short (6-mer) PNA oligomers that would hybridize in situ in such a way so as to produce dimeric DNA bis-intercalators. After experimentally establishing the successful hybridization of the chromophore/PNA molecules, the intercalating kinetics of these hybridized dimeric complexes were characterized and compared to those of existing DNA bis-intercalators. It is hoped that this work will lay a foundation for the design of self-locking macrocyclic DNA bis-intercalators, which would mechanically lock into a hybridized strand of DNA, providing a very powerful tool for DNA imaging and characterization.

UPROOTING THE RAMAYANA

STUDENTS Collin Cherubim *Chemistry* | Nicolas Marlton *BHA*
ADVISOR Bob Bingham *Art*
ROOM/TIME Connan / 12-2:30 pm

Wayang has evolved with Indonesia. From its origins at the confluence of Javanese folklore, Sanskrit epics, Hinduism and Buddhism, wayang has been influenced by Islam, Dutch colonization, politics, and pop-culture. During the postcolonial era, western perspectives began to infiltrate an art form founded on a thousand years of traditional knowledge. Thus, wayang has been an element of Indonesian history, faithfully documented for posterity as well as a platform for contemporary artistic innovation. This SURG funded project attempts to bridge the cultural gap separating the contemporary American artist from this discourse.

MATHEMATICS

ASSISTIVE NAVIGATION TECHNOLOGY FOR VISUALLY IMPAIRED TRAVELERS

STUDENTS Alekhya Jonnalagedda *Mathematics* | Lucy Pei *Business Administration* | Ming Y. Wu *Information Systems*
ADVISOR Mary Bernardine Dias *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

We explored different avenues through which computing technology can enhance the safety and independence of visually impaired people as they navigate transit stations such as airports, train stations, bus depots, etc. First, we studied the related work in the literature. Having established this foundation, we gathered information from a variety of relevant stakeholders through observation, interviews, and surveys.

The goal of this needs assessment was to understand the specific challenges, needs, existing solutions, governing policies, and ideas for future technology tools that would enhance the experience of visually impaired travelers using transit stations. Based on the findings from our needs assessment, we generated recommendations and guidelines for how technology can address some of the challenges faced by visually impaired travelers.

BUTLEBOT

STUDENTS Zachary Greenberg *Mathematics* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*
ADVISOR Michael Erdmann *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Our overarching objective is to develop the means for a personal robot to perform a wide spectrum of manipulation based tasks around the home. Personal robotics has an immediate need in supporting and assisting the elderly and disabled with household tasks that could be potentially hazardous or difficult. However current personal robotics has failed to address this need. On one end of the spectrum, highly functional personal robots, like Herb and Pr2, are restrained heavily by cost and are relegated to the realm of academia. On the other end, lower cost personal robots sacrifice functionality to the point where they are luxury items and novelties instead of fulfilling a concrete role in the consumer's life. Our goal is to develop a

personal robot that has advanced functionality while maintaining low costs. To achieve this we will start with developing a manipulation algorithm that is applicable to a large variety of handheld objects. The long term goal will be to contribute to the field of personal robotics by developing algorithms to perform robust manipulations of a wide variety, given low performance hardware and computing power. We will demonstrate the set of manipulation and vision algorithms we have developed thus far to this ends.

GENERALIZING ZECKENDORF'S THEOREM TO F-DECOMPOSITIONS

STUDENT Archit Kilkarni *Mathematics*
ADVISOR Steven Miller *Williams University*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:30 am

A beautiful theorem of Zeckendorf states that every positive integer can be uniquely decomposed as a sum of non-consecutive Fibonacci numbers $\{F_n\}$, where $F_1 = 1$, $F_2 = 2$ and $F_{n+1} = F_n + F_{n-1}$. For general recurrences $\{G_n\}$ with nonnegative coefficients, there is a notion of a legal decomposition which again leads to a unique representation, and the number of summands in the representations of uniformly randomly chosen $m \in [G_n, G_{n+1})$ converges to a normal distribution as $n \to \infty$.

We consider the converse question: given a notion of legal decomposition, is it possible to construct a sequence $\{a_n\}$ such that every positive integer can be uniquely decomposed as a sum of terms from $\{a_n\}$?

For a large class of notions of legal decomposition called f-decompositions, we show that the answer is yes, and that there is exactly one such increasing sequence $\{a_n\}$. Our notion of f-decomposition generalizes such existing notions as the base-b representation, the Zeckendorf decomposition, and the factorial number system. Using this new perspective, we are able to expand the range of Zeckendorf-type results, generalizing the scope of previous research. Finally, for specific classes of notions of decomposition we prove a Gaussianity result concerning the distribution of the number of summands for in the decomposition of a randomly chosen integer.

IMPACT OF ADVANCED PLACEMENT COURSES ON COLLEGE READINESS IN THE PITTSBURGH PUBLIC HIGH SCHOOLS

STUDENTS Aleksandra Arkhangelskaya *Statistics* | Cynthia Clement *Mathematics* | Kathryn McKeough *Statistics*
ADVISOR Cosma Shalizi *Statistics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:15 am

Pittsburgh public school students who take advanced placement (AP) courses, and do well in them, are more likely to enroll in and to finish college. We investigate how much of these differences are treatment effects (AP prepares students for college), and how much are selection (the college-ready are the ones who take AP classes). By comparing students who took AP classes with students with similar academic records but no AP courses, we determine the effect of finishing at least one AP course on college enrollment. We also examine the criteria used to admit students to AP classes. Finally, we assess if the beneficial effects of AP classes are reduced for high-performing students when more lower-tier students are allowed to enroll in AP classes.

MODELING PSYCHOSIS TRAJECTORIES IN ALZHEIMER'S PATIENTS USING LATENT CLASS ANALYSIS WITH NESTED HIDDEN MARKOV MODELS

STUDENT Shaina Mitchell *Mathematics*
ADVISOR Howard Seltman *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

This project explores nesting a Hidden Markov model in a Latent Class model with applications to Alzheimer's patient data.

MORTGAGE BACKED SECURITY PREPAYMENT MODELING

STUDENT Hongyang Yu *Mathematics*
ADVISOR William Hrusa *Mathematics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:30 am

As the largest segment and most actively traded securities in the U.S bond market, Mortgage Backed Securities(MBS), have almost permeated into everyone's life. They have once fulfilled people's dreams to allow them to purchase their own homes, and crashed their dreams starting in 2006, giving rise to the 2008 financial crisis. In this project, I've focused on modeling the variability of people's prepayment behaviors, incorporating people's reactions to changes in interests rates, seasons and locations, and refinance incentives. With the help of monte carlo simulation and different term structures, this prepayment model is implemented to price the 30-year fixed rate MBS prices using US treasury STRIPS and 6-month US treasury bills data.

MOVING OBJECT DETECTION AND TRACKING IN VIDEO

STUDENT Eun Ji Shim *Mathematics*
ADVISOR Andrew Thomas *Statistics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:45 am

Create a R package for a MATLAB code for tracking unknown objects in video streams

STRESS LEVEL AT CMU AND SOLUTIONS

STUDENTS Aashna Singh *Economics and Statistics* | Hannah Worrall *Economics and Statistics* | Tony Zhang *Mathematics* | Ruiqi Zhao *Business Administration*
ADVISOR Grant Weller *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

There are many surveys that have been done at CMU asking about students' stress level and their health condition related to stress.

However, few surveys digged into the real sources of stress and possible solutions to cope with stress. As students who work under the stressful environment, we are more interested in learning about what we can do or what can be done by the school to solve the stress problem.

Our research question for the survey is to find out the real sources that contribute to the stress culture at CMU and what can the university or professors do about it. There are mainly 6 sources of stress that have been targeted in this study: Coursework, Extracurricular activity, Sports, Job Search, Employment, and Stress Culture (Peer Competition). We want to find out if any of the sources specifically has a significant impact on students'

stress level or it is a combination of several sources. We also proposed some solutions in our survey and attempted to find students' opinion on each of the solutions proposed and tried to figure out the most effective solution. Some solutions we proposed in the survey included workshops for professors to deal with students, stress support groups and mandatory campus wide events to deal with stress. We plan to suggest our findings to CMU administration and Academic Development Staff for implementation to benefit all CMU students.

SYMBOLIC SUMMATION IN DIFFERENCE FIELDS

STUDENT Javier Vazquez-Trejo *Mathematics*
ADVISOR Victor Adamchik *Computer Science*
ROOM/TIME Wright / 4:00 pm

We seek to understand a general method for finding a closed form for a given sum $\sum_k s_k $ that acts as it's ``antidifference" in the same way that an integral has an antiderivative. Once an antidifference is found, then given the limits of the sum, it suffices to evaluate the antidifference at the given limits. When the sequence of s_k is hypergeometric, Gosper's algorithm finds the antidifference, that is it finds a solution z_k for $s_k=z_{k+1}-z_k$ if it exists. Many frequently encountered sums however are not hypergeometric, such as the harmonic numbers, $h_k=\sum_{i=1}^k 1/i$ and their generalizations $h^{\al}_k=\sum_{i=1}^k 1/ i^\al$. Karr's algorithm finds antidifferences by redefining the problem in terms of difference fields (a field equipped with an automorphism, denoted $\Fs$), specifically his $\Pi\Sigma$-fields. Once translated into a difference field setting, Karr's algorithm finds a solution to the corresponding difference equation, $\s(g)-g=f$, and if no solution is found, adjoins a symbolic solution which represents the sequence we are trying to sum up. In this way, sums involving harmonic numbers can be treated symbolically and so a closed form for the sum can be found in terms of the adjoined symbols. Karr's original paper leaves out several of the key proofs needed to implement his algorithm. Carsten Schneider expanded Karr's method of solving first order difference equations to higher order ones in special cases, however, he also leaves out key proofs which are necessary for Karr's algorithm. We attempt fill in these gaps and find that many of the steps to solve difference equations rely on being able to solve two problems: the equivalence problem and the homogenous group membership problem. Equivalence Problem: given $\Fte \text{ a difference field and } f,g\in\F(t)$, find all integers k such that $\s^k(f)/g\in\F$. Homogeneous Group Membership Problem: given a difference field $\Fte$ and $f\in\F(t)$, determine if there exists $g\in\F$ such that $f=\s(g)/g\in\HF$. This problem is generalized further to finding a basis of the j-dimensional module $M(\textbf{f},\F)$, over $\Z$ defined as $ M (\textbf{f}, \F):= \{\textbf{n} \ | \ \textbf{f}^{\ textbf{ n }} \in\HF\} $, where $\textbf{f}^{\textbf{ n }}= f_1^{n_1}... f_J^{n_J}$. Solving these two problems is essential to finding the polynomial degree bounds and denominator bounds for solutions of difference equations. We study Karr and Schneider's treatment of these problems and elaborate on the unproven parts of their work.

VARIABLE DEPENDENCE IN HYBRID PROGRAMS

STUDENT Jordan Williams *Mathematics*
ADVISOR Andre Platzer *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Hybrid programs are a language encoding hybrid systems, which are physical systems with discrete and continuous components such as autonomous vehicles and unmanned air vehicles, and allowing us to prove properties about such systems. We present an algorithm which uses dependencies in the variables of a hybrid

program represent to get rid of parts of the program unnecessary for proving properties about the system it represents. This algorithm benefits non-expert users of interactive deductive software such as KeYmaera and automatically simplifies certain classes of proofs. Additionally, we show a non-trivial case where this method yields significant reduction in proof complexity and time until proof completion.

PHYSICS

ANALYZING THE MECHANISMS OF TUNNELING FIELD EFFECT TRANSISTORS (TFETS) FOR APPLICABLE INTEGRATION INTO OUR DAILY LIVES

STUDENT Alaaddin Ismail *Physics*
ADVISOR Randall Feenstra *Physics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

In accordance with Moore's Law, in order for technology to continually develop, computer components must become smaller to increase any electronic device's capacity for logic operations. Science is constantly attempting to decrease the size of transistors so that more of them can fit onto a computer chip. However, the effects of quantum tunneling interfere with the desired performance once transistors are as small as a line of a few atoms. As well, power consumptions increases exponentially with the number of transistors on a chip. Therefore we are analyzing the possibility of using quantum tunneling, rather than avoiding it, to create different kinds of transistors - the type that will be used for Quantum Computation and other advanced applications. This is done by understanding how electrons may tunnel through a high potential difference without needing too much power. In other words, we want to maximize the subthreshold slope which relates the current generated at the drain to the voltage at the gate of the transistor. The outcome of the analysis can be used to motivate further research and development of quantum tunneling transistors.

COMPUTATIONAL NOISE REDUCTION IN BIOLOGICAL SYSTEMS

STUDENT Benjamin Plaut *Physics*
ADVISOR Maumita Mandal *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Single-molecule experiments using dual-beam optical-tweezers are highly sensitive to environmental noises such as temperature, sound, and air fluctuations. Optical-tweezers measure distances at 1 nm and forces at 0.1 pN along the time scale that can span from a few microseconds to several minutes depending upon the molecule in study. These fluctuations adversely affect the signal, thereby compromising the quality of the data collected and interpretation, despite high resolution of the instrument. While, the environmental noise from the surroundings can be minimized, it is almost impossible to remove the thermal motion of the bead trapped in the laser beams entirely. Furthermore, the experimental conditions such as the geometry and orientation of the beads in tweezers, buffer viscosity, trap stiffness adds to the level of noise thereby increasing the signal-to-noise ratio. The challenge therefore is find out the best algorithm that can systematically filter the signal taking into account the experimental conditions with minimal distortion of the data. Herein, we present an improved noise reduction algorithm, in addition to a state analysis algorithm.

CONSTRUCTION AND TESTING OF A MODEL MAGNETIC FORCE MICROSCOPE

STUDENTS Michael Matty *Physics* | Kevin Tkacz *Physics*
ADVISOR Sara Majetich *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Scanning probe microscopes are important tools for nanoscale measurements of surfaces to determine their height contours, their local magnetization or the local electrical conductivity. In magnetic force microscopy, a magnetic cantilever is rastered across the scan area and is subject to the magnetic interactions between the scanned material and the cantilever magnet. This interaction causes the cantilever to move up or down. Using a laser and photodiodes, this deflection can be related to the magnetic properties of the scanned material and a map of the magnetic forces felt by the tip can be created. Because the probe tips are so small, it is often difficult to "see" how a scanning probe microscope works. In this project, we will develop a model scanning probe system that works the same way but has much larger parts. Our model Magnetic Force Microscope (MFM) will help others to visualize the important components and understand how they work together in order to reveal the local magnetic properties of a surface.

DISPERSION OF SURFACTANT CARRIERS AND ITS EFFECTS ON DRUG TRANSPORT

STUDENT Ozichukwu Konkwo *Physics*
ADVISOR Stephen Garoff *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:30 am

The obtention of uniform drug distribution is the motivation for many areas of research. One of these areas of research is the treatment of illnesses pertaining to the lungs, such as obstructive lung disease. These illnesses can usually be treated with inhaled aerosol drugs but the deposition, retention and distribution of the drugs can be nonuniform. Research shows that addition of surfactant to aerosol drugs causes the drugs to spread more, leading to more uniform drug distribution. This increase in spreading is a result of the surface tension difference between aerosol droplets and the subphase. Although extensive research has been done looking into how to enhance the post-deposition distribution of drugs in the lungs, not much is known about how the surfactant drops interact with each other. The goal of this experiment was to observe different types of surfactant drop deposition and how the drops interact with each other and to determine how this affects drug transport in the lungs. This test was carried out with tyloxapol + fluorescein dye drops on a polyacrylamide subphase. It was concluded that the drops do not coalesce. This held true for lateral drop deposition as well deposition normal to the plane of the drop.

FAST PULSER FOR CALIBRATING LARGE ARRAYS OF PHOTOMULTIPLIER TUBES

STUDENT Peter Marchetti *Physics*
ADVISOR Brian Quinn *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:45 am

Large arrays of photomultiplier tubes can be calibrated by simultaneously sending light pulses of equal brightness to each individual tube.

In order to do this, we designed and built an LED pulser which produced extremely short (> 10 ns) bright pulses, which could then be distributed to up to 24 individual tubes. In addition, our design allowed us to easily scale the brightness of the pulse to a degree.

HEAT INDUCED DNA EJECTION FROM BACTERIOPHAGE LAMBDA

STUDENT Aditya Das *Physics*
ADVISOR Alex Evilevitch *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:00 am

Bacterial Viral capsids in aqueous solution can releases their genome in vitro by addition of heat to overcome the activation energy required for the necessary structural changes in the capsid for DNA ejection. It has been determined that the temperature at which DNA ejection in Bacteriophage occurs is 68oC, while the protein capsid melts at 87oC. The purpose of our experiment is to verify that the viral capsid stays intact after heat induced ejection of its genome. This was accomplished by causing only partial ejection of bacteriophage 's genome and detecting only the packaged DNA by gel electrophoresis. Partial ejection of DNA from bacteriophage was achieved by the addition of 20% polyethylene glycol (PEG) to the solution, which increases the external osmotic pressure and prevents the entire genome from being ejected from the capsid. The data collected shows that the viral capsid does stay intact after heat induced ejection of the packaged DNA. Further investigation shows that increasing the temperature above 68oC, but bellow the melting point of the viral capsid results in a greater number of bacteriophage particles reaching the activation energy required to result in the ejection of their genome.

MODELING METAL CONTAMINATION IN QUASAR SPECTRA

STUDENT Leslie Bartsch *Physics*
ADVISOR Shirley Chan Wan Ho *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

In the Lyman-alpha forest of quasar spectra, metals contribute significantly to the total line-of-sight power on small scales. A precise measurement of this power will allow for tighter constraints on the thermal and reionization history of the inter-galactic medium. I created a program to model metal contamination in the Lyman-alpha forest region of quasar spectra according to statistics presented in Boksenberg et al 2003.

MOLECULAR VOLUME MEASUREMENTS FOR A CUBIC PHASE LIPID AND LUNG PROTEIN/LIPID MIXTURES

STUDENT Zachary Dell *Physics*
ADVISOR Stephanie Tristram-Nagle *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:15 am

My project in the Nagle/Tristram-Nagle lab consisted of measuring the densities of lipids and proteins to determine their molecular volumes.

I used the Anton Paar DMA 5000 M densimeter for all measurements. This instrument measures the density of solutions by vibrating a small U-tube filled with the solution to be measured and recording the frequency of vibration as compared to that of a control tube of air.

The density of the solution, s, is calculated as $s - a = K(s - a)^2$ where s is the period of the vibration frequency of the tube containing the sample, a is the period of the vibration frequency of the tube of air, and a is the density of air.

First I measured the molecular volume of the lipid monoolein (MO) in water. This was a collaboration with Dr. Paul Harper at Calvin College in Grand Rapids, Michigan; Dr. Harper sent us the MO to use in our sample

preparation. Four samples of monoolein were prepared, but only one gave reproducible data. These samples were extremely difficult to prepare, and I could only get a homogeneous suspension when the concentration was limited to ~0.75% monoolein by weight. Samples with a higher concentration of monoolein formed clumps, preventing any reliable measurements. These clumps proved impossible to remove by sonication or vortexing. I did finally succeed in producing a homogeneous monoolein sample by varying the temperature and vortexing protocol. I determined that the best protocol was to alternate heating the sample with short bursts of sonication. Vortexing or longer sonication resulted in clumps of MO being stuck to the sides of the vial. The molecular volume, calculated from data from five full temperature scans, from 7°C to 50°C, and four partial scans, was shown to increase with several anomalies in the data at temperatures corresponding to known phase transitions of monoolein.

The next set of samples involved calf lung surfactant extract (CLSE) with neutral phospholipid (NPL), or Surfactant Protein B (SP-B) and Surfactant Protein C (SP-C) mixed with the lipid DOPC. This project was a collaboration with the lab of Professor Stephen Hall of the Health and Sciences University in Portland, Oregon. Professor Hall is a pulmonologist who treats people with acute respiratory distress syndrome (ARDS). Dr. Hall supplied our lab with proteins B and C. Alex Boscia (CMU Physics '13) collected the density data for these samples during the summer of 2013. I analyzed his data to calculate the partial molecular volume of SP-B by extrapolating the data to 100% concentration, which was determined to be 4753 $Å^3$. The partial molecular volume of the SP-B and SP-C mixture was extrapolated in the same manner and came out to 716 $Å^3$. My results led to the conclusion that SP-C must have a constricting effect on lipids, causing the molecular volume of the lipid/protein mixture to decrease as the concentration of SP-C increased. I calculated the partial molecular volume of SP-C to be -141 $Å^3$.

RECONSTRUCTION OF NEUTRINOS PRODUCED BY T' DECAYS IN THE COMPACT MUON SOLENOID EXPERIMENT

STUDENT Jarrett Brown *Physics*
ADVISOR Helmut Vogel *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:00 am

Neutrinos interact only weakly, which means that neutrinos can simply pass through normal matter without leaving a trace. This makes it impossible to detect neutrinos directly using conventional detector methods. As a result, when neutrinos are produced in decays within a detector, like the Compact Muon Solenoid (CMS) experiment at the LHC at CERN, it is impossible to determine anything about the paths neutrinos take through the detector. So information about the energy and direction of the neutrino is lost, which makes it difficult to reconstruct any particle which has a neutrino as a decay product. By utilizing well known, distinctive, decay channels, it is possible to reconstruct information about the undetected neutrino produced in the decay. This has been applied to the decay of a heavy top-like t' quark, t' --> b W, where W --> l v, which has a neutrino among the decay products. To determine the momentum of the neutrino, the properties of the neutrino generated in Monte Carlo simulations are compared to the properties of the other decay products - a charged lepton and a b quark jet - which can be identified and detected directly. Then, the kinematic properties of the neutrino relative to the other decay products are used to constrain the absolute properties of the neutrino. Using the invariant mass of the W and of the t' quark it is thereby possible to reconstruct, with finite precision, the momentum of the neutrino.

SOLVING THE INVERSE ISING PROBLEM WITH MULTI-SPIN INTERACTIONS

STUDENT Joseph Albert *Physics*
ADVISOR Robert Swendsen *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:15 am

While the usual goal in Monte Carlo simulations of Ising models is the efficient generation of spin configurations with Boltzmann probabilities, the inverse problem consists of determining the coupling constants that correspond to a given set of spin configurations. An early appearance of the problem concerned the determination of renormalized coupling constants in the context of Monte Carlo renormalization-group computations. The solution to this problem was found in 1984, and has been recently rediscovered by Aurell and Ekeberg [PRL, 108, 090201 (2012)] in a different representation. While the original solution included the determination of multi-spin interactions, Aurell and Ekeberg only considered the two-spin interactions that occur in the Sherrington-Kirkpatrick model of a spin glass. Both representations have advantages. The earlier solution is particularly useful in seeing the consequences of limited and imprecise information in the sample set of configurations. We apply the more general solution to models that go beyond the Sherrington-Kirkpatrick model to include multi-spin interactions.

STATISTICAL ANALYSIS OF MULTIPLANETARY SYSTEMS

STUDENTS Richard Lyons *Physics*
ADVISORS Shirley Chan Wan Ho *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

In order to better understand the process of planet formation of terrestrial and gas giant planets, we examined correlations of planet masses using the Scott statistical model. We then created simulation data using simple power law distributions and examined the uniqueness of this model. When compared to survey data from the NASA Exoplanet Archive and the Kepler Mission archive, this simulation values show stark similarities which may indicate a common formation process across many planetary systems. While these results are not conclusive, a consistent outcome from the formation of multiplanet systems is unexpected.

USE OF MOSAIC SPREAD TO CORRECT LIPID CHAIN ORDER PARAMETER SXRAY

STUDENTS Leah Langer *Physics*
ADVISORS Stephanie Tristram-Nagle *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

The Nagle/Tristram-Nagle Lab collects low angle and wide angle X-ray scattering (LAXS and WAXS) data at the Cornell High Energy Synchrotron Source (CHESS) to study the structure and properties of the lipid bilayer in cell membranes. My job this semester was to help analyze recently collected WAXS data. The samples are 2,000 bilayers stacked on a silicon wafer that is fully hydrated and then X-rayed at a grazing angle of incidence.. Our samples contained a peptide from the HIV virus, MA, which interacts with membranes during viral budding. A method was developed in the Nagle/Tristram-Nagle Lab that uses liquid crystal theory to determine Sxray (BJ 95, 669(2008)), which is a measure of lipid chain order. Sxray on these samples was obtained during midwinter break by a visiting undergraduate student, Davina Perera. However, her Sxray values were not exactly correct because the samples had a measurable mosaic spread, which is misorientation of the sample caused by the peptide. I used LAXS images at a fixed angle and a Matlab procedure and the Origin plotting program

to determine the mosaic spread. Once determined, I used Matlab and Mathematica to correct Sxray for the mosaic spread. With the correction, the Sxray value increased; i.e., the actual order of the chains was higher than first determined. These results are important for a manuscript that is in preparation on MA interactions with lipids. We also found that whenever the negatively charged lipid POPS is added to a sample, SXray increases, and whenever another lipid,PIP2, is added to a sample, SXray decreases. This means that PIP2, which is necessary for viral budding, tends to disorder the membranes.

SCHOOL OF COMPUTER SCIENCE

COMPUTER SCIENCE

A PROOF-BASED APPROACH TO FORMALIZING PROTOCOLS IN LINEAR EPISTEMIC LOGIC

STUDENT Elizabeth Davis *Computer Science*
ADVISOR Frank Pfenning *Computer Science*
ROOM/TIME Class of '87 / 12:00 pm

Linear epistemic logic can be used to reason about changing knowledge states of agents acting in a system. Here we use it to formalize the Needham-Schröder-Lowe public-key cryptographic protocol for establishing secure communication sessions. We have developed a notion of adequacy to refer to the formal compositional correspondence between the protocol and the formalism. Through the iterative process of attempting to prove adequacy theorems and noting where and how the proof breaks down, we have been able to refine the formalism so that it adheres to the structure and semantics of the protocol as it was originally specified. This work is the first step towards showing that rigorous formal reasoning can be applied to protocols and processes followed in the wild.

A SECURE HUMAN-COMPUTABLE IDENTIFICATION PROTOCOL

STUDENT Shaun Allison *Computer Science*
ADVISOR Manuel Blum *Computer Science*
ROOM/TIME Rangos Hallway / 12-2:30 pm

We seek a provably-secure challenge-response authentication protocol that is both resistant to eavesdropping attacks, and can be carried out directly between the user and the authenticator without any additional devices. An adversary would have to see a significant number of authentications by a single user before being able to successfully impersonate him or her. Authenticating users will use a shared secret to prove their identity through a public protocol, but without revealing their secret. Instead, they will use their secret to compute the responses to a series of security questions, doing all of the calculations completely in their head. Previous work suggests that the human mind may be capable of performing the necessary calculations, but so far all such proposed authentication protocols take too long for most people to authenticate, or require them to memorize too much information. We aim to propose a new human-computable protocol that improves on the usability of previous proposed protocols, while still retaining the security guarantees.

A SPATIAL COLLABORATIVE INFORMATION ORGANIZATION INTERFACE

STUDENTS Antonio Ono *Design* | Michael Chiu *Computer Science*
ROOM/TIME McKenna / 12:20 pm

This is a project to design, develop, and evaluate a large-scale, platform-agnostic gestural interface that allows collaborative organization and exploration of information. Our objective is to marry the experiential benefits of tangible means of organizing information — spatial consistency, visual familiarity, and in-person collaboration — with the functional benefits of digital means of organizing information — data redundancy, volume, location independence, sharability — such as email and tools like Dropbox and Pinterest. We intend to develop the application as a platform-agnostic web application that allows for collaborative simultaneous input from multiple users, be they on separate devices or using a single multi-user wall-based interface.

A TYPE SYSTEM FOR INTERACTIVE COMPUTATION

STUDENT William Duff *Computer Science*
ADVISOR Umut Acar *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30

Internet applications are increasingly important and have a major focus on interaction. The current model for handling interaction is the callback model. This model relies heavily on writing code that combines higher order functions and mutable state, which results in code that is difficult to understand. There have been several attempts to provide a simpler model for interactive programming, but these approaches have had space efficiency problems which make them unusable. We present a programming language that is simpler than the callback model. We model incoming data as a stream, but restrict access to the stream so that the efficiency problems of earlier models are avoided.

APPLICATIONS OF MACHINE LEARNING IN THE DETECTION OF PANCREATIC CANCER

STUDENT Jack Paparian *Computer Science*
ADVISOR Christopher Langmead *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Pancreatic cancer is currently the fourth leading cause of cancer death in the United States. This poor prognosis is mainly due to challenges in detecting the cancer at an early stage.

One potential way to detect cancer early on is through serum biomarker-based screenings. Machine learning can be used to construct classifiers that detect the presence of cancer by examining levels of biomarkers in serum. In this presentation we explore different approaches in machine learning to discriminate between cancer and non-cancer diagnoses using data collected from patients with pancreatic cancer (specifically pancreatic ductal adenocarcinoma), benign pancreatic conditions, and healthy control individuals.

ASSISTING POINTING IN 3D ENVIRONMENT THROUGH CORRECTING HAND TRAJECTORY FOR DEPTH PERCEPTION ERROR

STUDENT Shan Huang *Computer Science*
ADVISOR Nancy Pollard *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

When interacting with virtual environments, people often use avatar hands to manipulate 3D objects. However accurate pointing in 3D environment can be a challenging task, because users more or less loose depth information of the hand as they observe the 3D world through a flat screen. This study assists pointing by predicting the trajectory of the hand movement and adjusting the movement for the correct depth. The system tracks hands using a Leap Motion sensor. Iteratively, it makes prediction of the full trajectory based on sampled partial trajectory, matches the predicted target to a target in the scene, and adjusts the avatar hand along depth axis to correct for error from perception. The system also aims to make the adjusted motion look natural so that the correction can be unnoticed by users.

AUTOLAB

STUDENT Ian Huang *Computer Science*
ADVISOR David O'Hallaron *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

I surveyed students and instructors at Carnegie Mellon to find flaws in Autolab's user interface and redesigned part of the student facing user interface. I also did web development work in upgrading Autolab to Ruby on Rails 4.

BEACON - GESTURE SENSITIVE BICYCLE GLOVES

STUDENTS Connor Brem *Computer Science* | Jessica Phoa *History*
ADVISOR Steve Collins *Mechanical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:45 am

Many bikers use hand signals to inform cars of their intention to turn. However, these hand signals are difficult to see at night, and motorists often misinterpret them. We developed cycling gloves which illuminate LED turn signals when the wearer makes a hand signal. These gloves address two needs: intersections and night-riding are hazardous for cyclists. According to a 2013 study by the National Highway Traffic Safety Administration, 51% of fatal bicycle accidents occurred in the evening, after 4:00pm, and 31% occurred at intersections. The gloves increase a cyclist's visibility at night and allow the rider to better communicate with surrounding motorists.

The gloves also make use of a novel user interface: they track hand orientation and illuminate the appropriate signals automatically, so users do not have to change their behavior in order to use the gloves. Over the course of our research, we have conducted several studies that test the effectiveness of Beacon's interface compared to standard hand signals. Our main objective was to create a product that complemented existing technologies and safety practices.

BEHAVIORAL EFFECTS OF PERCEIVED MEMBERSHIP AGENCY

STUDENT Emily Yeh *Computer Science*
ADVISOR Chante Cox-Boyd *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

There are many ways people get to be in groups. We sometimes choose to join groups, and we are sometimes born into these groups. This study attempts to investigate the effects of perceived membership agency, the amount of control a person believes they have over their membership in a group. We will attempt to investigate these effects with a behavioral study where participants are assigned to minimal groups with labeled stereotypes, and asked to judge ingroup members following a group activity.

BILL GATES KISSING AN IGLOO — A PASSWORD MANAGEMENT APPLICATION WITH PROVABLE SECURITY AND MINIMAL USER EFFORT

STUDENT Shikun Zhang *Computer Science*
ADVISORS Manuel Blum *Computer Science* | Anupam Datta *Computer Science*
ROOM/TIME Class of '87 / 12:40 pm

Passwords are used by millions of users everyday to protect their important online accounts. However, because of the increasing number of accounts and limited human memory, people tend to adopt unsafe practices including the usage of weak or identical passwords for various accounts. In order to solve this problem, we want to develop both secure and usable password management schemes, which are systematic strategies for a use to create and remember multiple passwords. Shared Cues, a password management scheme proposed by Blocki et al., makes use of natural rehearsals of passwords and mnemonic techniques to achieve provable strong security with minimal user effort. In their scheme, the user memorizes several vivid Person-Action-Object stories, and uses subsets of the stories as passwords. The strategic sharing of PAO stories minimizes the number of stories that a user has to memorize, and also preserves security. Moreover, users can successfully maintain the memory of passwords by following a particular rehearsal schedule. The application which I am developing is an implementation of their scheme. Unlike other password managers, this application does not store any password or use any master password. It includes a memory game to facilitate with memorization of PAO stories, a reminder system to remind our users to rehearse stories that they have not practiced recently and a mechanism to help users recall stories if they forget. The web application is hosted on GitHub, and can also be used on mobile end utilizing cloud storage to allow synchronization across devices. For future work, we are planning to conduct user studies to gather feedback and advice on potential improvements to the application.

BUGHOUSE INTERNET CHESS SERVER

STUDENT Alexander Guo *Computer Science*
ADVISOR Daniel Sleator *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

To develop a new gaming server focusing on bughouse, a variant of chess. A CLI tool line (JARVIS) was developed to expedite development.

BUILDING AND EVALUATING APPCUBATOR, AN IDE FOR REALLY FAST WEB DEVELOPMENT

STUDENT Karan Sikka *Computer Science*
ADVISOR Anthony Tomasic *Language Technologies Inst.*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:45 am

In the past 10 years, web applications have become widespread, and the demand to build web applications has ballooned. Yet there's a shortage of competent developers able to build them due to their complexity. Appcubator, a web app IDE in the browser, aims to bridge the gap between simply learning how to code and creating full stack web applications. An HTML5 app and deployment solution were designed and implemented. The devised system was tested during a 6 week bootcamp for MBA students. It was also used by developers to develop web applications for entrepreneurs and enterprises. The results will be presented.

BUTLEBOT

STUDENTS Zachary Greenberg *Mathematics* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*
ADVISOR Michael Erdmann *Computer Science*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Our overarching objective is to develop the means for a personal robot to perform a wide spectrum of manipulation based tasks around the home. Personal robotics has an immediate need in supporting and assisting the elderly and disabled with household tasks that could be potentially hazardous or difficult. However current personal robotics has failed to address this need. On one end of the spectrum, highly functional personal robots, like Herb and Pr2, are restrained heavily by cost and are relegated to the realm of academia. On the other end, lower cost personal robots sacrifice functionality to the point where they are luxury items and novelties instead of fulfilling a concrete role in the consumer's life. Our goal is to develop a personal robot that has advanced functionality while maintaining low costs. To achieve this we will start with developing a manipulation algorithm that is applicable to a large variety of handheld objects. The long term goal will be to contribute to the field of personal robotics by developing algorithms to perform robust manipulations of a wide variety, given low performance hardware and computing power. We will demonstrate the set of manipulation and vision algorithms we have developed thus far to this ends.

CERTIFYING COMPILATION FOR LOGIC PROGRAMMING

STUDENT Brandon Bohrer *Computer Science*
ADVISOR Karl Crary *Computer Science*
ROOM/TIME Class of '87 / 1:00 pm

We seek a certifying compiler for logic programs (in a core subset of Prolog), meaning a compiler whose output provably implements the source program. We present a dependently-typed virtual machine based on the Warren Abstract Machine (WAM), prove soundness and completeness of the VM, and implement a compiler that targets it. We then demonstrate how the type system is expressive enough to encode the correctness of the compiled program.

COMPILER CORRECTNESS VIA CONTEXTUAL EQUIVALENCE

STUDENT Matthew McKay *Computer Science*
ADVISOR Karl Crary *Computer Science*
ROOM/TIME Class of '87 / 1:20 pm

We have developed a methodology for verifying the correctness of the closure conversion phase of a compiler, adapted from the work by Ahmed. This lets us verify that individual components of programs are compiled correctly, so they can be linked with any other code and still behave as desired. We do this by using a shared language that encompasses both the source and target languages in which the compiled code can be reasoned about alongside its source. Our main improvement over previous methods is that we don't need boundaries that separate the source and target language while inside the shared language.

COMPRESSING NATURAL GRAPHS AND A PRACTICAL WORK-EFFICIENT PARALLEL CONNECTIVITY ALGORITHM

STUDENT Laxman Dhulipala *Computer Science*
ADVISOR Guy Blelloch *Computer Science*
ROOM/TIME Class of '87 / 1:40 pm
Rangos 1 & 2/Sigma Xi Group 7 / 11:30 am

Over the past two decades, the explosive growth of the internet has triggered an enormous increase in the size of natural graphs such as social networks and internet link-structures. Processing and representing large natural graphs efficiently in memory is thus crucial for a wide variety of applications. Our contributions are 1) A parallel graph processing framework for representing compressed graphs with significantly fewer bits per edge, and 2) A simple and practical expected linear-work, polylogarithmic depth parallel algorithm for graph connectivity.

Natural graphs tend to contain a large amount of locality - vertices within a cluster mostly have edges to other vertices in their cluster. We discuss reordering techniques to make vertex labelings reflect locality inherent in the graph. We show that algorithms operating on compressed graphs in our framework are as fast, or faster than their uncompressed counterparts. We also test a variety of coding and relabling techniques, such as byte-codes, nibble codes and gap encoding.

In the second part of the work, we describe a simple and practical work-efficient parallel algorithm for graph connectivity. The algorithm is based on recently developed techniques for generating low-diameter graph decompositions. We discuss implementing both the decomposition algorithm, and our connectivity algorithm in C++ using CILK+, and show that our connectivity algorithm achieves 9--19 times speedup relative to the best known sequential implementation of connectivity on 40 cores.

The algorithm is also competitive with the fastest existing parallel connectivity implementations for large input graphs (0.88--1.41 times faster on a 40-core machine).

COOKING KNOWLEDGE REPRESENTATION IN SCONE

STUDENT Grant Della Silva *Computer Science*
ADVISOR Scott Fahlman *Language Technologies Inst.*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Scone is a knowledge-base system under development in the Language Technologies Institute, designed to perform efficient reasoning over complex domains. This project explores representation and automated reasoning over cooking knowledge via the creation of a gastronomical ontology in Scone. Cooking knowledge is largely universal, and accessible to a broader audience than many other applications of knowledge-base systems like immunology. As such, this work is a good illustrative example of Scone's capabilities, and will be useful as a source of tutorial examples. Benefits and drawbacks of working with the Scone system will be presented.

EVALUATING THE SUCCESS OF USER-GENERATED IDEAS IN CROWD INNOVATION

STUDENT Lingzhang Jiang *Computer Science*
ADVISOR Lixiu Yu Human *Computer Interaction Inst.*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Recent years have seen a rise in the number of people who are coming online with new and creative ideas, as well as a rise in the number of organizations that are building websites to harness these ideas. We call this phenomenon crowd innovation. One of the problems faced by crowd innovation is how to evaluate ideas and pick out good ideas from a large pool of ideas submitted by crowd inventors. In this study, we create a model with factors such as the description and category of ideas and the characteristics of inventors to predict the success of an idea. The findings of this study provide an efficient and accurate method of evaluating user-generated complex content. In addition, the proposed model can promote crowd innovation by accelerating idea evaluation.

EXECUTION-BASED DEBUGGING FOR HYBRID PROGRAMS

STUDENT William Zorn *Computer Science*
ADVISOR Andre Platzer *Computer Science*
ROOM/TIME Class of '87 / 3:00 pm

Hybrid programs let us express cyber-physical systems in a way that is amenable to verification. They contain classical programming language constructs to express a discrete control, as well as ordinary differential equations and nondeterministic choices to describe a continuous environment. Given a hybrid program, a set of initial conditions, and some desirable property, we can use a theorem prover (here, KeYmaera) to show that the property holds for the system the program describes.

This work provides a runtime for actually executing hybrid programs, as opposed to a theorem prover. The motivation is to make debugging hybrid programs easier. Finding exactly the right hybrid program to describe a system and the right property to prove about it is very difficult in practice, and the theorem prover can provide little better than binary feedback unless the user is intimately familiar with how it works.

With a hybrid runtime, we can build a debugger that takes a failing proof and steps through the program to show the user an execution path that violates their desired property. This provides a code-based intuition about the problem that is independent of the theorem prover, and would be helpful to any user who understands the hybrid program. The debugger can be both manual and automatic, allowing users to explore the behavior of programs or to mechanically search for counterexamples.

EXPLORING THE QUIC PROTOCOL

STUDENT Sang Jin Han *Computer Science*
ADVISORS Matthew Mukerjee *Computer Science* | David Naylor *Computer Science* | Srinivasan Seshan *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

In the modern internet era, the available bandwidth between end users and servers has increased dramatically and, as a result, the performance of applications such as video delivery and large file transfers has improved significantly. However, the performance of web page downloads and similar short data transfers remains largely limited by the round trip time between end hosts and servers, which has not improved much over time. This is exacerbated in settings with mobile clients, which often suffer from large RTTs, and the use of TCP and

SSL, which incur multiple RTTs of overhead before any data transfer can start. The Google QUIC protocol, or the Quick UDP Internet Connections, aims to decrease the number of round trips by multiplexing connections and optimizing handshakes that could take about 1.5 RTTs in TCP to 0 RTT. In this study, we conduct experiments to measure performance and explore possible gains users may receive in the real world.

EXPLORING THE RELATIONSHIP BETWEEN FUNCTIONAL AND STRUCTURAL CONNECTIVITY IN THE BRAIN

STUDENT Alexis Larry *Computer Science*
ADVISOR Aarti Singh *Machine Learning*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:30 am

Our brain comprises of millions of pathways that help us make decisions every second. Within the brain exist many elements interconnected in a complex manner. By fully understanding these pathways and elements, we can better grasp how human cognition works. There are two important characteristics measured in the brain: structural and functional connectivity. Structural connectivity refers to the arrangement of connections between neuron elements while functional connectivity shows the dependencies in the time-series of neuron elements. Although there have been some studies on the relationship between structural connectivity of the brain and its functional connectivity, this project explores the extent to which structure in the brain can predict its functionality. Based on the number of fibers that connect any two regions in the brain, we will determine the effect it has on the amount of functionality that can be detected between the same two regions.

FITTING 3D OBJECTS TO 2D IMAGES WITH GPU-BASED NORMALIZED CROSS-CORRELATION

STUDENT David Allen *Computer Science*
ADVISOR Yaser Sheikh *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

We are working on a process to manipulate 3D objects such as a chair, desk, or piece of fruit in a 2D image. Because of the increase in popularity of 3D model databases, many everyday objects have a corresponding 3D model that can be found online. We look to fit such a model onto a 2D photograph of the object in a way that looks realistic. To accomplish this we take renders of the 3D model from many different viewpoints and cross-correlate them with the 2D image. A probabilistic algorithm has been developed to score these correlations and determine the object's placement and rotation in the image. However, this method requires hundreds of thousands of normalized cross-correlation operations to make an accurate prediction. My work involves implementing normalized cross-correlation on the GPU.

Because these algorithms are naturally parallel, we hope to achieve a significant speedup over a CPU-based implementation. Furthermore, the implementation must be flexible enough to handle both small and large filter sizes. The basic operation of implementing a multi-scale normalized cross-correlation procedure on a GPU has the potential to widely impact a large number of visual analysis problems such as object recognition, 3D reconstruction, and activity analysis.

FORMAL VERIFICATION OF A CONTROLLED FLIGHT BETWEEN TWO ROBOTS: A CASE STUDY

STUDENT Annika Peterson *Computer Science*
ADVISOR Andre Platzer *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

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 formally prove collision avoidance within the rules of differential dynamic logic, a logic for hybrid systems consisting of discrete controlled steps and continuous physics, using a deductive verification tool, KeYmaera. This case study also applies to aircraft collision avoidance and unmanned aerial vehicles where unsafe operation is fatal.

HEAD TRACKING AUDIO SYSTEM

STUDENTS James Allen *Computer Science* | Kenneth Murphy *Computer Science* | Joshua Newby *Design*
ADVISOR Stephen Stadelmeier *Design*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

We propose to design and fabricate a functioning set of head-tracking loudspeaker stands that will greatly improve the the quality and accuracy of an audio environment as experienced by the listener. Loudspeakers are used in a multitude of different applications from monitoring, recording, and mixing music, to immersive 3D virtual environments. Both mixing and virtual environments rely on a high level of audio precision in order to be effective. Our system will track the position of the listener's head and move speakers along their x and z-axis to keep the speakers equidistant, symmetrical, and aligned with the listener's head. This will ensure that sounds generated from the left and right channels both arrive at the listener's ears simultaneously, so the user can move about the room without experiencing distorting in the speaker's audio image.

IMPROVED METHODS IN SEMANTIC RELATIONS

STUDENT Daniel Sedra *Computer Science*
ADVISOR William Cohen *Machine Learning*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:15 am
Class of '87 / 2:00 pm

The goal of this project was to develop improved methods of measuring semantic distance between strings. This was done using graphical methods over Wikipedia hyperlinks to generate features which were then combined to determine the semantic similarity between strings. The resulting scores were evaluated against a baseline in order to gauge performance improvements. The accuracy, speed, and scalability of the algorithm were the key issues targeted for improvement by this project.

LUDWIG

STUDENT Akshay Nanavati *Computer Science*
ADVISOR Umut Acar *Computer Science* | Guy Blelloch *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Wrote the 15-210 Sequence library and assignments in Parallel using Scala. The idea was to observe speedups when running code in Parallel. Also designed a formalization of pseudocode called Ludwig. The idea is to be able to easily express algorithms while also verifying correctness and cost bounds. The Ludwig compiler will be a translation from Ludwig source code to SML and/or Scala so the user can run the algorithm.

MACHINE LEARNING FOR DISCOVERING NEW MOLECULAR MATERIALS

STUDENT Eric Wong *Computer Science*
ADVISOR Jeremy Kolter *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

With hundreds of atoms and infinitely many ways to arrange them, searching for new molecules that have certain properties is a difficult and time consuming problem, but its results are valuable in areas ranging from chemical engineering to alternative energy. This project aims at a specific part of this molecular search problem, namely using machine learning to quickly and accurately predict the energy of a given set of atoms. By combining machine learning techniques with the problem of molecular search, I have designed and implemented two algorithms. The first of which searches for the most stable configuration of a fixed set of atoms, and the second aims to predict the energy using many different molecules. The algorithms were respectively evaluated on permutations of a single molecule and on a large range of organic compounds.

ONBOARD TERRAIN MODELING FOR SUBORBITAL ROCKET FLIGHT

STUDENT Kerry Snyder *Computer Science*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

A recent discovery of planetary science is features called “skylights”, believed to be entrances to subsurface caves on the Moon and Mars.

These skylights and caves could be the key to making human life multiplanetary. Through a NASA funded research grant, this project develops the software to build a high resolution texturized mesh model from color imagery and laser ranging scanner. The software will fly onboard a suborbital reusable launch vehicle in the Fall of 2014 to demonstrate this capability.

OPENISR 2.0

STUDENT Da-Yoon Chung *Computer Science*
ADVISOR Mahadev Satyanarayanan *Computer Science*
ROOM/TIME Class of ‘87 / 3:20 pm

I explore a new approach to “Web-based Transient Personal Computing” by building upon the ideas from Professor Satyanarayanan’s ISR (Internet Suspend/Resume) to better fit modern VM technology and computing needs. ISR decouples PC state and hardware by storing the state in a virtual machine. It increases convenience

and productivity for users by allowing them to securely access personal machine state on an anonymous machine (e.g. a PC in a waiting room at the doctor's office) or more portable devices like tablets instead of being bound to particular hardware. Although the existing ISR is functional, its codebase is complex and some of the decisions made in its development would have been made differently today. I reconsider the original premises for ISR and build a system that can fill a niche today. Rather than working from the ISR codebase, I build upon the newer VMNetX codebase, which developed from ISR but differs in that its VMs are read-only and are stored and executed on-demand from a web server. The new implementation is novel approach to solving an otherwise well-established problem because of this HTTP-based storage and execution.

PREDICTING BRAIN ACTIVITY AND EXPLORING CONNECTOMICS WITH LASSO REGRESSION

STUDENT Madeleine Clute *Computer Science*
ADVISORS Aarti Singh *Machine Learning* | Timothy Verstynen *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:45 am

Connectomics refers to the study of structural and functional connectivity patterns of brain networks. While characterizing connectivity patterns can provide useful insights about the structure of the neural network itself, relatively little is known about how incoming connections into a given brain region can explain the activity being observed there. This research tested the predictive utility of functional connectivity by investigating how connectivity estimated during a simple sensorimotor task could explain future task related responses in that region. The functional connectivity was measured using Lasso regression and the use of autoregressive Lasso regression was also investigated. The results show that functional connectivity in macroscopic neural networks not only has a utility for describing the state of the network itself, but also provides predictive explanations of task-relevant brain activity observed in connected areas.

PROTECT MY PRIVACY: PRIVACY INVASIVE APPLICATIONS IN THE ANDROID ECOSYSTEM

STUDENT Haozhe Gao *Computer Science*
ADVISOR Yuvraj Agarwal *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Recently, there has been an explosion in mobile computing and users, and a move towards an app-based distribution of software. Specifically, the Android ecosystem has gained a majority of the world's smart phone users, distributing apps from the Google Play store. Security and privacy in this ecosystem is accomplished by the install-time granting of permissions to access certain information on the phone, such as the location, the contacts list, and the phone's unique identifier. However, applications are taking advantage of naive users by over-requesting the amount of permissions needed, leading to an unnecessary invasion of privacy. The aim of this project is two-fold. First, an application will be developed for the Google Play store, that allows the user to control, post-installation, what resources each application will be able to access. Secondly, it will capture information about what apps and permissions users choose to deny most often, to gather information about what kind of accesses a user finds intrusive, as well as the types of applications that has these intrusive accesses.

QUANTUM REINFORCEMENT LEARNING

STUDENT Guillermo Cidre *Computer Science*
ADVISOR Geoffrey Gordon *Human Computer Interaction Inst.*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Approximating properties of classical physical systems is a very important problem in reinforcement learning since many systems people deal with in practice have properties that are too big to represent in memory. Researchers have tackled this problem by trying out various approximations with limited success.

The aim of our research is to use techniques from quantum mechanics to approximate certain properties of classical physical systems, like the value function in Markov Decision Processes. In previous works, the algorithms used to extract properties of the physical system do not interact well with approximations used, like Support Vector Machines and Neural Networks. The hope is that by re-expressing both the algorithm and the system using Quantum Mechanics, they will become more compatible with one another.

Currently, we are experimenting with different ways to represent these classical physical systems as quantum systems which are easy to approximate.

REIMPLEMENTATION OF THE WOMEN@SCS WEBSITE USING NEWER TECHNOLOGIES

STUDENT Nivedita Chopra *Computer Science*
ADVISOR Carol Frieze *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

I explored the pros and cons of newer technologies in relation to the Women@SCS website. Although the initial version of the site was created in 1999, my research was based on a later version created in the mid 2000's and was coded in PHP and MySQL. After researching newer technologies, I decided that Node.js and MongoDB were the most appropriate technologies for a web site in which team members change as students graduate. I began implementing parts of the website using these technologies. This proved to be quite a challenge because the current code base is vast and not very well documented. In addition, the team maintaining the website (which is usually 2--4 undergraduate women) has changed over the years, leading to a mix of different coding styles within the code base.

SBO BROWSING SENSORS

STUDENT Sunny Nahar *Computer Science*
ADVISOR Alain Forget *Human Computer Interaction Inst.*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

The Security Behavior Observatory project at the CUPS Lab seeks to create a framework for collecting user data for security research. One component of this project is building web sensors to glean information about browsing behaviors. My project seeked to continue to build on the previous sensor architecture, performing code review on the previous implementation, adding new features, and investigating possible approaches to current problems we are facing. The browsers that are currently being developed on are Chrome and FireFox.

SESSION TYPE CONCURRENCY IN C0

STUDENT Rokhini Prabhu *Computer Science*
ADVISOR Frank Pfenning *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

In this research project, we aim to implement session type concurrency in C0 while ensuring that progress and preservation still hold. This means that we would like to allow concurrent executions of programs which are guaranteed to be deadlock and race condition free, thereby ensuring determinism in results (equivalent to progress) while still maintaining our types in a well defined manner (equivalent to preservation). A functional language has already been conservatively extended to include session types and concurrency under the SILL project. This project, therefore, aims to extend session type concurrency into to an imperative Clike language with a strong type system. As such, the natural choice for this was C0. Session type concurrency is abstracted to the user of C0, as blocking asynchronous or synchronous message passing between concurrent processes on a specified channel. Each channel therefore has 2 end points thereby allowing 2 processes to communicate back and forth. We have thus far successfully implemented the additional parsing and typechecking necessary for this to happen in a C0 compiler. Current and future work include designing and implementing the backend of the runtime system (the message passing interface) and code generation necessary to compile session type C0 code into C code.

SKYLIGHT SURVEY AVIONICS

STUDENTS Neal Bhasin *Computer Science* | Edward Nolan *Electrical & Computer Engineering* | Brent Strysko *Electrical & Computer Engineering*
ADVISOR William Whittaker *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Recently, pits known as skylights have been observed on the surface of the moon. These pits are hypothesized to be entries to cave networks beneath the lunar surface that could one day provide protection for human housing. Our team's goal is to design and implement the electrical components of a sensor package that could map these geographic features. This sensor package would observe skylights from overhead and use collected camera data to create a 3D model of the features.

SUMMERS CAMP

STUDENT Bryce Summers *Computer Science*
ADVISOR David Kosbie *Computer Science*
ROOM/TIME Pake / 3:00 pm

The Summers Computer Aided Mathematics Program, a computer program designed to reduce tediousness in Linear Algebra classes, will be discussed.

We will also be discussing opportunities for technology to aid and improve the learning experience.

THE (N, K) PROBLEM: INVESTIGATING THE EFFECT OF REPLICATING JOBS ON SERVERS

STUDENT Stephen Bly *Computer Science*
ADVISOR Mor Harchol-Balter *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

We consider an M/M/n queuing system, but with jobs replicated among all n servers. The (n,k) problem is to determine the expected response time E[T] when k of the copies must finish for a job to be considered completed. This problem is unsolved for k 2, even using numerical methods, though approximations exist.This poster will describe our approach and current results.

THE CHARACTERIZATION OF UV ABSORPTION IN PHOTOACTIVE COMPOSITES.

STUDENTS David DePoi *Computer Science* | Andrew Garibaldi *Mechanical Engineering* | Theodore Houlis *Biomedical Engineering* | Robert Isopi *Materials Science Engineering* | Gabriel Rodriguez *Materials Science Engineering* | Mariana Rodriguez *Materials Science Engineering*
ADVISOR Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:00 am

This intention of this projection is to study the effects of different photo-active composites. We will begin this project by constructing our own x,y,z gantry from basic materials. Once it is constructed, we begin to mix metals with photoactive composites and attempt to curate the composite. Different combinations of certain composites will be mixed to see which outcome has the most effecient results.

THERE AND BACK AGAIN: CODE GENERATION AND INTERPRETATION OF FOREIGN BYTECODE.

STUDENT Benjamin Chung *Computer Science*
ADVISOR Jonathan Aldrich *Computer Science*
ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

Our programming language, Wyvern, is a new language designed to make developers lives easier through the usage of domain-specific languages, which can be defined in-language. This presents unique code generation and interpretation challenges, by requiring that language code be executable at compile time. We present a method based around Java bytecode and semantic data to allow the compiler to execute existing Wyvern code.

WRCT: A RADIO MUSIC DATABASE

STUDENTS Matthew Baron *Electrical & Computer Engineering* | Salem Hilal *Computer Science*
ADVISOR Jeffrey Eppinger *Computer Science*
ROOM/TIME McConomy Auditorium / 11:00 am

Over the past decade, WRCT (CMU's own radio station) has been using the same software system to manage users, shows, playlists, and music.

Although the demands of the station have changed, the software is more or less in the same state it was in ten years ago. Our aim is to fully rewrite the system, perform much needed upgrades and add features.

For example, the old system contains a number of security vulnerabilities, and its difficult interface often leads to multiple copies of artists and albums.

The new system is written using Node.js, Express, MySQL, and Angular.js, and aims to be a usable, secure, well-tested replacement to the existing Perl-based system.

ZERO KNOWLEDGE PROOF FOR KNOWLEDGE OF PRIME FACTORIZATION OF A BIPRIME

STUDENT Kechun Mao *Computer Science*

ADVISOR Manuel Blum *Computer Science*

ROOM/TIME Rangos Hallway, 2nd Floor / 12-2:30 pm

In cryptography, a zero-knowledge proof or zero-knowledge protocol is a method by which one party (the prover) can prove to another party (the verifier) that a given statement is true, without conveying any additional information apart from the fact that the statement is indeed true. That means even if the verifier is convinced of the given statement he can not prove to others. In our case, we want to show a zero knowledge (or nearly zero knowledge proof) to a following problem: The prover wants to convince the verifier that he knows prime factors P of a large biprime (the product of two primes) N without revealing P to the verifier.

HUMAN COMPUTER INTERACTION INSTITUTE

TABLET BASED TOCODYNAMOMETER

STUDENTS Whitney Aaronson *Human Computer Interaction Institute* | Dale Best *Electrical & Computer Engineering* | Arnob Mallick *Electrical & Computer Engineering* | Sara Saheb Kashaf *Chemical Engineering* | Matthew Sarett *Electrical & Computer Engineering* | Eric Wise *Mechanical Engineering*

ADVISOR Conrad Zapanta *Biomedical Engineering*

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

A tocodynamometer is a medical device used to measure the frequency and duration of uterine contractions. It is used quite often in hospitals to monitor the condition of a woman's pregnancy. Typically, a tocodynamometer is used at around 39 weeks into a woman's pregnancy. It uses a pressure sensing button that must be strapped tightly to the patient by the nurse or other assistant. This button sends a signal to a box that processes the stimulus. It can output plots and analyses of the contractions.

Another component of pregnancy care is a fetal heart rate monitor. This is another device that is generally confined to hospitals. Specialized equipment must be used due to the inherent challenges of filtering the relatively small fetal heart rate signal from the more prominent electrical signals present in a pregnant woman. Consideration of this device is important because the fetal heart rate monitor is often used in conjunction with a toco to help doctors understand the state of the pregnancy and make important decisions.

Both tocodynamometers and the fetal heart rate monitors suffer from usability issues. For the toco, the patient is dependent on a nurse to strap on the button sensor in exactly the correct position. The patients must remain still to ensure that the reading is based on contractions and not on any shifting of position that may occur while the patient is in pain. Both devices are bulky (~1' x 1' x 0.5'), expensive (~$10,000), and difficult to use, meaning that both are confined to specialized hospitals. Many low resource hospitals do not have tocos and, in general, the toco device is not portable or convenient.

Our goal is to create an Android application and small embedded system to take the place of both of these devices. We will use electrodes to read an electrical signal that may represent heart rate or muscle

contractions. The Muscle Sensor v3 takes in an analog value (voltage) from the electrodes, amplifies it, and passes it via a wire to the Arduino Uno. The Arduino Uno converts the analog signal to a digital value that it packages and sends over a serial connection to the Google Nexus 7 tablet via a USB Adapter. The Google Nexus 7 tablet filters the input signal, plots the data, and calculates useful metrics.

LANGUAGE TECHNOLOGIES INSTITUTE

DEVELOPMENT OF A SCONE INTERFACE

STUDENT Jacob Buckman *Language Technologies Institute*
ADVISOR Scott Fahlman *Language Technologies Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

Scone is a high-performance, open-source knowledge-base (KB) system intended for use as a component in many different software applications. Previously, in order to input new knowledge into a Scone network, it was necessary to have some knowledge of the Lisp language and an understanding of Scone's internal structure. This project aimed to eliminate that barrier by developing a web application which can provide users with an intuitive way to enter new concepts. The interface includes a graphical display and natural-language feedback.

SCIENCE AND HUMANITIES SCHOLARS

SCIENCE AND HUMANITIES SCHOLARS

A COMPARATIVE ANALYSIS OF THE ARAB SPRING EFFECT IN EGYPT AND SAUDI ARABIA

STUDENT Emily Furnish *Science and Humanities Scholars*
ADVISOR Silvia Borzutzky *Social & Decision Sciences*
ROOM/TIME Wright / 12:40 pm

Egypt and Saudi Arabia have traditionally played critical roles in the Middle East and exercised political and economic influence over the other countries in the region. This thesis studies the effects of the Arab Spring on each country and analyzes the historical, economic and political factors that led to contrastingly different outcomes. The ideas of Mancur Olson on the nature of autocratic governments and Charles Tilly's theories of revolution provide the analytical frameworks that allow us to understand the events that led to the rise to power of the Egyptian military in the 1950s, Mubarak's overthrown in 2011, and the military's return to power in 2013. Olson and Tilly also allow us to explain the stability of the Saudi Arabian monarchy which has maintained control of power despite the turmoil in the region.

A CORRECTIVE META ANALYSIS OF PERSONALIZED NORMATIVE FEEDBACK

STUDENT David Zimmerman *Science and Humanities Scholars*
ADVISOR Baruch Fischhoff *Social & Decision Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

Personalized Normative Feedback (PNF) has been proposed as an inexpensive and scalable intervention to reduce problematic consumption of alcohol, particularly among college students. Many individual studies, as well as meta-analyses, have tested the efficacy of PNF. The findings have been generally positive, demonstrating that it decreases alcohol consumption and associated problems with excessive consumption. Unfortunately, many of these studies have less than ideal methodologies, which potentially introduce bias to the results. We use a quantitative adjustment procedure on the findings of each study to account for these biases. Results were divided by a factor of 1.61 on average to account for biases. While many of the results remain significant after correction, they have relatively small effects. The effect sizes for every outcome were less than 0.2, post adjustment. Additional methods will need to be developed in order to achieve dramatic progress towards reducing drinking with PNF. Insufficient evidence exists on the long-term impacts of PNF, particularly as college students transition out of school.

APPLICATIONS OF RECORD LINKAGE TO THE SYRIAN CIVIL WAR

STUDENT Emily Furnish *Science and Humanities Scholars*
ADVISORS Stephen Fienberg *Statistics* | Rebecca Steorts *Statistics*
ROOM/TIME Wright / 12:20 pm

Record linkage seeks to find records in a data set which refer to the same entity across different data sources. Using record linkage, my research team and I intend to estimate the actual number of war casualties from the ongoing Syrian conflict by analyzing death records reported by six civil rights groups and the Syrian

governments. In particular, this presentation focuses on the difficulty of employing standard record linkage techniques when we have no real idea about the number of casualties, data entry is often unreliable, and all names are written in Arabic. We will compare the effectiveness of standard English string metrics against developing Arabic metrics.

CATEGORIZATION OF HORIZONTALLY TRANSFERRED GENES

STUDENT Charlotte Darby *Science and Humanities Scholars*
ADVISOR Dannie Durand *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5 pm

Xenologs are defined as genes related through a horizontal transfer event as opposed to through vertical decent. However, this definition encompasses a wide variety of evolutionary histories and relationships among genes in families where a horizontal transfer occurred. A subdivision of the term "xenolog" based on tree topology could potentially shed light on gene function or transfer event history. This project seeks to characterize a relationship between a specific method of xenolog categorization and gene function in order to determine if this particular subdivision is biologically informative. Using phylogenetic software developed in the Durand lab, I categorized xenologous relationships in examples from the literature which posited horizontal gene transfer from prokaryotes to fungi. I investigated whether the distribution of xenolog subtypes in a gene family where a horizontal transfer occurred is correlated to the gene's function.

CONSTRUCTION AND TESTING OF A MODEL MAGNETIC FORCE MICROSCOPE

STUDENTS Michael Matty *Science and Humanities Scholars* | Kevin Tkacz *Physics*
ADVISOR Sara Majetich *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30 pm

Scanning probe microscopes are important tools for nanoscale measurements of surfaces to determine their height contours, their local magnetization or the local electrical conductivity. In magnetic force microscopy, a magnetic cantilever is rastered across the scan area and is subject to the magnetic interactions between the scanned material and the cantilever magnet. This interaction causes the cantilever to move up or down. Using a laser and photodiodes, this deflection can be related to the magnetic properties of the scanned material and a map of the magnetic forces felt by the tip can be created. Because the probe tips are so small, it is often difficult to "see" how a scanning probe microscope works. In this project, we will develop a model scanning probe system that works the same way but has much larger parts. Our model Magnetic Force Microscope (MFM) will help others to visualize the important components and understand how they work together in order to reveal the local magnetic properties of a surface.

DISCLOSURE OF DIABETES IN THE CONTEXT OF ROMANTIC RELATIONSHIPS

STUDENTS Stephanie Chen *Psychology* | Priscilla Kim *Psychology* | Seth Schlisserman *Science and Humanities Scholars*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30 pm

The goal of this study was to explore the evolution of romantic relationships in persons with type 1 diabetes. We enrolled 68 young adults (ages 18 to 36) with type 1 diabetes into this study. Participants had to be in a romantic relationship in order to participate: they were married (21%), engaged (6%), living together (26%), or

dating (48%). Participants were recruited from an ongoing study (n = 14) or from online advertising (n = 54). The focus of the study was on how participants disclosed their diabetes to their romantic partners and how their partners reacted to this disclosure specifically and to diabetes more generally. We examine how demographic variables, such as participant sex and relationship length, were related to diabetes disclosure and partners' reaction to disclosure, how disclosure and partner reactions are related to relationship satisfaction, and compare disclosure to romantic partners to disclosure to friends.

EVALUATING STATISTICS OF GALAXY CLUSTER DETECTION

STUDENT Kathryn McKeough *Science and Humanities Scholars*
ADVISOR Peter Freeman *Statistics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:15 am

A galaxy cluster is a set of galaxies held together by gravity. Astronomers study clusters because they are the most massive gravitationally bound objects in the Universe. Counting them gives us the ability to constrain parameters of cosmological models. This project examines the statistical methodology of cluster detection. This is done by simulating galaxy counts in regions of the sky. Using the simulated data, we compare the maximum likelihood and minimum chi-square estimators to determine which performs better in a cluster detection setting. The statistics are quantitatively compared by completeness, the rate of true galaxy clusters detected, and purity, the fraction of cluster detections which are correct.

HEARING TONES: HOW PREVIOUS LINGUISTIC EXPERIENCE INFLUENCES LEXICAL PROCESSING

STUDENT Amritha Mallikarjun *Science and Humanities Scholars*
ADVISOR Erik Thiessen *Psychology*
ROOM/TIME Wright / 3:00 pm

Studies indicate that the input people receive in their native language shapes their perceptual understanding of unfamiliar speech. As infants, people tend to under-generalize their speech input; when given words in a certain affect or pitch, they cannot recall the word if it is presented in a different affect or pitch to them (Houston & Jusczyk, 2000, Singh et al., 2004). As they get older they focus only on the aspects of speech that provide important lexical information to them. For example, Japanese speakers cannot perceive the difference between /r/ and /l/ because their language groups these two sounds together in one phoneme, and as such they have difficulty learning words in English that require an r/l distinction to use properly, like [rip] and [lip]. This study will explore the differences in perceptual understanding between Mandarin speakers and English speakers in a statistical learning paradigm. The participants will listen to words that either have a consistent Mandarin tone associated with them or a random tone. We would expect that the Mandarin speakers, who store tone contour as an important aspect of words, would have trouble with an inconsistent tone cue, while English speakers would disregard the tone cue entirely and perform similarly in both conditions.

IMPACT OF ADVANCED PLACEMENT COURSES ON COLLEGE READINESS IN THE PITTSBURGH PUBLIC HIGH SCHOOLS

STUDENTS Aleksandra Arkhangelskaya *Statistics* | Cynthia Clement *Mathematics* | Kathryn McKeough *Science and Humanities Scholars*

ADVISOR Cosma Shalizi *Statistics*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:15 am

Pittsburgh public school students who take advanced placement (AP) courses, and do well in them, are more likely to enroll in and to finish college. We investigate how much of these differences are treatment effects (AP prepares students for college), and how much are selection (the college-ready are the ones who take AP classes). By comparing students who took AP classes with students with similar academic records but no AP courses, we determine the effect of finishing at least one AP course on college enrollment. We also examine the criteria used to admit students to AP classes. Finally, we assess if the beneficial effects of AP classes are reduced for high-performing students when more lower-tier students are allowed to enroll in AP classes.

IMPROVING INSTRUCTION IN EDUCATIONAL CONTEXTS USING VISUAL REPRESENTATIONS

STUDENTS Jae-Won Kim *Psychology* | Jennifer Shin *Science and Humanities Scholars*

ADVISOR Anna Fisher *Psychology*

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

The purpose of this study was to evaluate the learning benefits of two different approaches to combining "concrete", real-world visual representations, and "abstract", symbolic visual representations of novel concepts, in educational instruction materials. In the "concreteness fading" approach, concrete representations are followed by abstract representations, whereas in the "simultaneous presentation" approach, both types of representation were presented at the same time. Each approach has been shown to yield better learning outcomes than approaches that use either concrete or abstract materials only. The effectiveness of each approach has been attributed to different underlying cognitive learning mechanisms. However, these approaches have never been compared to each other. This study performed this comparison using a paradigm in which participants learned a novel electrical engineering calculation procedure from instruction materials that either: 1) combined concrete and abstract representations according to the concreteness fading approach, 2) combined concrete and abstract representations according to the simultaneous presentation approach, 3) used entirely concrete representations, or 4) used entirely abstract representations. Participants' performance on learning tests were then used to evaluate the efficacy of these approaches and illuminate the nature of the cognitive mechanisms that underpin learning.

LEISURE ACTIVITIES AND WELL-BEING: PART ONE

STUDENTS Luke Masa *Science and Humanities Scholars* | John Ra *Biology and Psychology*

ADVISOR Vicki Helgeson *Psychology*

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

The primary goals of this research study are to examine a causal 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 behind such a relation. The study is longitudinal, with the second part taking place 6-8 months after the first part. Fifty participants will be interviewed

in-person primarily for their recent volunteer history and level of cognitive functioning in the Spring of 2014 and then again about 6-8 months later in the Fall of 2014. The participants (preferably over the age of 75) will be drawn from the Osher Lifelong Learning Institute (OLLI) at CMU and the University of Pittsburgh through advertisement. The independent variables will be the various aspects of recent volunteer history (e.g., hours spent volunteering in the past year, type of volunteering, motives for volunteering), and the dependent variables will be health, specifically cognitive functioning. The effects of different moderator variables, such as socioeconomic status (SES), on the relation between volunteering and cognitive functioning will also be examined. SES will be of particular interest because previous research has been divided on whether low SES people reap more health and well-being benefits from volunteering or high SES people reap more health and well-being benefits from volunteering. The results from this study could provide convincing evidence favoring one relation and initiate new discussion regarding whether low or high SES people experience less cognitive impairment from volunteering.

LINGUISTIC OVERVIEW AND ANALYSIS OF L1 EFFECTS ON ARTICULATION OF SAMARITAN HEBREW

STUDENT Daniel Davis *Science and Humanities Scholars*
ADVISOR Thomas Werner *Philosophy*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30 pm

While the name may sound familiar, Samaritan was not originally a term applied to those who engaged in the practice of helping others.

The Samaritans, at the time of the Christian Bible story to which they lend their name, were a religious sect distinct from and in conflict with the Judeans. Due to their dissociation from mainstream Judaism, Samaritan culture and language have evolved in a manner which sets them apart from the other descendant languages of Ancient Hebrew; in fact, given their relatively sedentary history and general lack of cultural interference, many argue that the form of liturgical Hebrew which they use today is far more loyal to the original than any current Hebrew dialects, a proposal for which there is significant linguistic evidence.

My research concerns the language of Samaritan Hebrew and intends to compare it to other dialects of Hebrew, both Ancient and Modern, in the context of phonology (sound systems) and affixational morphology (prefixes/suffixes in word structure). I will especially focus on making my research accessible to non-linguists, as the Samaritan language is of value to Jewish, Christian, and secular academics in a wide range of disciplines.

This presentation is part of the completion of my Senior Honors Thesis in Linguistics, and will include findings from field work completed in Israel and the Palestinian Territories over Winter Break.

METAL COMPLEXES IN PEPTIDE NUCLEIC ACID TRIPLEXES

STUDENT Sarah Menio *Science and Humanities Scholars*
ADVISOR Catalina Achim *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:30 am

My research involves the synthesis of Peptide Nucleic Acid (PNA) triplexes that contain two or three 1,2-hydroxypyridone (HOPO) ligands and the study of Eu(III) binding to the HOPO-modified PNA triplexes. The UV-Visible titrations showed the formation of Eu(III)-HOPO complexes with the PNAs. Coordination of Eu(III) increased the thermal stability of the two- and three-ligand-modified triplexes. Circular Dichroism (CD)

spectroscopy showed that the addition of Eu(III) to the ligand-modified triplexes affected the structure of the triplexes but did not change their handedness. Luminescence studies showed that HOPO sensitizes the Eu(III) emission. These results suggest that Eu(III) coordinates the 2 and 3 HOPO ligands of the two-ligand-modified and the three-ligand modified triplexes respectively. These complexes will be used in the study of charge transfer between donors and acceptors linked by PNA and DNA bridges, which have potential applications in molecular electronics.

MODELING COSMIC VARIANCE

STUDENT Andersen Chang *Science and Humanities Scholars*
ADVISORS Jessica Cisewski *Statistics* | Peter Freeman *Statistics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5 pm

The distribution of galaxies in the Universe has large variation. Surveys of the Universe show that some volumes have large clusters of galaxies, while others have very few galaxies, if any at all. This variance in the distribution of galaxies is called cosmic variance. My project focuses on modeling cosmic variance using data from the Sloan Digital Sky Survey, an extensive survey of a large contiguous area in the sky. I first consider a homogeneous Poisson point process and find that this model does not fit the data from the survey very well. I then consider different two-dimensional inhomogeneous point processes; some of them, such as the Thomas and MatClust distributions, do not fit the SDSS data well, while others, such as the Cauchy and the Log Gaussian Cox, are visually more consistent with the data. Using the results of the modeling, I estimate the distribution for the density of galaxies in the Universe and the cosmic variance.

MOLECULAR VOLUME MEASUREMENTS FOR A CUBIC PHASE LIPID AND LUNG PROTEIN/ LIPID MIXTURES

STUDENT Zachary Dell *Science and Humanities Scholars*
ADVISOR Stephanie Tristram-Nagle *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:15 am

My project in the Nagle/Tristram-Nagle lab consisted of measuring the densities of lipids and proteins to determine their molecular volumes.

I used the Anton Paar DMA 5000 M densimeter for all measurements. This instrument measures the density of solutions by vibrating a small U-tube filled with the solution to be measured and recording the frequency of vibration as compared to that of a control tube of air.

The density of the solution, s, is calculated as $s - a = K(s - a)^2$ where s is the period of the vibration frequency of the tube containing the sample, a is the period of the vibration frequency of the tube of air, and a is the density of air.

First I measured the molecular volume of the lipid monoolein (MO) in water. This was a collaboration with Dr. Paul Harper at Calvin College in Grand Rapids, Michigan; Dr. Harper sent us the MO to use in our sample preparation. Four samples of monoolein were prepared, but only one gave reproducible data. These samples were extremely difficult to prepare, and I could only get a homogeneous suspension when the concentration was limited to ~0.75% monoolein by weight. Samples with a higher concentration of monoolein formed clumps, preventing any reliable measurements. These clumps proved impossible to remove by sonication or vortexing. I did finally succeed in producing a homogeneous monoolein sample by varying the temperature and vortexing protocol. I determined that the best protocol was to alternate heating the sample with short bursts

of sonication. Vortexing or longer sonication resulted in clumps of MO being stuck to the sides of the vial. The molecular volume, calculated from data from five full temperature scans, from 7°C to 50°C, and four partial scans, was shown to increase with several anomalies in the data at temperatures corresponding to known phase transitions of monoolein.

The next set of samples involved calf lung surfactant extract (CLSE) with neutral phospholipid (NPL), or Surfactant Protein B (SP-B) and Surfactant Protein C (SP-C) mixed with the lipid DOPC. This project was a collaboration with the lab of Professor Stephen Hall of the Health and Sciences University in Portland, Oregon. Professor Hall is a pulmonologist who treats people with acute respiratory distress syndrome (ARDS). Dr. Hall supplied our lab with proteins B and C. Alex Boscia (CMU Physics '13) collected the density data for these samples during the summer of 2013. I analyzed his data to calculate the partial molecular volume of SP-B by extrapolating the data to 100% concentration, which was determined to be 4753 $Å^3$. The partial molecular volume of the SP-B and SP-C mixture was extrapolated in the same manner and came out to 716 $Å^3$. My results led to the conclusion that SP-C must have a constricting effect on lipids, causing the molecular volume of the lipid/protein mixture to decrease as the concentration of SP-C increased. I calculated the partial molecular volume of SP-C to be -141 $Å^3$.

OBJECTION!: AN ANALYSIS OF THE MODERN AMERICAN LEGAL EDUCATION SYSTEM

STUDENT Hannah Loo *Science and Humanities Scholars*
ADVISOR Joseph Devine *History*
ROOM/TIME Pake / 1:40 pm

This paper presents a review of the current American legal education system and how the system came to be, with an analysis of the history and development of American law schools. This paper attempts to piece together the different parts of the American legal system that have contributed to the development of law schools throughout the history of the United States of America, before moving on to the current controversies of law school. Finally, by drawing from a variety of published sources and various interviews, this paper presents responses to the criticisms and offers a few predictions regarding the future of the American law school.

PREDICTING BRAIN ACTIVITY AND EXPLORING CONNECTOMICS WITH LASSO REGRESSION

STUDENT Madeleine Clute *Science and Humanities Scholars*
ADVISORS Aarti Singh *Machine Learning* | Timothy Verstynen *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:45 am

Connectomics refers to the study of structural and functional connectivity patterns of brain networks. While characterizing connectivity patterns can provide useful insights about the structure of the neural network itself, relatively little is known about how incoming connections into a given brain region can explain the activity being observed there. This research tested the predictive utility of functional connectivity by investigating how connectivity estimated during a simple sensorimotor task could explain future task related responses in that region. The functional connectivity was measured using Lasso regression and the use of autoregressive Lasso regression was also investigated. The results show that functional connectivity in macroscopic neural networks not only has a utility for describing the state of the network itself, but also provides predictive explanations of task-relevant brain activity observed in connected areas.

SOCIAL STIGMA OF VISIBLE AND NON-VISIBLE PHYSICAL ILLNESS

STUDENT Lazar Lalone *Science and Humanities Scholars*
ADVISOR Vicki Helgeson *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

Culturally established social stigma is known to result in negative social and psychological consequences for the bearer and the perceiver of the condition. This laboratory study investigated the effect of visible and non-visible stigmatizing conditions on the perceiver's mood and impressions of the bearer. Sixty-one undergraduate participants were made to believe they would be interacting with another student whose condition's visibility had been manipulated. It was hypothesized that the perceiver would report more negative impressions when the bear's condition was visible versus non-visible and that both would be more negative than control. It was also believed that the perceiver would implement the norm to be kind to the stigmatized and would present a more favorable, positive mood than they were truly feeling in the stigmatized conditions compared to control. Results showed no difference in perceptions across any of the conditions. However, while non-significant, the expected mood change was observed for both anxiety and well-being measures. It is believed that the nature of the questionnaire may have prevented meaningful results from being drawn in regard to the perceptions of the stigmatized individual, but the results of the less overt mood measure seemed promising for future work.

SYNTHESIS AND NATIVE CHEMICAL LIGATION OF MP-L-PNA MONOMERS.

STUDENT Yidan Cong *Science and Humanities Scholars*
ADVISOR Danith Ly *Chemistry*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5 pm

It has been dated that more than 20 genetic diseases are associated with unstable expansion repeat. Research works have been currently focusing on Myotonic Dystrophy (MD1), whose mechanism has been fairly known. It has been found that patients who are affected by MD1 have genome consists of RNA triplet CUG repeat. The number of this repeat exceeds normal phenotype by a large amount. RNA repeats form hairpin structures that bind with muscle-blind-like protein 1, and consequently, inhibit alternative splicing. To open up these hairpin structures, a mechanism was proposed that short complementary gamma peptide nucleic acid (PNA) triplets to be delivered into the cells and bind with repeats in a native chemical ligation fashion. To test this hypothesis, MP-L-PNA monomers were synthesized and PNA 3mers and 6mers GAC were made from monomers. Native chemical ligation (NL+CL) between PNA oligomers and RNA sequences with various lengths were performed. Matrix-assisted laser desorption/ionization (MALDI) was used to analyze and investigate the occurence of NCL.

SYNTHESIS OF PHOSPHORUS HETEROCYCLES

STUDENT Daniel Davis *Science and Humanities Scholars*
ADVISOR Kevin Noonan *Chemistry*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5 pm

The integration of heteroatoms, especially phosphorus and nitrogen, into the aromatic system of small molecules is an exciting new direction in the field of organic synthesis. This research focuses on attempts to synthesize previously unattested compounds, all part of a class known as azaphospholes, whose electronic properties could make them ideal candidates for, among other things, the development of new conductive polymers.

SYNTHESIS OF TANDEM FRET ACTIVE DYES FOR BIO SENSOR

STUDENT Jeffery Kurish *Science and Humanities Scholars*
ADVISOR Marcel Bruchez *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:00 am

Malachite green (MG) fluorescent dye was covalently linked to cyanine three (Cy3) dye to create a fluorescent active tandem dye wherein excitation of the Cy3 dye can show emission in the MG spectrum. A synthetic pathway was described for the creation of MG linked to a reduced Cy3 dye with spectroscopic data supporting the claim. The reduced Cy3 dye does not absorb energy and therefore does not fluoresce in the MG region. This dye can be used as a sensor for singlet oxygen the reduced Cy3 is oxidized slowly increasing the fluorescent signal. MG has two separate excitation regions the larger of the two overlapping with the emission spectrum of Cy3. The other excitation spectrum however overlaps strongly with the emission spectrum of a coumarin. In order to create another FRET dye tandem pair MG dye was linked with coumarin. Initial data has shown that the coumarin MG dye has shown quenching of MG emission but not significant energy transfer. Different linkers between the coumarin and MG dye should be attempted in the future.

TAML-CATALYZED DEGRADATION OF PROPRANOLOL

STUDENT Abigail Burton *Science and Humanities Scholars*
ADVISOR Terrence Collins *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:00 am

Propranolol, a pharmaceutical present in water at concentrations that may be dangerous to sensitive species, is efficiently degraded by FeIII-TAML activators and hydrogen peroxide in aqueous solutions at pH 6-8. The rate equation for this reaction, neglecting reversibility of catalyst activation, is rate = kIkII[FeIII][HOOH][propranolol]/(kI¬¬[HOOH] + kII[propranolol]), where FeIII represents the catalyst. The rate constant kI equals 29 ± 3, 150 ± 10, and 810 ± 80 M-1 s-1 at 25o C at pH 6, 7, and 8, respectively. The rate constant kII equals (4.4 ± 0.2) x 103, (2.9 ± 0.2) x 104, and (5.7 ± 0.2) x 104 M-1 s-1 under the same conditions. The products for this reaction have not all been identified; one has been identified as 1,4-naphthoquinone but at least one other colored intermediate is produced.

THE EFFECTS ON PEPTIDE BINDING AFFINITY FOR TNF BY CONJUGATION TO POLYMERS

STUDENT Sophia Wu *Science and Humanities Scholars*
ADVISOR Newell Washburn *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:15 am

The human body responds quickly to injury, infection, and disease through the immune system's inflammatory response, governed by a group of cytokines - the tumor necrosis factor superfamily. Specifically, tumor necrosis factor alpha (TNF) is one of the most notable transmembrane proteins involved in this inflammatory response. Although TNF is a necessary protein for the body's healing process, its overexpression can cause chronic inflammation and has been known to be involved with syndromes such as rheumatoid arthritis, Chrohn's disease, and psoriasis. In order to overcome some of the symptoms connected to TNF, it is vital to focus on the development of anti-TNF therapy through the use of TNF inhibitors. These TNF inhibitors need to carry certain properties such as good solubility, high binding affinity, and high circulation time. The conjugation of poly(ethylene glycol) (PEGylation) has become a novel strategy for increasing the circulation time of

therapeutics while at the same time not impacting the binding affinity negatively. In our previous studies, we have utilized the WP9QY peptide, which is known to be a TNF antagonist. We specifically determined that conjugation of this WP9QY peptide to PEG resulted in improved binding affinity of the peptide to TNF. In this study, we performed comparison studies in which the WP9QY peptide was conjugated to two other polymers through site-specific conjugation: poly(acrylic acid) (PAA) and poly(2-hydroxyethylacrylate) (pHEA). Different molecular weights of the polymers were also utilized to analyze whether or not a change in polymer length affects the binding affinity. The obtained binding affinities were compared to the binding affinity of the PEG-WP9QY conjugate to directly determine the capabilities of other WP9QY peptide-polymer conjugates as anti-TNF agents. Measurements of kinetic parameters such as kon, koff, and KD will be presented and correlated with polymer chemistry.

TEPPER SCHOOL OF BUSINESS

BUSINESS ADMINISTRATION

ASSISTIVE NAVIGATION TECHNOLOGY FOR VISUALLY IMPAIRED TRAVELERS

STUDENTS Alekhya Jonnalagedda *Mathematics* | Lucy Pei *Business Administration* | Ming Y. Wu *Information Systems*
ADVISOR Mary Bernardine Dias *Robotics Institute*
ROOM/TIME Rangos Hallway, 2nd Floor / 3-5 pm

We explored different avenues through which computing technology can enhance the safety and independence of visually impaired people as they navigate transit stations such as airports, train stations, bus depots, etc. First, we studied the related work in the literature. Having established this foundation, we gathered information from a variety of relevant stakeholders through observation, interviews, and surveys.

The goal of this needs assessment was to understand the specific challenges, needs, existing solutions, governing policies, and ideas for future technology tools that would enhance the experience of visually impaired travelers using transit stations. Based on the findings from our needs assessment, we generated recommendations and guidelines for how technology can address some of the challenges faced by visually impaired travelers.

COLLEGE AS A FINANCIAL INVESTMENT

STUDENT Young Joon Kim *Business Administration*
ADVISOR Carey Morewedge *Social & Decision Sciences*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30 pm

Despite solid numbers and statistics that prove higher earnings with a college degree, many students decide to go straight to work at the expense of giving up higher education. Why is this? The purpose of the study is to find out why as well as to lead them to making a financially sound decisions regarding their education.

CORPORATE SOCIAL RESPONSIBILITY AND FINANCIAL PERFORMANCE

STUDENT Kun Ho Baik *Business Administration*
ADVISOR Bryan Routledge *Business Administration*
ROOM/TIME Dowd / 1:40 pm

In the recent years, issues in corporate social responsibility has gained a significant amount of attention. At least for the listed companies, it is a norm to release corporate social responsibility reports to document their contribution to the society and the environment. While so many companies are focused in CSR values, it is an open question as to how that whether this attention to CSR is a good return on investment.

My central question of the thesis will be, "How is the relationship between CSR and financial metrics structured?" I plan to take major financial metrics and compare them to the CSR-related metrics to analyze the relationship. I also would like to analyze whether which counterpart is the leading factor (does the poor financial performance affect the CSR values? Or is it the other way around?).

To start, we gather the reported metrics in CSR reports. Since there is no standard set of metrics or methods of reporting, the reports are hard to compare. We use a clustering algorithm to unify the reporting by statistically inferring the ``missing'' metrics in reports. This yields a standard set of CSR metrics to consider.

DIETRICH COLLEGE FRESHMAN SEMINAR EVALUATION

STUDENTS Megan Garvey *Business Administration* | Anas Hoque *Economics and Statistics* | Bryan Ketterer *Statistics* | Anton Razanav *Economics* | Christopher Wysocki *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

An evaluation of the Faculty and Student perspectives on the Freshman Seminar Program. The evaluation includes perspectives on whether or not the goals of the program are achieved as well as analysis of downstream effects generated from the FS.

FACULTY COURSE EVALUATION

STUDENTS Shivika Dhar *Statistics* | Shannon Ho *Business Administration* | Hyo Na Lee *Economics* | Yuxuan Li *Statistics* | Kristina Schiffhauer *Statistics*

ADVISOR Grant Weller *Statistics*

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

Explore the different methods of FCEs and their effectiveness. Look for ways to have higher response rates that is to have more students fill out the FCEs. Through FCEs, give students more information about courses and corresponding instructors. Use FCEs to help students make wiser choices in choosing courses.

PARTICIPATION IN THE ARTS: AN ECONOMIC PERSPECTIVE

STUDENT Stephen Serrao *Business Administration*

ADVISOR Robert Monroe *Business Administration*

ROOM/TIME Pake / 2:00 pm

Research has shown that involvement in the performing and visual arts gives even the novice dancer, dramatist, or musician a communicative ability for human expression. Whether involvement in these activities can generate long-term benefit beyond just immediate intrinsic value has become of particular concern for policymakers and educational leaders alike. Evaluating data from the National Education Longitudinal Study of 1988 conducted by the National Center for Education Statistics, the present study aims to explore an economic perspective with a novel individual focus to determine the value that participation in the arts at youth may have for early adulthood economic outcomes.

RESOURCES AT HUNT LIBRARY

STUDENTS Zhuling Li *Psychology* | Ahnsik Shin *Business Administration* | Abigail Volynsky *Statistics* | Sungkyu Yang *Statistics*

ADVISOR Trent Gaugler *Statistics*

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

For the benefit of the CMU community, we have decided to conduct a survey about the use of Hunt Library and its various resources. Through this survey, we hope to achieve a better understanding of the resources that are being used (i.e. CAMEO, eJournals, Online databases, etc) and the resources that many students fail to utilize properly. Additionally, we aim to understand why these resources are not being properly exploited. We hope the university will consider these results regarding future improvements in Hunt Library.

STEEL TOWN SHORT FILM SCREENING

STUDENTS Nicolas Hurt *Business Administration* | Talia Levin *BHA* | Anna Nelson *BHA*

ADVISOR Jane Bernstein *English*

ROOM/TIME McConomy Auditorium / 12:00 pm

We will be screening our 18-minute historical drama film, "Steel Town," which displays the creative talents of the student filmmakers at Carnegie Mellon University while bringing to life a legendary event in Pittsburgh's history. A brief introduction and Q&A session will be led by the film's director, Nick Hurt.

STRESS LEVEL AT CMU AND SOLUTIONS

STUDENTS Aashna Singh *Economics and Statistics* | Hannah Worrall *Economics and Statistics* | Tony Zhang *Mathematics* | Ruiqi Zhao B*usiness Administration*

ADVISOR Grant Weller *Statistics*

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

There are many surveys that have been done at CMU asking about students' stress level and their health condition related to stress. However, few surveys digged into the real sources of stress and possible solutions to cope with stress. As students who work under the stressful environment, we are more interested in learning about what we can do or what can be done by the school to solve the stress problem.

Our research question for the survey is to find out the real sources that contribute to the stress culture at CMU and what can the university or professors do about it. There are mainly 6 sources of stress that have been targeted in this study: Coursework, Extracurricular activity, Sports, Job Search, Employment, and Stress Culture (Peer Competition). We want to find out if any of the sources specifically has a significant impact on students' stress level or it is a combination of several sources. We also proposed some solutions in our survey and attempted to find students' opinion on each of the solutions proposed and tried to figure out the most effective solution. Some solutions we proposed in the survey included workshops for professors to deal with students, stress support groups and mandatory campus wide events to deal with stress. We plan to suggest our findings to CMU administration and Academic Development Staff for implementation to benefit all CMU students.

TEPPER STUDENTS' ATTITUDE TOWARDS CURRENT GRADING SYSTEM

STUDENTS Karthik Annaamalai *Business Administration* | Andres Anzola *Economics* | April Jianto *Business Administration* | Dixon Liang *Business Administration* | Jisoo Park *Statistics*

ADVISOR Trent Gaugler *Statistics*

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

Grades are not only an indication of how well a student is performing, but also a hiring criterion for employers and graduate schools.

Recently, controversy over Harvard's grading system has gained national media attention. Some schools, most notably Harvard, are known for grade inflation, while others, such as MIT, are known for grade deflation. As Tepper attempts to move forward in national rankings, it's important for university officials to understand a range of grading alternatives.

Recently, the undergraduate Tepper administration has been implementing grading policy changes including introducing a grade cap on the maximum number of students who receive an A grade in a particular class at 30% of the class size. The administration is also evaluating additional alternatives. Thus, our findings can

have a substantial impact on the future policies that Tepper may introduce. This survey needs to be conducted now because of the immediate consequences for the future of students. Unlike the leniency of some employers in other fields, business employers arguably view GPA as the most important factor for consideration. For example, employers often have a set GPA requirement for most jobs in business, with 3.3/4.0 being the most common. The requirement isn't school specific, but is standard across all schools and thus, does not take into consideration the distribution of grades at any particular school.

University officials, from career center employees to school deans, can use this research to better understand, adjust grading systems, or inform employers or graduate institutions to put students in competitive positions relative to their peers.

The main question we hope to answer in this project is "Do undergraduate Tepper students prefer the hybrid grading system that is currently used, which combines both absolute grading scales and relative curved grading scales? If not, what alternatives are most popular?"

Tepper's undergraduate business program currently employs a hybrid grading system where some classes use an absolute grading method while others a relative one. Given that students understand the current system, it is possible that students prefer an absolute grading system because it can lend itself to a more collaborative environment in which students are less likely to compete with one another. Because of this synergistic climate, students may feel more comfortable to share their ideas and unique perspectives and in turn create a better learning experience.

ECONOMICS

CONSUMER BEHAVIOR IN UPGRADING TECHNOLOGICAL GOODS

STUDENTS Akwasi Brefo *Economics* | Maya Geleroff *Economics* | Zaneta Grant *English* | Michelle Lin *Social & Decision Sciences*

ADVISOR Rebecca Lessem *Economics*

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

We have taken usual behavioral economic theories applied to generalized consumer behavior and applied them specifically to technological good purchasing choice. Factors such as normative versus informational decision making, anchoring bias, and income effects have been proven to be significant influencers in consumer choice of technological goods.

CONTROLLED SCHOOL CHOICE WITH MIXED BOUNDS APPROACH: A BALANCE BETWEEN STABILITY AND DIVERSITY CONSIDERATIONS

STUDENT Paul Ko *Economics*

ADVISOR Mehmet Yenmez *Economics*

ROOM/TIME Peter / 1:00 pm

Controlled school choice over public schools has been an important concern for both the parents of students and schools. It gives numerous options for how fairness and diversity considerations can be balanced. The notion of diversity is often imposed by limiting the number of admitted students who have the same type (quotas), or by reserving seats for each student type (reserves). The controlled school choice rule that we explore in this paper is the combination of "reserves" and "quotas," where schools implement minimum reserves (a "soft" bound) and maximum quotas (a "hard" bound) together. In this paper, we provide a full characterization of the mixed bounds approach, and show that it satisfies the requirements for the existence of a student-optimal stable matching.

DIETRICH COLLEGE FRESHMAN SEMINAR EVALUATION

STUDENTS Megan Garvey *Business Administration* | Anas Hoque *Economics and Statistics* | Bryan Ketterer *Statistics* | Anton Razanav *Economics* | Christopher Wysocki *Economics and Statistics*

ADVISOR Grant Weller *Statistics*

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

An evaluation of the Faculty and Student perspectives on the Freshman Seminar Program. The evaluation includes perspectives on whether or not the goals of the program are achieved as well as analysis of downstream effects generated from the FS.

SPECIAL COMPETITIONS

ALCOA UNDERGRADUATE RESEARCH AWARDS

Alcoa Inc. is sponsoring this award for projects in Information Technology, with a focus on mobility. Mobility is a key 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?

THE ALLEN NEWELL AWARD FOR EXCELLENCE IN UNDERGRADUATE RESEARCH

Open only to students in SCS. This endowed award, established in 1993, is presented annually by the School of Computer Science. Allen Newell had a long, rich and distinguished scientific career that contributed to multiple subdisciplines in computer science. Still, each individual endeavor was pursued with a characteristic style that his colleagues, students, and friends recognized as essential to Allen. Owing to the breadth and scope of Allen's contributions, this award recognizes extraordinary undergraduate research in his scientific style rather than computer science research in a particular area. The criteria by which a research project is judged is predicated, foremost, on the belief that a good idea is not enough. The qualities that transform a good idea into good science can be captured in three maxims attributable to Allen:

1) Good science responds to real phenomena or real problems.

2) Good science is in the details.

3) Good science makes a difference.

ALUMNI AWARD FOR UNDERGRADUATE EXCELLENCE IN COMPUTER SCIENCE

Open only to students in SCS. The Alumni Award for Undergraduate Excellence in Computer Science, established in 2003, is granted on behalf of Carnegie Mellon School of Computer Science alumni. The Award recognizes technical excellence in research and development. The Award is also intended to promote awareness within the undergraduate community that graduation represents both the end of an important phase of life and the beginning of a new phase within the vibrant Carnegie Mellon University School of Computer Science community as an alumnus. The Alumni Award recognizes such factors as contribution to the state of the art; technical excellence; potential societal impact; accessibility; quality of the written, oral, and poster presentations; and generated excitement among the alumni community participating in the process.

AWARD FOR ARTISTIC EXCELLENCE

The Award for Artistic Excellence is sponsored by engineers in support of the arts and the Center for the Arts in Society at Carnegie Mellon. Awards will be given to outstanding visual and performing arts presentations.

Marian Aguiar, *English*
Harrison Apple, *Center for Arts & Society*
Krista Campbell, *Foundation Relations*
Robert Cavalier, *Philosophy*
Catherine Davidson, *President's Office*
Sharon Dilworth, *English*
Jim Duesing, *Art*
Gabriele Eichmanns, *Modern Languages*
Sarah Emory, *Intercultural Communications Center*

AWARD FOR ARTISTIC EXCELLENCE (CONTINUED)

Sara Faradji, *English*
Emanuela Grama, *History*
Tim Haggerty, *Director, Humanities Scholars Program*
Kerry Ishizaki, *Global Communications Center*
John Mackey, *Mathematical Sciences*
Margaret Myers, *Studio for Creative Inquiry*
Mame-Fatou Niang, *Modern Languages*
Nisha San
Richard Simpson, *Humanities Center*
Elena Versari, *Art*
Danielle Wetzel, *English*
Jesse Wilson, *History*
Joanne Wolfe, *Global Communications Center*

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.

Denise Holiman, *Manager, Information Technology Functional Excellence*
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.

FACULTY:
Michael Bockstaller, *Materials Science & Engineering*
Warren Garrison, *Materials Science & Engineering*
Peter Gilgunn, *ICES & Electrical and Computer Engineering*
Kelvin Gregory, *Civil and Environmental Engineering*
John Kitchin, *Chemical Engineering*
Albert Presto, *Mechanical Engineering*
Jayshree Ranka, *Cylab*
Astav Sacheti, *Alumni, Software Manager at Apple*
Satbir Singh, *Mechanical Engineering*
John Wesner, *Institute for Complex Engineered Systems/ME*

DIETRICH HUMANITIES PRIZE

The Dietrich Humanities Prize is awarded to student projects that best exemplify the humanities as they are understood at Carnegie Mellon: that the study of philosophy, history, language, and cultures enriches our experience and offers a template for understanding both traditional disciplinary legacies and new directions in scholarly inquiry. In addition to concrete emphasis on problem solving, the humanities at Carnegie Mellon seek ongoing dialogues with — not isolation from — the arts, sciences and technologies.

Marian Aguiar, *English*
Harrison Apple, *Center for Arts & Society*
Krista Campbell, *Foundation Relations*
Robert Cavalier, *Philosophy*
Catherine Davidson, *President's Office*
Sharon Dilworth, *English*
Jim Duesing, *Art*
Gabriele Eichmanns, *Modern Languages*
Sarah Emory, *Intercultural Communications Center*
Sara Faradji, *English*
Emanuela Grama, *History*
Tim Haggerty, *Director, Humanities Scholars Program*
Kerry Ishizaki, *Global Communications Center*
John Mackey, *Mathematical Sciences*
Margaret Myers, *Studio for Creative Inquiry*
Mame-Fatou Niang, *Modern Languages*
Nisha San
Richard Simpson, *Humanities Center*
Elena Versari, *Art*
Danielle Wetzel, *English*
Jesse Wilson, *History*
Joanne Wolfe, *Global Communications Center*

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*
Lawrence Heckel, *IT Manager*
Mark Speer, *IT Manager*

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.

Brooke Feeney, *Associate Professor, Psychology*
Anna Fisher, *Associate Professor, Psychology*
Vicky Helgeson, *Professor, Psychology*
Laurie Heller, *Associate Teaching Faculty, Psychology*
Charles Kemp, *Assistant Professor, Psychology*
David Rakison, *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.

Ben Anglin, *Materials Science & Engineering*
Joseph Ayoob, *Biological Sciences*
DJ Brasier, *Biological Sciences*
Maggie Braun, *Biological Sciences*
Derek Carlson, *Engineering and Public Policy*
Gregory Cary, *Biological Sciences*
Jill Dembowski, *Biological Sciences*
Mark Fichman, *Tepper School of Business*
Ilhem-Faiza Hakem, *Material Science Engineering*
Robert Heard, *Material Science Engineering*
Veronica Hinman, *Biological Sciences*
Michael Kazar, *Alumni, Computer Science*
Hari Chandan Mantripragada, *Engineering and Public Policy*
Deanna Matthews, *Engineering and Public Policy*
Armaghan Naik, *Computational Biology*
Parul Nisha, *Alumni, Biological Sciences*
Joe Orens, *Alumni, Berkeley Research Associates*
Kaustubh Sinha, *Biological Sciences*
Raja Sooriamurthi, *Engineering & Public Policy*
Koushil Sreenath, *Mechanical Engineering*
Deborah Stine, *Engineering and Public Policy*
Shoba Subramanian, *Biological Sciences*
Cheryl Telmer, *Biological Sciences*
Karen Thickman, *Computational Biology*
Henry Thorne, *Alumni, Mechanical Engineering*
Jing Wen, *Biological Sciences*

SRC-URO POSTER COMPETITION

This competition, sponsored by SRC (Semi-Conductor Research Corporation), seeks to recognize significant and creative work supported by the SRC-URO (Semi-Conductor Research Corporation – Undergraduate Research Opportunities) program, and to encourage students to develop and practice visual and oral presentation skills suitable for academic conferences and industrial research venues. Three prizes will be awarded.

Treci Bonime, *CIT Dean's Office*
Emma Brunskill, *Computer Science*
Claire Le Goues, *Institute for Software Research*
Marylisabeth Rich, *SRC*

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.

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.

TRIPLE HELIX COMPETITION

The Triple Helix is the undergraduate journal of science, society, and law at Carnegie Mellon. Through the venues of written expression and campus lectures, our goal is to promote the understanding of the impact of science and technology on society and their interaction with the law. This award is presented to students conducting research in any field and recognizes the impact that their research has on both science and society.

Jill Jaycox, *Chemisty*
Michelle Yu, *Biological Sciences*

TOYOTA IDEAS FOR GOOD SCHOLARS AWARD

This award was created to encourage learning and investigation in green ideas and technology, emphasizing areas that can create improvement in the lives of people in the US and internationally. This award is sponsored by a gift from Toyota Motor Sales, U.S.A., Inc.

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.

Dennis Epple, *Economics*
Carol Goldburg, *Economics*
Yaroslav Kryukov, *Economics*
Rebecca Lessem, *Economics*

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.

Neil Dohahue, *Director, Steinbrenner Institute for Environmental Education*

John Rohe, *Vice President for Philanthropy, Colcom Foundation*

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.

LaShanti Jenkins, *Yahoo! Labs*

Amanda Stent, *Yahoo! Labs*

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