CARNEGIE MELLON UNIVERSITY

MEETING OF THE
MINDS

2012
UNDERGRADUATE RESEARCH OFFICE
CMU.EDU/URO

Welcome

A warm welcome to the 17th 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, in all of the disciplines, across campus. Congratulations to our students for their contributions, whether it be in the laboratory, out in the community, in an archive, or working in a studio. The results of their innovative research and their work with faculty mentors are on display today and give all of us good reason to be proud of them and the work that takes place at Carnegie Mellon.

Please feel free to browse through the abstracts in this program. They are a good place to start as you plan your time at Meeting of the Minds. Then you can travel around to 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 along the second floor corridor; visit the visual art projects in the Connan Room on the first floor; and enjoy a performance or film in McConomy Auditorium.

There are two afternoon times that are important to keep in mind. At 2:30, Amy Burkert, Vice Provost for Education, will deliver a short keynote address in the first floor Kirr Commons area. We will also hold a drawing for a student prize and make announcements for the final rounds of particular competitions.

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

Thank you again for coming to celebrate undergraduate research at our 17th Annual Meeting of the Minds.

Stephanie Wallach
Assistant Vice Provost for Undergraduate Education
Undergraduate Research Office

Table of Contents

Table of Contents

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, Dan Barnett, Nancy Brown, Amy Burkert, Catherine Copetas, Marcia Gerwig, Michelle Guarino, Anna Houck, Stephanie Jin, Jen Keating-Miller, M. Stephanie Murray, Kurt Larsen, Lizzee Solomon, Mark Stehlik, Shoba Subramanian, Joanne Ursenbach, Jen Weidenhof, Instructional Technology, University Catering Staff, the University Center Staff, AlphaGraphics, Balloons Instead, A.G. Trimble Company, ImagePoint Pittsburgh and all the other wonderful students and staff who make this event work.

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

Presentations

DESCRIPTIONS OF TYPES OF PRESENTATIONS

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

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

2 ORAL PRESENTATIONS
Students have been assigned a 20-minute time slot and will be located in one of five rooms along the second floor corridor (Dowd, Pake, McKenna, 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.
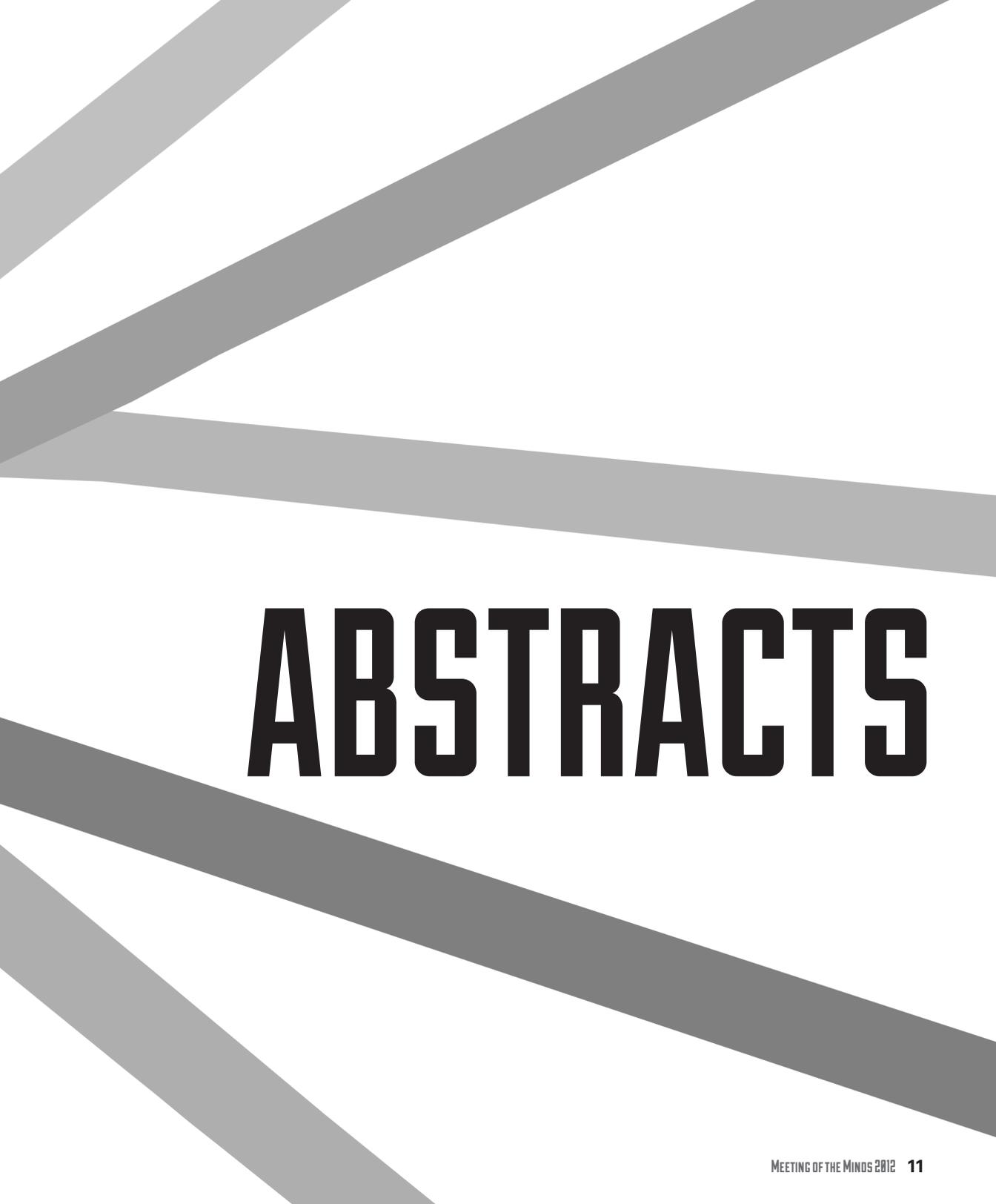
ABSTRACTS

CARNEGIE INSTITUTE OF TECHNOLOGY

BIOMEDICAL ENGINEERING

DEVELOPING A FLEXIBLE, LOW-COST ROBOTICS PLATFORM FOR THE EDUCATION COMMUNITY

STUDENTS Nicolas Paris *Electrical & Computer Engineering* | Harrison Rose *Biomedical Engineering* |
Robert Wedler *Electrical & Computer Engineering*

ADVISORS George Kantor *Robotics Institute*

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

The vast majority of robotics kits on the market are either severely limited in functional capacity, or hide functionality within black boxes. We seek to create a cost-effective robotics platform that exposes users to the fundamentals of robotics and electronics. Additionally, we seek to make the platform flexible so that users can easily apply their new-found knowledge to microcontrollers in general. This will be accomplished by tightly integrating a multi-use and open-source development environment into the robotics platform.

DEVELOPMENT AND DESIGN OF TWO CHEMICALLY POWERED MINIATURE CARS

STUDENTS Katia Bazzi *Chemical Engineering* | Madison Calhoun *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Eric Chu *Chemical Engineering* | Jyo Lyn Hor *Chemical Engineering* | Rebecca Lui *Biomedical Engineering* | Harley Montano *Undecided* | Kaitlyn Nowak *Chemical Engineering* | Yijie Qiu *Chemical Engineering* | Anand Sastry *Chemical Engineering* | Stephen Scannell *Chemical Engineering* | Alexander Yoshikawa *Chemical Engineering* | Amy Yuan *Chemical Engineering* | Minghui Zhang *Chemical Engineering*

ADVISORS James Miller *Chemical Engineering*

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

The Chemical Engineering Car Club developed two chemically powered cars that were entered in the regional Chemical Engineering Car Competition. The first car is powered by a home made copper zinc battery and is stopped by a controlled iodine clock reaction. The second car uses the pressure generated by the catalysed decomposition of hydrogen peroxide to operate a piston which powers the car.

EVALUATION OF ADIPOSE ECM GELS FOR BREAST RECONSTRUCTIVE SURGERY

STUDENTS Kathryn Kukla *Biomedical Engineering*

ADVISORS Conrad Zapanta *Biomedical Engineering* | Stephen Badylak, *University of Pittsburgh*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:15

This study suggests potential differences in the host response to gels made of different source materials and gels modified by chemical cross-linking agents. This study represents the first step towards the creation of a natural, biocompatible device for breast reconstructive surgery. Current work is in process to assess the gels ability to promote the growth of tissue specific cells.

KEYCHAIN EPINEPHRINE AUTO-INJECTOR

STUDENTS Bradley Edelman *Biomedical Engineering* | Bryan Good *Biomedical Engineering*

ADVISORS Conrad Zapanta *Biomedical Engineering*

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

Current designs of epinephrine auto-injectors prove to be very effective; however, the burdensome sizes and shapes lead to the devices being forgotten or left behind in times of need. By creating an auto-injector that is smaller, more portable, and keychain adaptable, the rate of incidence for this occurrence will decrease greatly. In order to fulfill these design inputs, we propose new designs that employ length-adjustable mechanisms so that storage space is minimized without inhibiting the device's ease of use, safety, or injection features. The devices are constructed using rapid prototyping technology so that the designs can be analyzed in reality based on a variety of criteria.

MODELING THE IMPACT OF SUBSTRATE NANOTOPOGRAPHY ON CELL MORPHOLOGY

STUDENTS Robert Morhard *Biomedical Engineering*
ADVISORS Christopher Bettinger *Materials Science Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:15

Cell's respond to a variety of environmental cues through morphology changes and migration in embryogenesis, wound healing and immune surveillance. One cue of interest is the nanotopography of the substrate. In vivo, integrins transduce the surrounding mechanical information from proteins such as collagen, neighboring cells, or other structures on the micron-scale. In order to decrease the strain on the cell, the morphology adapts to these nanotopographical cues. While cell morphology can be altered via integrin-mediated active processes, this model demonstrates that passive mechanisms can describe cell elongation on nanogrooves. Lamellipodium, or actin-rich structural components on the cellular cytoskeleton and microtubules can be stained to provide easily analyzed data regarding the cellular morphology changes over time on different topographies. This data can be used to calibrate and refine a mathematical model of the relation of cell morphology on substrate topography. Current research is focused on changes of cell morphology on elastomeric substrates oscillating between nanogrooves and flat substrates, but little is known about the kinetics of these changes. By creating a model to describe the dynamics and morphological data of cells in relation to substrate type and variance profiles, it will be possible to better understand the relationship between cell morphology, actin-rich cellular machinery and microtubules and the substrate.

UNDERSTANDING THE CROSS-TALK BETWEEN THE TWO IMMUNE CELLS, MACROPHAGES AND DENDRITIC CELLS, AND THEIR ROLE IN OSTEOBLASTOGENESIS

STUDENTS Hirotaka Nakagawa *Biomedical Engineering*
ADVISORS Phil Campbell *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:30

The immune system works to destroy pathogens and foreign substance that can cause potential harm. As a result, it can also induce rejection of implanted biomaterials and transplants. These responses are often necrotic and cause fatal damage to a body. During an immune response, cells such as T cells, macrophages, and dendritic cells interact among each other to induce immune activity. The objective of this experiment is to observe the interaction of these cells during an inflammatory response. This research will lead to the minimization of the necrotic rejection response during biomedical transplantation.

CHEMICAL ENGINEERING

BLOCK-COPOLYMER HYDROGELS AS PROTECTIVE ENVIRONMENT FOR PROTEINS

STUDENTS Lauren Powers *Chemical Engineering*
ADVISORS Lynn Walker *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Pluronics, PEOx-PPOy-PEOx tri-block copolymers, are the basis of this research project. With increasing temperature the block copolymers to form micelles. The interstitial spaces can be tailored in size based on concentration of the polymer, and this research project concentrated on the behavior of Bovine Hemoglobin within the polymer. Numerous salt, pH, and heat studies were performed to characterize the protein within the polymer.

CHARACTERIZING FLUID FLOW THROUGH A POROUS MATERIAL: EXPERIMENTS & MODELING

STUDENTS Alexander Chou *Chemical Engineering*
ADVISORS Cecil Higgs *Mechanical Engineering*
ROOM/TIME Ratngos 1 / 12-2:30

Particle beds have applications in chemical separation processes such as filtration, absorption, or chromatography as well as in packed bed reactors. For these processes, it is important to characterize the fluid flow through the particle bed. A model of fluid flow through a particle bed is developed by coupling computational fluid dynamics (CFD) with a discrete element method (DEM) of determining particle interactions. Alongside this model, an experimental rig is built to characterize filtration. Using the rig, a study of fluid flow across a particle bed is performed. The results of the experimental study are used to test the validity of the computational model.

COUPLING STRATEGIES FOR THE CONJUGATION OF LIGNIN AND SYNTHETIC POLYMERS

STUDENTS Khevna Desai *Chemical Engineering*
ADVISORS Newell Washburn *Chemistry*
ROOM/TIME Rangos 1 / 12-2:30

Lignin, a component of call walls in woody plants, is one of the most abundant biopolymers on the planet, with over a million tons being produced as a byproduct of paper production. There is growing interest in modifying lignin and conjugating it with different polymers to make more renewable materials. One such polymer is polystyrene, a commonly used plastic, that is not as sustainable. The process to conjugate the two materials involves modification or lignin followed by an SN2 reaction to add the polystyrene. Three methods to modify the lignin to have suitable functional groups have been identified as well as a method to react the lignin with the styrene. This research provides a launching point for material characterization as well as conjugation with additional polymers.

DESIGN AND DEVELOPMENT OF COPPER-ZINC BATTERY POWERED CAR AND PRESSURE-BASED CAR

STUDENTS Stacey Lee *Chemical Engineering*
ADVISORS James Miller *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

The purpose of this project is to design two cars to compete at the AIChE Chemical Engineering Car Regional Competition in the Spring of 2012. The Chemical Engineering Car Competition is a national, collegiate competition sponsored by the American Institute of Chemical Engineers (AIChE). It is based on the challenge of designing and building a model-sized car that is powered by a chemical reaction. The car must stop at a distance between 50 and 100 feet and carry a load of water. Both the distance and load are specified on the day of the competition. The competition is designed to give student engineers the opportunity to apply their knowledge to a design project and to gain research experience. It also gives students an opportunity to meet with other students across the country, share ideas, and network. We are developing two separate cars for the competition. The first car is a pressure based car powered by the catalyzed degradation of hydrogen peroxide and the second will be powered by a copper-zinc battery and use a heat-based stopping mechanism. In October 2011, the team placed 5th out of the 33 best teams throughout the United States at AIChE's National Competition. Our goal is to enter the two cars in the Regional Competition and perform well enough to qualify for the 2012 National Competition. We are requesting a budget of $1000 to build two new cars for the upcoming Regional Competition in Spring 2012.

DESIGN OF MICRORNA DETECTION

STUDENTS Li Ang Zhang *Chemical Engineering*
ADVISORS James Schneider *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

MicroRNA (miRNA) is responsible for post transcriptional silencing. miRNA dysregulation has been linked to many diseases, making its detection highly valuable for diagnostic purposes. miRNA detection is difficult due to its variety, short length, and low concentration. Synthetic peptide nucleic acids and DNA nanotags with YOYO-1 dye were found to form stable and highly selective sandwich complexes with miRNA targets. Separation of these complexes with drag-tag micelles in end-labeled free-solution electrophoresis (ELFSE) enabled multiplexed detection. Furthermore, the injection of a plug of a high density micelle into the electrophoresis capillary greatly increased the multiplex detection.

DEVELOPMENT AND DESIGN OF TWO CHEMICALLY POWERED MINIATURE CARS

STUDENTS Katia Bazzi *Chemical Engineering* | Madison Calhoun *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Eric Chu *Chemical Engineering* | Jyo Lyn Hor *Chemical Engineering* | Rebecca Lui *Biomedical Engineering* | Harley Montano *Undecided* | Kaitlyn Nowak *Chemical Engineering* | Yijie Qiu *Chemical Engineering* | Anand Sastry *Chemical Engineering* | Stephen Scannell *Chemical Engineering* | Alexander Yoshikawa *Chemical Engineering* | Amy Yuan *Chemical Engineering* | Minghui Zhang *Chemical Engineering*
ADVISORS James Miller *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

The Chemical Engineering Car Club developed two chemically powered cars that were entered in the regional Chemical Engineering Car Competition. The first car is powered by a home made copper zinc battery and is stopped by a controlled iodine clock reaction. The second car uses the pressure generated by the catalysed decomposition of hydrogen peroxide to operate a piston which powers the car.

DNA SURFACTANTS AS SURFACE MOBILE PROBES FOR MICROARRAYS

STUDENTS Xingyi Zhao *Chemical Engineering*
ADVISORS James Schneider *Chemical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:00

Modifications are made on both DNA probes and solid surfaces to create a more effective biosensor for microarray. DNA probes were synthesized with a 16 or 18 carbon chain and labeled with BODIPY on a large scale. The glass microscope slides were silanized with Octadecyltrichlorosilane (OTS) to form a self-assembled monolayer on the surface. The adsorption of DNA probes on the surface was quantified by measuring the intensity of fluorescence using a fluorescence plate reader. YOYO-1 was used as a tool to assess the effectiveness of hybridization between the DNA probes and their complementary. Fluorescence analysis indicated that the modified DNA had effectively adsorbed on the silanized surface. The results obtained from this research can be utilized in developing viable ways to improve upon DNA microarray in biological and medical research.

DNA "INKS" FOR RAPID BIOSENSING

STUDENTS Helen Bunker *Chemical Engineering*
ADVISORS James Schneider *Chemical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:15

The objective of this research was to improve DNA biosensors by altering the surface attachment chemistry to allow DNA probes to become mobile. Using non-permanent DNA binding would result in more cost efficient, time effective, and accurate microarray data. The DNA probes were composed of 24 DNA bases, a fluorophore, and a carbon chain backbone. As a solution containing the DNA probes is passed across the quartz slide, the probes will attach and then de-attach, creating the impression of the DNA probes acting as an "ink". The level of adsorption and subsequent de-adsorption of the DNA probes was quantified through Total Internal Reflection Fluorescence Microscope (TIRFM). To create an attraction of varying intensity between the DNA probes and a quartz slide, twelve carbon or sixteen carbon DNA probes were run over a silanized or non polarized surface. The results showed that the strength of the connection is dependent on the length of the carbon chain backbone on the probe and the polarity of the quartz slide. Using a longer carbon-chain backbone of C16 rather than C12 increased DNA adsorption by 14.7% . Using a silanized quartz slide rather than a non-silanized slide increased DNA adsorption by 89.5% . The results of this experiment showed that a strong, but not permanent binding between the DNA probe and the slide can be created and the binding can be varied through altering the backbone of the DNA probes and silanizing the surface of the quartz slide.

EFFECTS OF CARBON NANOTUBES ON THE CYTOSKELETON

STUDENTS Travis Horst *Chemical Engineering*
ADVISORS Kris Dahl *Biomedical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Changes in cytoskeletal components such as actin, myosin and alpha-actinin due to single wall carbon nanotubes were analyzed using fluorescent imaging. Primary chick cardiomyocytes and C2C12 cells were used to analyze changes in sarcomere development and characteristics in muscle cells. Actin and myosin interactions in the presence of nanotubes were analyzed in HeLa and NIH-3T3 cells.

EFFECTS OF PDMAEMA-SI ON CONTACT ANGLE AND OIL WETTING

STUDENTS Alexandra Dixon-Ernst *Chemical Engineering*
ADVISORS Robert Tilton *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

The addition of surfactant to water will cause the surfactant to aggregate at the air-water interface and the water-substrate as it dropped onto substrate, reducing the surface tension. The effects of silica nanoparticles with poly(2-dimethylamino)ethylmethacrylate (PDMAEMA) brushes were analyzed using a Ramy-Hart Goniometer. The goniometer measures the contact angle - the angle formed between the solid/liquid interface and the liquid/vapor interface. The particles were then analyzed for their effects on the wetting of an oil droplet to determine whether the silica surfactants could be used to pull the oil off a hydrophilic surface.

ENHANCING SELECTIVITY IN AFFINITY CHROMATOGRAPHY OF MONOCLONAL ANTIBODIES VIA PEGYLATION OF PROTEIN A LIGANDS

STUDENTS Alexander Yoshikawa *Chemical Engineering*
ADVISORS Todd Przybycien *Biomedical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Affinity chromatography is a key process step for the purification of many therapeutics such as monoclonal antibodies. By PEGylating protein A, the protein responsible for capture of monoclonal antibodies, we hope to improve both the selectivity of the process and the stability of protein A. Improving the stability and selectivity of affinity chromatography could help drive down the cost of production for many drugs.

NANOPARTICLE DRUG SEPARATION

STUDENTS Abigail Ondeck *Chemical Engineering*
ADVISORS Nisha Shukla *Physics*
ROOM/TIME Rangos 1 / 12-2:30

In 1957, the drug thalidomide was taken by pregnant women to treat morning sickness. The drug was racemic, and contained one enantiomer that treated morning sickness while the other enantiomer caused birth defects. The current method to separate racemic drugs, like thalidomide, is gas chromatography. The goal of this project is to find a cheaper and more efficient method to separate racemic drugs using nanoparticles. Nanoparticles have a high surface area to volume ratio, and when attached to the correct ligands and coated with different surfactants, have the ability to separate racemic compounds and possibly drugs.

PRICE-RESPONSIVE DEMAND STRATEGY FOR INDUSTRIAL PRODUCTION PLANNING

STUDENTS Yanis Chibani *Chemical Engineering*
ADVISORS Sumit Mitra *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

As the "smart grid" continues to become a reality, and as advanced metering systems become more widely available, it is now easier than ever for industrial consumers of electricity to realize significant savings on utility costs through participation in the wholesale electricity market. In this work, Principal Component Analysis is used to create price forecasts and scenarios. Stochastic Programming is then used create offering curves that consumers can use to plan operations while minimizing utility costs over varying price scenarios.

REDUCED FORM PERFORMANCE AND ECONOMIC MODEL OF CARBON DIOXIDE STORAGE

STUDENTS Christopher DiAndreth *Chemical Engineering*
ADVISORS Edward Rubin *Engineering and Public Policy*
ROOM/TIME Rangos 1 / 12-2:30

The Integrated Environmental Control Model (IECM) is a tool developed to calculate the performance, emissions, and costs of a fossil-fueled power plant that employs various alternative environmental control methods. One of the latest environmental controls currently being developed for the model is of carbon dioxide through CCS. Detailed carbon capture technologies and a pipeline transport module have already been implemented, but only a simple cost per ton storage module exists in the IECM. The purpose of this project is to implement a module into the IECM that will estimate the costs involved with a particular storage project based on specific geological parameters and costing factors. This was done by developing a reduced order model of the aquifer storage model developed by Sean McCoy, a postdoctoral researcher within the IECM group. The reduced order model minimizes the necessary inputs to only the overall project injection rate, reservoir properties of depth, permeability, thickness, and porosity, and specific regional costing factors.

ROBORCHESTRA: AUTOMATED HARMONICA AND MODULAR DRUM PROJECTS

STUDENTS Jonathan Boerner *Mechanical Engineering* | Andrew Burks *Mechanical Engineering* | Madeline Cramer *Materials Science Engineering* | Rebecca Wells C*hemical Engineering* | Yutong Zeng *Electrical & Computer Engineering*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, RobOrchestra has created a number of robots with specific musical functions and generated meaningful ways for them to play together cooperatively. In previous years, this organization was dedicated to establishing a basis upon which a few instruments could play, but this year we plan to expand the number of instruments at our disposal and to bring out the "Orchestra" in RobOrchestra. In addition to building more instruments, expanding our reach to both the string and brass sections, we will also investigate creating alternative methods for humans to interact with the robots' performance. In this manner we will expose the connection between science and art by showing the mathematical complexity of music and the artistic possibilities of robotics.

SYNTHESIS AND CHARACTERIZATION OF SHAPE MEMORY IN BIODEGRADABLE POLYMERS

STUDENTS Sharanya Venkat *Chemical Engineering*

ADVISORS Christopher Bettinger *Materials Science Engineering*

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

Biodegradable polymers have significant potential in biotechnology and bioengineering. However, for some applications, they are limited by their inferior mechanical properties and unsatisfactory compatibility with cells and tissues. A strong, biodegradable, and biocompatible elastomer could be useful in fields such as tissue engineering, drug delivery, and in vivo sensing. We plan to design, synthesize, and characterize a tough biodegradable polymer from biocompatible monomers. We seek for the biopolymer to show both in vivo and in vitro biocompatibility, which will be tested using culturing techniques in the laboratory. To gain further insight into the material's chemical structure and mechanical properties, we also plan to model the polymer structure and study its properties using computer software and spectroscopy. Utilizing Monte Carlo methods, we will create virtual models of the elastomer that are consistent with experimental data such as the material's cross-linking density, elasticity, and tensile strength. We seek to develop a realistic multi-scale model of the material as well as a probabilistic explanation of the material degradation. Thus, we will obtain significant practical and theoretical information about these materials through both lab experimentation and computer simulation. Researching these materials is important because they have a wide range of biomedical applications, including regenerative medicine, neural interfaces, and drug delivery. In particular, these biopolymers can be used to release a drug in a controlled environment, thus improving the efficiency of drug action.

SYNTHESIS AND SURFACE TENSION REDUCING PERFORMANCE OF A BACITRACIN-DERIVED MOLECULE

STUDENTS Masanari Kato *Chemical Engineering*

ADVISORS Robert Tilton *Chemical Engineering* | Newell Washburn *Chemistry*

ROOM/TIME Rangos 1 / 12-2:30

Recent efforts in the development and production of "green" surfactants have been on the rise. This research focuses on the synthesis procedure and surface tension lowering performance of a potentially "green" and efficient bacitracin-derived surfactant. Its "green" quality is predicted by its biodegradable design, which comprises of bacitracin, a commonly used antibacterial peptide, coupled to C12 hydrophobic tails. In order to obtain these molecules, hydrazide linkages were formed by reacting dodecyl hydrazines and aspartic acid residues present in the peptide. The resulting products were then tested for surface tension reducing properties utilizing the Du Nuoy Ring to provide comparative results to unmodified bacitracin samples. Positive results from these measurements in surface activity can indicate possible antiseptic applications of the surfactant.

THE DC FORCE EXERTED ON A CHARGED PARTICLE BY AN AC ELECTRIC FIELD

STUDENTS Edmund Tang *Chemical Engineering*

ADVISORS Dennis Prieve *Chemical Engineering*

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

In 0.15 mM solutions of KOH or NaHCO3 in water, a negatively charged 6-micron polystyrene sphere is levitated about 200 nm above a negatively charged planar indium tin oxide electrode by double-layer repulsion. The potential energy profile of forces acting on the sphere is determined by monitoring the distribution of elevations

sampled by Brownian motion of the sphere and measured using total internal-reflection microscopy, which can detect changes in elevation as small as 1 nm. The application of a 10 kV/m electric field oscillating at 10 kHz produced oscillations in elevation which were swamped by Brownian motion. Nonetheless an unexpected steady attractive force was detected which was comparable in magnitude to the net weight of the sphere (0.05 pN). This additional force was proportional to the square of the electric field strength and is about a factor of 2 stronger in KOH compared to NaHCO3.

THE EFFECT OF POROUS MEDIA ON ZETA POTENTIAL MEASUREMENTS

STUDENTS Kong Wong *Chemical Engineering*
ADVISORS Paul Sides *Chemical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Zeta potential measurements are known for samples with hard, impermeable surfaces, but a large concern in the semiconductor industry is the zeta potential of porous pads and brushes. Flow in porous media has been studied extensively and characterized following Darcy's Law and the Brinkman equation. A recent modification to the Joseph Theory attempts to approximate the fluid flow in the porous media and its amplification of the streaming potential of the media. Using COMSOL multiphysics software, the experimental amplification of the zeta potential is studied and compared to the modified Joseph's theory.

VISION-BASED OBJECT FOLLOWING WITH AN AUTONOMOUS QUADROTOR

STUDENTS Julian Binder *Undecided* | Christian Burchhardt *Electrical & Computer Engineering* | James Church *Chemical Engineering* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Graham Harvey *Electrical & Computer Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Peter McHale *Physics* | Nicolas Mellis *Electrical & Computer Engineering* | Doci Mou *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Matthew Sebek *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Thomas Wucherpfennig *Mechanical Engineering* | Alexander Zirbel *Computer Science*
ADVISORS Sanjiv Singh *Robotics Institute*
ROOM/TIME Class of '87 / 3:40

Robots are becoming a common sight in every aspect of modern life. In aerial robotics, helicopters and other flying platforms are perfect for surveillance in harsh environments where ground-based navigation is extremely difficult or impossible - such as in dangerous military zones or disaster-stricken regions. Aerial robots are also useful for supporting ground vehicles: they can use their increased visual range to scout ahead, extend the range of communication with outside entities, or provide supplies and tactical assistance in emergency situations. However, the challenge of visually tracking and keeping up with an object on the ground is difficult enough that current implementations usually involve a human controller for the vehicle. This symposium presents our efforts to make the tracking of a grounded object both autonomous and robust, so that the robot can provide support for a ground vehicle without human assistance.

ZNO FUNCTIONAL LAYERS FOR CHEMIRESISTIVE SENSORS

STUDENTS Shihyun Ahn *Chemical Engineering*
ADVISORS James Miller *Chemical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Zinc oxide has numerous properties that accounts for its use in sensors, catalysts, and optoelectronic devices. Previous research has shown that functionality of zinc oxide can be varied through its composition and its structure. Different heat treatment temperatures addition of a second oxide component are examples of strategies that can alter important properties of zinc oxide. A second component can be used to optimize zinc oxide's electronic properties for specific applications. This project focuses on the use of an Al dopant to tailor ZnO properties for chemical sensing applications.

CIVIL AND ENVIRONMENTAL ENGINEERING

CREATING A PUBLIC DATASET FOR NON-INTRUSIVE LOAD MONITORING ALGORITHMS

STUDENTS Da Eun Sung *Civil and Environmental Engineering*
ADVISORS Mario Berges *Civil and Environmental Engineering*
ROOM/TIME Rangos 1 / 12-2:30

This research focuses on creating a public dataset for non-intrusive load monitoring (NILM) algorithms. NILM research aims to find an efficient method of obtaining disaggregated data from a single sensing point. With the current electricity pricing model, which depends on aggregate data collection, an electricity consumer cannot know the amount of electricity each appliance in their house consumes and a cost efficient way of reducing electricity cost. Since the disaggregated data can provide the consumers with detailed information about electricity usage, NILM has a potential to transform the way people consume electricity. For NILM algorithms to be developed a dataset that can be used for the classification of appliances must be created. Since each appliance consumes a different amount of real and reactive power, an appliance can be classified according to its power consumption. This research describes the process, including hardware and software setups, for collecting power consumption data for various household appliances and discusses some of the challenges in collecting such data.

DESIGN AND MANUFACTURE OF HIGH EFFICIENCY HULLS FOR SOLAR POWERED VEHICLES

STUDENTS Jonathan Boerner *Mechanical Engineering* | Zachary Furman *Mechanical Engineering* | Ibuki Kamei *Mechanical Engineering* | Paul Kimball, Jr. *Mechanical Engineering* | Nathaniel Krasnoff *Civil and Environmental Engineering* | Jessica Lee *Mechanical Engineering* | Robert Wedler *Electrical & Computer Engineering*
ADVISORS Susan Finger *Civil and Environmental Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Solar-powered aquatic vehicles represent an opportunity to replace nonrenewable energy with renewable energy in a key market. In order to be successful, however, these vehicles need to have well-designed hulls that are appropriate for the specific conditions of a solar-powered boat. The research group plans to design such a hull by taking the most desirable features available in commercial hulls and combining them into a set of possible hulls for a solar-powered boat. A smaller set of the most efficient hulls will be determined through a computational fluid dynamics analysis of the larger set. Lastly, the group plans to verify the results of the CFD analysis by creating scale models, and testing the models in an analysis tank.

MONITORING AND MANAGEMENT OF WATER USE AND WASTE MONITORING AT ASHESI UNIVERSITY COLLEGE, GHANA

STUDENTS Corinne Clinch *Civil and Environmental Engineering* | Julie Mallis *BHA*
ADVISORS Yonina Cooper *Computer Science* | Mary Bernardine Dias *Robotics Institute* | Malcolm Dias *Robotics Institute* | Ermine Teves *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:45

The iSTEP (innovative Student Technology ExPerience) internship program offered by TechBridgeWorld at Carnegie Mellon University brought together an interdisciplinary team of students to perform technology field

research in collaboration with developing communities. This year's team is working with Ashesi University College (Ashesi) in Ghana on two environmental sustainability projects: 1) water monitoring and management, and 2) waste monitoring. In order to more efficiently utilize its water sources and handle waste in an environmentally sustainable manner, Ashesi desires the technological tools to track consumption, collection and dispersal of resources throughout the campus. During the spring semester, the team worked on the project's technical and country-specific literature review, as well as management and dissemination strategies. To prepare for possible project solutions, the team also researched content management systems and relevant sensor options. This summer, the team will continue its research by traveling to Ashesi and performing an in-depth needs assessment to become knowledgeable about the campus' current conditions, systems, behaviors and attitudes toward the issues of water and waste among campus community members. This will be followed by solution brainstorming, prototype development, testing, and evaluation. The team approaches field work from a participatory research framework with Ashesi being an integral partner that can best articulate its priorities. The team's poster presents the project background, completed research, and continuing plans. The iSTEP team draws from the disciplines of anthropology, economics, public policy, civil engineering, computer science, and design to uniquely approach Ashesi's distinct challenges.

NANOMATERIAL MEASUREMENT CONSISTENCY

STUDENTS Sophie Grodsinsky *Civil and Environmental Engineering*
ADVISORS Elizabeth Casman *Engineering and Public Policy*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:15

This research project aims to better unify nanomaterial risk research by identifying the important factors and properties affecting observed nanomaterial toxicity in published experiments involving different nanoparticle types and different living organisms through compilation of all existing experimental findings into a database to allow for enhanced analysis. Specifically, the database will help by enabling meta-analysis of the results to more easily identify the best factors and properties indicative of toxicity risk of the many that are being researched currently by allowing for more efficient comparison between existing data. This work of collecting and manipulating data to become comparable and then coding it into the database for further analysis and comparison could significantly advance the current field of nanomaterial risk research. By making research more efficient in sharing the knowledge that has already been found along with highlighting the most important and least important properties to be included in risk models could progress the field beyond where it is now.

ELECTRICAL & COMPUTER ENGINEERING

ACCELERATING FINANCIAL CALCULATIONS USING AN FPGA

STUDENTS Abeer Agrawal *Electrical & Computer Engineering*
ADVISORS James C. Hoe *Electrical & Computer Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Financial market derivatives are priced using Monte Carlo simulations. These simulations are performed using Euler's method, which involves several "stages" and "paths" and is thus highly parallelizable. Consequently, there is scope for significant performance improvement is these calculations are performed using specialized hardware. An FPGA is connected to a host computer using PCI-Express. The host computer can then offload certain calculations to the FPGA. The FPGA uses a specially designed deeply pipelined core to perform these calculations, and returns them to the computer, where they can be further manipulated. This leads to significantly improved performance because of the highly parallel nature of the computations, and fast random number generation on the FPGA.

AERIAL NAVIGATION AND MAPPING USING A LIGHTWEIGHT SENSOR ARRAY

STUDENTS Daniel Jacobs *Electrical & Computer Engineering*
ADVISORS Benjamin Grocholsky *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

A current trend in robotics is reducing the size of robots. A small robot can enter and move about in places a large robot simply cannot fit. However, as platforms get smaller, their ability to carry payload is reduced. To remain useful, it must be possible to extract information from the smaller and less reliable sensors available on small robots. The Parrot AR Drone quadrotor provides an attractive platform from which to investigate this problem. The drone comes with a basic autopilot capable of simple translational and rotational movement, and an array of onboard sensors. I aim to tackle the problem of using the limited sensors available on the drone to autonomously navigate and map environments.

AUTOMATED MOTION CAPTURE FOR HUMAN-ROBOT INTERACTION

STUDENTS Christian Burchhardt *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*
ADVISORS Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

One of the major obstacles preventing robots from working in human environments is the difficulty of communicating with and understanding people. To communicate effectively and efficiently with humans, a computer needs to have the ability to understand body language; however, most robot sensors are not designed to view and process visual data describing human position and gestures. This symposium presents our work toward building a physical workspace with mounted cameras facing a static scene from all angles, allowing a computer to collect and analyze data about human action within the workspace. Secondly, we present our analysis of the camera output to provide a single source of information regarding the position, gestures, and expressions of any human in the workspace.

AUTOMATED WAREHOUSE STORAGE AND RETRIEVAL SYSTEM USING A LOW COST ROBOT COLONY

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Jonathan Goldman *Computer Science* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*

ADVISORS George Kantor *Robotics Institute*

ROOM/TIME Dowd / 1:40

As robotic capabilities improve and costs decrease, the use of robots in commercial applications is greatly increasing. One emerging application of robotics is warehouse distribution: robots can autonomously store and retrieve physical inventory. The warehouse system can be made safer and more efficient by eliminating human operators. The Colony Scout research team aims to advance the state of the art in this area using distributed robotics: a swarm of robots will divide warehouse tasks among itself and cooperate to move inventory in the least amount of time practical. We intend to overcome the swarm robotics challenges presented by this task, namely navigating the warehouse, responding to a series of tasks, and cooperating efficiently to complete all assigned work.

BIPEDAL WHEELED PLATFORM FOR HYBRID LOCOMOTION

STUDENTS Neil Abcouwer *Electrical & Computer Engineering* | Job Bedford *Undecided* | Cory Chang *Computer Science* | Chad Cole *Electrical & Computer Engineering* | Jitu Das *Computer Science* | Siddharth Dedhia *Electrical & Computer Engineering* | Priyanka Deo *Computer Science* | Connor Dixon *Mechanical Engineering* | Alexander Franchuk *Electrical & Computer Engineering* | Zachary Greenberg *Mathematics* | David Mehrle *Physics* | Corey Sobel *Computer Science* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*

ADVISORS Chris Atkeson *Robotics Institute* | Elliot Rosen *Electrical & Computer Engineering*

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

Most robots are designed to specialize in one task, but at the cost of versatility. In mobile robotics, maneuvering diverse terrain is often difficult for robots with only one form of motion. For example, urban search and rescue robots designed for flat surfaces will fail on rubble, and robots designed for rubble will move slowly on flat surfaces. Our team proposes to solve this problem by creating a robot that can change its method of motion depending on the type of terrain it encounters. We will build a robot that combines wheeled and bipedal motion, allowing it to handle multiple types of terrain. The robot will be able to adapt its motion to the current terrain. Wheels provide benefits such as fast, power-efficient movement on flat terrain, whereas bipedal locomotion allows a robot to handle complicated environments like stairs or rocky terrain. This "hybrid locomotion" has enormous potential to benefit the field of robotics since a successful hybrid gets both the benefits of speed and maneuverability.

CMUCAM4: OPEN SOURCE PROGRAMMABLE EMBEDDED COLOR VISION SENSOR

STUDENTS Kwabena Agyeman *Electrical & Computer Engineering*
ADVISORS Anthony Rowe *Electrical & Computer Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The goal of the CMUcam4 project is to provide simple vision capabilities to small embedded systems in the form of an intelligent sensor. The CMUcam4 open source programmable embedded color vision sensor is a low-cost, low-power sensor for mobile robots. You can use the CMUcam4 vision system to do many different kinds of on-board, real-time vision processing tasks. Go to www.cmucam.org for more information.

COLONY SCOUT: A LOW-COST, VERSATILE PLATFORM FOR AUTONOMOUS SYSTEMS IN COLLABORATIVE ROBOTICS

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*
ADVISORS George Kantor *Robotics Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Cooperative robotics is the concept that a group of robots working as a team can solve problems faster and more efficiently than a single robot. In the past, the Colony Project has explored numerous applications of group robotics, from mapping to formation control to cooperative manipulation. As is the case with a group whose stated goal is to be low-cost, past projects have always been hindered by imprecise sensors, faulty hardware components, and limited mobility. We propose to design and develop a new generation of Colony robots, the Colony Scout, to overcome these obstacles and increase performance, consistency, and robustness. Scout will dramatically improve upon the current generation of robots, Colony 3.0, with an innovative design that includes a more powerful drive system, more capable processing, and more reliable sensors. The main innovations of the Colony Scout will be capability to handle rough terrain and the ability to add new components (for example, a forklift) on an enhancement bay at the back of the robot. With more reliable and capable hardware, the Colony Project hopes to embark on more ambitious projects than in the past and to contribute in a more significant way to swarm robotics research.

CREATING VIRTUAL MARKETPLACES FOR THE COMMODITIZATION OF RENTAL SPACES

STUDENTS Jonathan Francis *Electrical & Computer Engineering* | Zhijun Huang *Economics* | Kenneth Wong *Mathematics*
ADVISORS Carol Goldburg *Economics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:30

Our research team has identified specific difficulties and frustrations that prospective renters and property owners have encountered, whilst transacting over residential entities (i.e., houses, lofts, apartments, garages, parking spaces, etc). We have developed mitigation strategies that may be used to overcome those market challenges and issues that are hereafter mentioned, while still assessing how such variables as "distance from campus", "type of housing", "price", "area", etc. affect user tastes and preferences.

DATAHIGH: GRAPHICAL USER INTERFACE FOR VISUALIZING AND INTERACTING WITH HIGH-DIMENSIONAL NEURAL ACTIVITY

STUDENTS Benjamin Cowley *Electrical & Computer Engineering*
ADVISORS Byron Yu *Electrical & Computer Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:30

Our recent work has shown that the correlated activity of tens to hundreds of neurons can be succinctly summarized by a smaller number of latent variables, which are extracted using dimensionality reduction methods such as Gaussian-process factor analysis (Yu et al., 2009, Churchland et al., 2010). These latent variables define a reduced-dimensional space in which we can study how population activity varies over time, across trials, and across experimental conditions. Ideally, we would like to visualize the population activity directly in the reduced-dimensional space, whose optimal dimensionality (as determined from the data) is typically > 3. However, direct plotting can only provide a 2D or 3D view. To address this limitation, we developed a Matlab graphical user interface (GUI) that allows the user to quickly navigate through a continuum of different 2D projections of the reduced-dimensional space. We will present an interactive demo where the user can continuously rotate a 2D projection plane within the reduced-dimensional space, while being guided by thumbnail previews for each rotation direction. To demonstrate the utility and versatility of this GUI, we applied it to visualize population activity recorded in premotor and motor cortices during reaching tasks. Examples include single-trial population activity recorded using a multi-electrode array, as well as trial-averaged population activity recorded sequentially using single electrodes. Because any single 2D projection may provide a misleading impression of the data, being able to see a large number of 2D projections is critical for intuition- and hypothesis-building during exploratory data analysis. The use of visualization tools like the GUI developed here, in tandem with dimensionality reduction methods, has the potential to further our understanding of neural population activity.

DESIGN AND MANUFACTURE OF HIGH EFFICIENCY HULLS FOR SOLAR POWERED VEHICLES

STUDENTS Jonathan Boerner *Mechanical Engineering* | Zachary Furman *Mechanical Engineering* | Ibuki Kamei *Mechanical Engineering* | Paul Kimball Jr. *Mechanical Engineering* | Nathaniel Krasnoff *Civil and Environmental Engineering* | Jessica Lee *Mechanical Engineering* | Robert Wedler *Electrical & Computer Engineering*
ADVISORS Susan Finger *Civil and Environmental Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Solar-powered aquatic vehicles represent an opportunity to replace nonrenewable energy with renewable energy in a key market. In order to be successful, however, these vehicles need to have well-designed hulls that are appropriate for the specific conditions of a solar-powered boat. The research group plans to design such a hull by taking the most desirable features available in commercial hulls and combining them into a set of possible hulls for a solar-powered boat. A smaller set of the most efficient hulls will be determined through a computational fluid dynamics analysis of the larger set. Lastly, the group plans to verify the results of the CFD analysis by creating scale models, and testing the models in an analysis tank.

DESIGN OF A LEAD ACID BATTERY CHARGE ESTIMATION AND MONITORING SYSTEM

STUDENTS Peter McHale *Physics* | Christopher Palmer *Electrical & Computer Engineering* | Esha Uboweja *Computer Science* | Robert Wedler *Electrical & Computer Engineering*
ADVISORS Susan Finger *Civil and Environmental Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

State of charge information from lead acid batteries is important in any system which relies on batteries as a primary power source. It is difficult to predict the current capacity of a lead acid battery because capacity changes due to wear over time and is also a function of ambient temperate. A computer data model has the ability to improve estimation of the capacity of a set of batteries by recording previous battery history and predicting how the maximum capacity has changed over time.

DESIGN OF A NEURALLY-CONTROLLED AUDIO SYSTEM

STUDENTS Benjamin Shih *Electrical & Computer Engineering*
ADVISORS Thomas Sullivan *Electrical & Computer Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

Modern day technology is slowing growing towards a more compact and transportable era. Devices such as bluetooth and GPS have led to the introduction of technology that can be used without much physical interaction. The purpose of my project is to design a hands-free music player, with the capabilities of an audio synthesizer, in order to better understand the allure behind wireless technology. Transmitter technology has introduced a new facet of computing to the wireless domain. Humans are traditionally accustomed to using handheld devices for the performance of everyday activities, ranging from the computer to the car. The tablet has enabled the removal of familiar keyboards from our computers and replaced them with giant touch screens. While the wireless technology is both useful and practical for certain tasks, it is not always convenient for all purposes. Consider the evolution of the telephone. Initially, it was a corded, tethered device that forced its user to remain at a static position. However, the mobile cellular phone was soon introduced, and leaving behind the cord has revolutionized the world of phones. The cell phone started off as a large, clunky device, with people generally still preferring wired telephones, but has become pocket-sized and ubiquitous because of its convenience. With the advent of bluetooth devices, phones have become hands-free and more convenient than ever before. An additional goal is to better quantify electronic music. Current sounds are often made by taking a known sound, and modifying and distorting the signal until it produces a desirable sounds. I would like to further examine this process to determine if the arbitrary tweaking done by music producers have mathematical foundations. After combining the two components of my project, the goal of the neurally-controlled audio system is to demonstrate and inspire the next generation of wireless technology by showing the convenience of making a hands-free audio player. The device I aim to produce represents a merge between technology and art, in the way that Apple's iPod both simplified and revolutionized the way that people interact with their music players.

DEVELOPING A FLEXIBLE, LOW-COST ROBOTICS PLATFORM FOR THE EDUCATION COMMUNITY

STUDENTS Nicolas Paris *Electrical & Computer Engineering* | Harrison Rose *Biomedical Engineering* | Robert Wedler *Electrical & Computer Engineering*
ADVISORS George Kantor *Robotics Institute*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The vast majority of robotics kits on the market are either severely limited in functional capacity, or hide functionality within black boxes. We seek to create a cost-effective robotics platform that exposes users to the fundamentals of robotics and electronics. Additionally, we seek to make the platform flexible so that users can easily apply their new-found knowledge to microcontrollers in general. This will beaccomplished by tightly integrating a multi-use and open-source development environment into the robotics platform.

DRONE-RK: A MULTI-AGENT UAV PLATFORM

STUDENTS Steven Devincentis *Electrical & Computer Engineering*
ADVISORS Anthony Rowe *Electrical & Computer Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Historically, Unmanned Aerial Vehicles (UAVs) have been used for surveillance and reconnaissance and were simply remote piloted aircraft. Today, increasing autonomous behavior in UAVs has expanded the possibilities to a variety of civilian and military applications including intelligent and larger scale surveillance, infrastructure inspection, ad-hoc communication relays, environmental sampling, transport and search and rescue. These aircraft can be rapidly deployed to provide information about areas that might be too dangerous or difficult for humans to reach.

The Drone-RK project focuses on creating a low-cost platform and a high-level interface to simplify dispatching and coordinating autonomous routines. Our platform is based on the Parrot AR-Drone quadrocopter with the inclusion of a custom hardware expansion platform as well as a custom firmware image and application-programming interface (API). The hardware expansion board provides additional sensors (GPS, compass, and barometric pressure) required for autonomous flight and long-range radio communication. Our software infrastructure includes a real-time scheduling framework that ensures flight control and sensor-processing task deadlines are met even while executing potentially malicious user code. To facilitate the control of multiple drones simultaneously, we constructed a high-level scripting language that executes intermediate sub-tasks locally on each drone that together can accomplish larger and more complex missions. For example, in one of our demos we demonstrate a mission involving two UAVs that autonomously fly to predefined GPS waypoints and communicate in order to establish a coordinated rotation pattern.

EFFORTLESS EMBEDDED ENGINEERING

STUDENTS Nathaniel Barshay *Computer Science* | Tomer Borenstein *Electrical & Computer Engineering* | Brandon Kase *Computer Science* | Dylan Koenig *Electrical & Computer Engineering* | Evan Shapiro *Computer Science* | Nisha Singh *Psychology* | Leonard Sokol *Information Systems*
ADVISORS David Kosbie *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:30

The availability of tools for the software programmer has made it easy for amateurs to build world changing companies in a day. Until now, this productivity has remained trapped inside the computer. We are providing an easy interface between hardware and software, so the next generation of innovators will be be free to hack the physical world.

ENDURASENSE: AN ENERGY HARVESTING WIRELESS SENSOR NETWORK

STUDENTS George Davis *Electrical & Computer Engineering*
ADVISORS Eric Paulos *Human Computer Interaction Inst.*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Electronic sensors offer a way for us to learn about the state of our environment both instantaneously and over time. Deploying these sensors in the form of a wireless sensor network enables sensing of a large area without the need for wired data connections. However, these sensors still require power, usually in the form of batteries, which must be replaced periodically. I propose a platform of wireless sensors utilizing energy harvesting techniques to eliminate the need for a replaceable battery and enable a wireless sensor network constructed from such nodes to operate indefinitely.

FOOT ULCER DETECTION

STUDENTS Samantha Tan *Electrical & Computer Engineering*
ADVISORS James Antaki *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

Foot ulcers are generally a breakdown of the skin on the plantar aspect (bottom) of the foot. Severe foot ulcers can lead to serious infections and loss of the limb. They have many causes, but the most common are diabetes, and vascular insufficiency. The reason for this project is for the diagnostic of the ulcers and will determine the condition of the ulcer. The current prototype of this design will be finished within the semester. The goal of this proposal is to continue this project, allowing a more polished and better design to be put in place for patients at risk of this condition.

FORMULA SAE CAR PROJECTS FOR SPRING 2012

STUDENTS Pronoy Biswas *Electrical & Computer Engineering* | Adam Brecher *Mechanical Engineering* | Anne Dirkes *Mechanical Engineering* | Uriel Eisen *Design* | Margaret Hall *Materials Science Engineering* | Eva Humphrey *Mechanical Engineering* | Brian Langone *Mechanical Engineering* | Derek Miller *Electrical & Computer Engineering* | Jack Moldave *Mechanical Engineering* | Michael Ornstein *Mechanical Engineering* | Mark Sun *Mechanical Engineering* | Gabrielle Williams *Design* | Tom Zhang *Computer Science*
ADVISORS Reinhard Schumacher *Physics* | Satbir Singh *Mechanical Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Formula SAE creates a high performance race car from the ground up every year. We compete against hundreds of other universities around in engineering design, cost analysis, business potential, and vehicle performance. This year is focused on the development of new manufacture techniques for the car's carbon fiber body, implementation of new mass optimization strategies, and instrumentation of vehicle loads and dynamics for future development.

HIGH VOLTAGE ON-CHIP POWER DISTRIBUTION USING VOLTAGE STACKING IN 45NM CMOS

STUDENTS Allan Wang *Electrical & Computer Engineering*

ADVISORS L. Carley *Electrical & Computer Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:30

While CMOS scaling has provided great benefits for processing speed, its corresponding increase in device current, faster switching speeds, and smaller supply voltages have increased the requirements of the on-chip power distribution network. Significant amounts of on-chip resources like metal interconnect and decoupling capacitors are used to maintain power supply voltage within a certain tolerance from resistive I*R and inductive di/dt effects. In modern VLSI systems, decoupling capacitors typically occupy 10 – 20% of the total chip area, increasing cost. To reduce this requirement while keeping performance the same, we propose an on-chip power distribution topology in which N digital voltage domains are stacked in series. For digital blocks with identical workloads, this reduces total current consumption and decoupling capacitor size by a factor of N. To handle imbalanced workloads with different current draws, fast shunt regulators are placed at each voltage domain to prevent local power supply overshoot. To communicate between voltage domains, a 5GHz, 100um^2 asynchronous AC-coupled interface was designed, consuming only 50uW at 0.8V. Simulation results show a decrease in power supply noise amplitude with this new topology compared to a regular system. To confirm these results, a full custom 45nm SOI CMOS test chip with a stack of four has been taped out in March 2012.

INVESTIGATING THE EFFECTS OF NBTI AND PBTI ON EMERGING TRANSISTOR TECHNOLOGIES

STUDENTS Niharika Singh *Electrical & Computer Engineering*

ADVISORS Diana Marculescu *Electrical & Computer Engineering*

ROOM/TIME Pake / 4:00

NBTI and PBTI (Negative and Positive Temperature Instability respectively) are transistor aging phenomenon that cause degraded circuit performance over the circuit's lifetime. NBTI and PBTI both depend on the probability of PMOS and NMOS transistors being under stress respectively to increase the threshold voltages and thus reduce switching speeds and circuit reliability. Newer and smaller transistor technologies have left less room for error so the need to reduce the effects of NBTI and PBTI has increased. This project first focused on simulating the effects of NBTI on a variety of transistor sizes. Then, certain parameters were identified that could be used to simulate the effects of PBTI. These simulations were used to calculate coefficients to model the effects of PBTI. Finally, the information from the simulations was used in a framework that aims to reduce the effects of these phenomenon by changing the positions of and connections between the transistors when they are arranged in circuits. Circuits utilizing many transistor sizes were made more reliable through the use of the restructuring technique.

LOCALIZING MOBILE CAMERA SENSOR NETWORKS IN PRESENCE OF UNRELIABLE COMMUNICATION

STUDENTS Karanhaar Singh *Electrical & Computer Engineering*

ADVISORS Soummya Kar *Electrical & Computer Engineering*

ROOM/TIME Rangos 1 / 12-2:30

Visual sensor networks, including networks of security cameras and mobile cellular phones, are currently major areas of research. While there is a large body of work on visual sensor networks in general, further

study is required to better understand distributed and decentralized sensor networks—networks wherein each sensor node can only communicate with a subset of nodes from the entire network. These distributed networks have many potential practical applications. For example, a network of Predator Drones could potentially use a distributed and decentralized communication algorithm, along with image processing, to process data from a settlement on the ground and reliably predict if the settlement is a civilian town or a military stronghold. For sensor networks, an important issue is the ability to estimate the node poses relative to each other. As an example, with regards to a camera sensor network, accurate estimation of node poses would greatly facilitate a 3D model reconstruction. To this end, Tron and Vidal proposed a way to estimate the poses of a network of distributed cameras using image measurements in their paper "Distributed Image-Based 3-D Localization of Camera Sensor Networks". In the current research we aim to generalize the algorithms proposed in the aforementioned paper so they can be applicable to situations wherein communication between individual nodes are not reliable. Furthermore, we hope to generalize these algorithms such that the cameras are now mobile. These proposed modifications can address major problems with real world networks. Many of these networks, especially wireless ones (such as mobile cellular phone networks), are known to be notoriously unreliable. In this work, we begin by reviewing a set of algorithms proposed by Tron and Vidal. We then design our algorithms to generalize their work to the case of unreliable communication and for mobile networks. Finally, we show results by running the algorithm over a variety of simulated networks in MATLAB.

LUNAR LANDER EMULATION BY WEATHER BALLOON

STUDENTS Nicholas Letwin *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering*
ADVISORS William Whittaker *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

When landing on the moon, many things can go wrong, and everything must go right to land softly. Landing mishaps were the leading cause of failure of early lunar landing missions. Carnegie Mellon will land its robotic rover on the moon in late 2013. Carnegie Mellon must land successfully on the first try. To gather vital data to test landing algorithms, a balloon will be sent up to 100,000 feet at which point it will drop a camera with a parachute. The camera will take GPS tagged photos all the way to the ground. These photos will be fed into machine vision algorithms to calculate the motion of the package. The calculated motion will be compared with the GPS motion to gauge the correctness of the algorithms.

POWERING LUNAR EXPLORATION

STUDENTS Derek Kozel *Electrical & Computer Engineering* | Nicholas Letwin *Electrical & Computer Engineering*
ADVISORS William Whittaker *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Carnegie Mellon is sending a robot to the moon in 2013. Its intended purpose is to win the Google Lunar X-Prize. To win the prize, the rover must, among other things, travel 500 meters. The robot has four battery packs to power itself. The rover cannot complete the journey on battery alone and thus has four solar panels on its back to recharge itself. Special circuitry is required to facilitate this recharging. Unlike many other power sources which output a constant power, regardless of load, Solar Panels have a specific load at which they operate most efficiently. This load is called the maximum power point. The rover's power system must include a circuit called a maximum power point tracker (MPPT). A separate MPPT is required for each panel. Together, these four circuits regulate the power flowing into the battery, keeping it within safe parameters. Building this circuit

to work in space presents additional challenges. Most importantly, it cannot fail. If the rover can no longer recharge, its mission life is limited to the charge contained within its batteries. To prevent failure, critical components are made redundant. Special chips must be used to survive the radiation that bombards the moon. Because there is no atmosphere to carry heat away, components can only be used at a fraction of the power that they can be run at on earth. Rover batteries must be safeguarded against electrical abuse. If they are overcharged, the batteries become damaged, and may lose capacity, or in the worst case, cease to function. The same thing is true if they are over discharged. Within the batteries, a single cell can fail which could cause the other batteries to dump all of their power into the failing battery, damaging it even more. Circuitry must be designed to prevent battery damage and ensure that the rover meets its goals. Both systems require oversight. A robust, fault-tolerant controller must be developed to keep track of all of the rover's electrical systems. The controller will be actively involved in maximum power point tracking and battery protection. It will also be responsible for relaying data on battery voltages, charge rates, and power usage back to mission control. Because of the relatively small market for space electronics, and the uniqueness of spacecraft, a commercial solution to manage the power usage of a lunar rover does not exist. The technology developed for this project represents the state of the art of space power technology. The most advanced planetary rovers currently in operation (the Mars Exploration Rovers) lack power point tracking technology, which would have substantially increased their efficiency. The goal of this project is to build a maximum power point tracking system and a battery protection system that have been hardened for space. The success of this project is critical to the success of Carnegie Mellon's moon mission

RESEARCH IN QUESTION ANSWERING

STUDENTS John Montgomery *Information Systems* | Kevin Schaefer *Information Systems* | Shane Smith *Electrical & Computer Engineering*
ADVISORS Eric Nyberg *Language Technologies Inst.*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:15

Throughout the semester our team worked with Dr. Eric Nyberg and the OAQA 2.0 team in the Language Technologies Institute. The main goal of the OAQA 2.0 initiative is to create a question answering system in the biomedical domain. Our team explored the early stages of data mining and the Apache UIMA annotation process. Additionally, we contributed several modules to the OAQA annotation pipeline.

ROBORCHESTRA: AUTOMATED HARMONICA AND MODULAR DRUM PROJECTS

STUDENTS Jonathan Boerner *Mechanical Engineering* | Andrew Burks *Mechanical Engineering* | Madeline Cramer *Materials Science Engineering* | Rebecca Wells *Chemical Engineering* | Yutong Zeng *Electrical & Computer Engineering*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, RobOrchestra has created a number of robots with specific musical functions and generated meaningful ways for them to play together cooperatively. In previous years, this organization was dedicated to establishing a basis upon which a few instruments could play, but this year we plan to expand the number of instruments at our disposal and to bring out the "Orchestra" in RobOrchestra. In addition to building more instruments, expanding our reach to both the string and brass sections, we will also investigate creating alternative methods for humans to interact with the robots' performance. In this manner we will expose the

connection between science and art by showing the mathematical complexity of music and the artistic possibilities of robotics.

THE FUTURE OF MAGNETIC MEDIA, SELF-ASSEMBLY OF BLOCK COPOLYMERS

STUDENTS Neereja Sundaresan *Electrical & Computer Engineering*

ADVISORS Jian-Gang Zhu *Electrical & Computer Engineering*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:00

In this project we use self-assembling block copolymers to develop templates which could be used to fabricate magnetic devices. Block copolymer thin films self assemble into a variety of nanostructures depending on the molecular weight, composition and processing conditions. One such block copolymer Poly(styrene-b-dimethyl siloxane) micro-phase separates to form a hexagonal lattice of PDMS spheres in a PS matrix. We studied the ordering of these spheres and formulated a process to optimize the micro-phase separation. By processing the thin film copolymer on a stack of mask underlayers, we are able to transfer the polymer nanostructure pattern and use it as a template to guide the growth of magnetic thin films. Currently, we are attempting to use these templates to guide the growth of smaller block copolymers, which, if accomplished, could push the limits of fabrication using current lithography techniques.

VISION-BASED OBJECT FOLLOWING WITH AN AUTONOMOUS QUADROTOR

STUDENTS Julian Binder *Undecided* | Christian Burchhardt *Electrical & Computer Engineering* | James Church *Chemical Engineering* | Jeffrey Coope *Computer Science* | Priyanka Deo *Computer Science* | Graham Harvey *Electrical & Computer Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Peter McHale *Physics* | Nicolas Mellis *Electrical & Computer Engineering* | Doci Mou *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Matthew Sebek *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Thomas Wucherpfennig *Mechanical Engineering* | Alexander Zirbel *Computer Science*

ADVISORS Sanjiv Singh *Robotics Institute*

ROOM/TIME Class of '87 / 3:40

Robots are becoming a common sight in every aspect of modern life. In aerial robotics, helicopters and other flying platforms are perfect for surveillance in harsh environments where ground-based navigation is extremely difficult or impossible - such as in dangerous military zones or disaster-stricken regions. Aerial robots are also useful for supporting ground vehicles: they can use their increased visual range to scout ahead, extend the range of communication with outside entities, or provide supplies and tactical assistance in emergency situations. However, the challenge of visually tracking and keeping up with an object on the ground is difficult enough that current implementations usually involve a human controller for the vehicle. This symposium presents our efforts to make the tracking of a grounded object both autonomous and robust, so that the robot can provide support for a ground vehicle without human assistance.

VOICE OVER XIA, A FUTURE INTERNET ARCHITECTURE

STUDENTS Wei Shi *Electrical & Computer Engineering*

ADVISORS Peter Steenkiste *Computer Science*

ROOM/TIME Rangos 1 / 12-2:30

The intent of this research is to explore and evaluate the impact of XIA by developing an concrete application that leverages most of the new features in XIA. The research will start by building a VoIP conference

application over XIA network. We choose VoIP for several reasons. It is a widely used protocol. It is also complex enough to make use of most features of XIA network, e.g. custom content principal. Moreover, VoIP involves publishing and fetching dynamically generated content, which is similar to the format of more recent websites. While some research on other content-centric framework(CCN) has implemented a solution for VoIP, there are still a lot of room for improvement. Further research could also include interfacing XIA and CCN.

WIRELESS MONITOR AND CONTROL

STUDENTS Guillermo Manuel Cidre *Undecided* | Brent Strysko *Electrical & Computer Engineering*
ADVISORS James C. Hoe *Electrical & Computer Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Electronic test equipment is both bulky and expensive. Oscilloscopes for example provide the ability to measure a wide variety of frequencies and inputs but an individual unit is large and most units begin with a price range in the thousands of dollars. In a digitally evolving world data no longer needs to be shown on an individual unit and instead data can be transmitted to a laptop where it can be viewed, analyzed, and stored. This project will consist of designing an adjustable power supply and oscilloscope limited in electrical characteristics that can communicate wirelessly to a client computer. Both the limited scope of the power supply and oscilloscope as well as the lack of high end displays on the units will make the project much more affordable for a typical hobbyist. The device is to be powered off of batteries making it ideal for in-the-field applications where a laboratory is not always accessible. Furthermore, the device will use a processor similar to, if not the ARM processor. For this reason a small linux like kernel will be running on the device allowing both automated testing and advanced monitoring to occur.

MATERIALS SCIENCE ENGINEERING

ASSEMBLY OF PLASTIC PARTICLE ARRAY STRUCTURES

STUDENTS Meera Lakhavan *Materials Science Engineering*
ADVISORS Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:00

My research question focuses on the specific mechanical property effects of grafting various length polymer chains to a nanoparticle surface, in this case polystyrene chains on silica nanoparticles. It is expected that the material will be altered to become flexible, tough, and ultimately more useful. The significance lays in the fact that once it is known how to alter mechanical properties on the nanoscale level, such knowledge can be implemented into making various materials more practical and even synthesizing new qualities. I will go about exploring this question by using material science lab methods to graft the polystyrene particle brushes, or polymer chains onto the surface of silica particles, and observe the new mechanical properties of a material that would have otherwise arranged into a fragile and brittle structure. The specific techniques that I will be utilizing include spin coating; optical and atomic force microscopy; and tensile stress-strain experiments, including nanoindentation.

AUTOMATED HISTOLOGICAL CLASSIFICATION OF TERATOMA TISSUE CLASSES

STUDENTS Leah Yingling *Materials Science Engineering*
ADVISORS Jelena Kovacevic *Biomedical Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:30

Many issues fundamental to understanding the etiology and consequences of diseases are best understood at the level of tissue pathology and cellular architecture and function. Pathologists recognize abnormal and normal tissues based on visual cues seen in Hematoxylin and Eosin (H&E) stained images of the tissue; however, this process is time consuming. A classifier automatically identifying germ-layer components in H&E-stained images of teratomas based on the visual cues used by a pathologist could be utilized as a basis for creating more organ-specific features for recognition of a certain disease. Distinct features of different tissue classes are present in H&E teratoma images, and tissues can be classified based on the presence of these features. Automated recognition in H&E images could potentially lead to early recognition and treatment for pathophysiological recognized diseases.

ELECTROCHEMICAL STUDY OF LAYERED OXIDE NACRO2 IN AQUEOUS ELECTROLYTE

STUDENTS Daniel Becerra *Materials Science Engineering*
ADVISORS Jay Whitacre *Materials Science Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Layered structure (R-3m) $NaCrO_2$ has been showed to have excellent electrochemical performance in organic electrolytes. It is desirable to use it in aqueous electrolytes as well due to the toxic and combustible nature of many organic electrolytes. $NaCrO_2$ was synthesized by solid state reaction and studied in aqueous Na_2SO_4 solution using cyclic voltemetry (CV) and found to be only partially stable. Further testing in varied electrolyte pH and without the presence of O_2 was conducted, based on literature that indicated enhanced stability of layered structure transition metal oxides in high pH.

FORMULA SAE CAR PROJECTS FOR SPRING 2012

STUDENTS Pronoy Biswas *Electrical & Computer Engineering* | Adam Brecher *Mechanical Engineering* | Anne Dirkes *Mechanical Engineering* | Uriel Eisen *Design* | Margaret Hall *Materials Science Engineering* | Eva Humphrey *Mechanical Engineering* | Brian Langone *Mechanical Engineering* | Derek Miller *Electrical & Computer Engineering* | Jack Moldave *Mechanical Engineering* | Michael Ornstein M*echanical Engineering* | Mark Sun *Mechanical Engineering* | Gabrielle Williams *Design* | Tom Zhang *Computer Science*
ADVISORS Reinhard Schumacher *Physics* | Satbir Singh *Mechanical Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Formula SAE creates a high performance race car from the ground up every year. We compete against hundreds of other universities around in engineering design, cost analysis, business potential, and vehicle performance. This year is focused on the development of new manufacture techniques for the car's carbon fiber body, implementation of new mass optimization strategies, and instrumentation of vehicle loads and dynamics for future development.

INVESTIGATION INTO OPTIMAL VIBRATING MAGNETIC SENSOR GEOMETRIES FOR USE IN MEASURING MAGNETIC REMANENCE IN MARTIAN MINERALS

STUDENTS David Evans *Materials Science Engineering*
ADVISORS Michael McHenry *Materials Science Engineering*
ROOM/TIME Rangos 1 / 12-2:30

The purpose of this project is to investigate and through literature research determine optimal magnetic sensor geometries to measure magnetic remanence in martian minerals for use in a mars rover mission organized by the ESA (European Space Agency). The current proposed sensor is a cross between an AGM and VSM. Therefore, in this project I examine the geometries of vibrating sample magnetometers (VSM), alternating gradient magnetometers (AGM), and magnetic force microscopy (MFM). Using the information from this research, I perform an assessment of the strengths and weaknesses of each technique, while considering methods of combining the techniques to avoid inherent flaws. The ultimate goal of this research is to produce a recommendation for an optimized sensor geometry that minimizes noise and other errors that can occur when measuring the magnetization in potentially uneven surfaces like Martian soil, while creating a small, light, robust sensor.

NANOPARTICLE SIZE REDUCTION BY MECHANICAL MILLING AND ITS ROLE IN THE RF HEATING OF MAGNETIC NANOPARTICLE/SOLDER NANOCOMPOSITES FOR FLIP CHIP PACKAGING

STUDENTS Emily Walker *Materials Science Engineering*
ADVISORS Michael McHenry *Materials Science Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The electronics industry has recently begun to limit its use of lead-based solders for flip chip packaging applications because of environmental concerns. Although there are many less toxic lead-free alloys that may be used as solder, these alloys typically have a higher melting point than lead alloys. It is therefore difficult to cause the lead-free solder to reflow using conventional techniques without damaging the chip involved. Our group has previously established that combining magnetic nanoparticles with lead-free solder results in a composite solder paste that can be heated to reflow temperatures using an AC magnetic field. We have also concluded that the heating rate of the solder composites strongly depends on the size of the solder ball, which limits the possible packaging designs. To address this problem, we are currently investigating whether combining the solder paste with smaller, mechanically milled magnetic nanoparticles will improve the heating rate of smaller sized solder balls to match industry standards.

PHASE DIAGRAM OF TITANOMAGNETITES

STUDENTS Dunyang Wang *Materials Science Engineering*
ADVISORS Michael McHenry *Materials Science Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Titanomagnetites are important minerals in basalts and commonly found on the moon and Mars. Studies of titanomagnetites have found that the pseudo-binary Fe_3O_4-Fe_2TiO_4 solid solution system decomposes into a phase rich in magnetite which is strongly magnetic, and a phase rich in Fe_2TiO_4 spinel which is weakly magnetic. The spinodal decomposition is thought to contribution to the large remnant magnetization on Mars. In order to have a better understanding of titanomagnetites, we need a phase diagram of Fe_3O_4-Fe_2TiO_4 system. Evidence of asymmetric miscibility is found under microscopy. In this paper, enthalpy of mixing is calculated

based on Madelung energy and exchange energy, configurational entropy and free energy curves are calculated for three cation distribution models, and a phase diagram of the pseudo-binary system is calculated for one of the cation distribution model.

POLYMER GRAFTED NANOPARTICLES AND ITS OPTICAL PROPERTIES

STUDENTS Dunyang Wang *Materials Science Engineering*
ADVISORS Michael Bockstaller *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

Nanoparticles are ubiquitously being used as fillers in polymer-based materials in order to enhance a wide range of physical properties such as wear and UV resistance, stiffness, barrier properties, and others, A major challenge in this area of polymer nanocomposite materials is that the presence of filler particles gives rise to increased scattering. The opaqueness is detrimental to the application of polymer nanocomposites in a wide range of applications where optical transparency is a key requirement. The goal of this project is to evaluate whether the grafting of polymer chains to the surface of nanoparticles can decrease the scattering strength of embedded particle fillers. The proposed research is basaed on the hypothesis that grafted polymer chains can act both as compatibilizers as well as 'index-matching functionalities' that reduce the polarizability of particles embedded in polymer matrices. The project will provide training in a range of synthesis and characterization techniques that are of key relevance in the are of polymer nanomaterials.

RESISTIVE SWITCHING OF THE RUDDLESDEN-POPPER PHASE SR2TIO4

STUDENTS Juan Infante *Materials Science Engineering*
ADVISORS Paul Salvador *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Resistance switching has now widely been studied for many transition metal oxides, such as TiO_2 and Sr_2TiO_4. The potential applications for these electro-resistive materials range from non-volatile data storage to reconfigurable logic to trainable neural networks. Non-volatile memory based on electrically switchable resistance have attracted considerable attention, often summarized under the umbrella term resistance (switching) random access memory (RRAM) because of the cell high storage density and simple device structure . Sr_2TiO_4 adopts the so-called Ruddlesden-Popper phase, in which conductivity is a function of crystallography orientation. In this project, epitaxial thin films of Sr_2TiO_4 will be grown on $SrLaAlO_4$ single crystal substrates via Pulse Laser Deposition. The resistive switching properties of Sr_2TiO_4 thin films will be measured as a function of the Ruddlesden-Popper thin films' orientation.

ROBORCHESTRA: AUTOMATED HARMONICA AND MODULAR DRUM PROJECTS

STUDENTS Jonathan Boerner *Mechanical Engineering* | Andrew Burks *Mechanical Engineering* | Madeline Cramer *Materials Science Engineering* | Rebecca Wells *Chemical Engineering* | Yutong Zeng *Electrical & Computer Engineering*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, RobOrchestra has created a number of robots with specific musical functions and generated meaningful ways for them to play together cooperatively. In previous years, this organization was dedicated

to establishing a basis upon which a few instruments could play, but this year we plan to expand the number of instruments at our disposal and to bring out the "Orchestra" in RobOrchestra. In addition to building more instruments, expanding our reach to both the string and brass sections, we will also investigate creating alternative methods for humans to interact with the robots' performance. In this manner we will expose the connection between science and art by showing the mathematical complexity of music and the artistic possibilities of robotics.

SILVER NANOWIRE-POLYMER COMPOSITE FILMS AS FLEXIBLE, TRANSPARENT CONDUCTORS

STUDENTS Shiqi Fu *Materials Science Engineering*
ADVISORS Lisa Porter *Materials Science Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Transparent conductors have been used in a variety of devices including solar cells, OLEDs and large-area displays. The conventional materials used in this area are metal oxides, in particular indium tin oxide (ITO). Due to the scarcity of indium and the expensive, brittle and chemically unstable nature of ITOs, research has been conducted to seek alternative transparent conducting materials that have comparable optical and electrical properties in addition to being flexible as well Several material systems have been investigated over the past decade in this regard, including ultra-thin metal films, carbon nanotubes, graphene, etc. among others. One such material system, comprising amorphous silver nanowire (AgNW) networks, demonstrates similar properties compared to ITO, showing high transmittance and low sheet resistance. Also, composites of these AgNW networks with polymers have been shown to increase the stability of these films. In our experiments with composited of AgNW-PEDOT: PSS (polyethylene dioxythiophene: polystyrene sulfonate, a conducting polymer), results have shown that the conductivity of the film increases almost linearly with an increase of AgNW concentration while maintaining approximately 80% transparency in the visible spectrum. A 120nm film of this composite, having a concentration of 5mg/mL of AgNW was ~78% transparent, with a low sheet resistance of ~20/square. Also, to examine the functionality of AgNW films under various conditions, we have deposited AgNW-PEDOT composite films on polyethylene terephthalate (PET) substrates. Results have shown that the sheet resistance does not vary much with bending. This means that AgNW films can also be used in flexible applications, in contrast to the conventional ITO, which is brittle. Our results indicate that AgNW/PEDOT: PSS composite thin films are potential replacements for ITO as flexible, transparent conductors.

STRAIN-TO-FAILURE OF EXTRACELLULAR MATRIX PROTEIN NANOFIBERS

STUDENTS Gabriel Diamond *Materials Science Engineering*
ADVISORS Adam Feinberg *Biomedical Engineering*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

The extracellular matrix (ECM) is a protein network formed by cells for structural support and organization, which plays important roles in cell signaling and transfer of mechanical forces. Understanding the chemical and mechanical properties of the ECM is important in elucidating basic biological processes and designing more effective tissue engineering scaffolds. Fibronectin (FN) was chosen for study because it is highly expressed during embryonic development and wound healing and known to have strain-dependent functionality. Here we characterized the mechanical properties of FN nanofibers that mimic the nascent FN fibrils assembled by cells. The FN nanofibers were formed in a cell-free, in vitro environment through microcontact printing on thermally responsive poly(N-isopropylacrylamide), followed by subsequent thermal release. The FN nanofibers

were then suspended across laser cut trenches in a polydimethylsiloxane (PDMS) coated coverslip. The nano-fibers were uni-axially strained along the axis of the trenches with a microscale glass probe under an inverted phase contrast microscope until failure. Fiber lengths prior to straining and just prior to failure were compared to determine the strain-to-failure. Since FN nanofibers were attached to the PDMS under tension, fiber lengths before straining and after failure were also compared. We found that FN nanofibers can be extended at least five-fold from their pre-strained, suspended state. Further, the pre-strained nanofibers are stretched approximately two-fold relative to the fully-relaxed state. This shows remarkable extensibility and suggests that straining FN nanofibers unfolds secondary structure of the type III repeats. Future experiments will characterize the mechanical properties of nanofibers composed of the ECM proteins laminin and collagen type-IV.

STUDY OF POLY(GLYCEROL-CO-SEBACATE) IN ENDOVASCULAR EMBOLISM TREATMENT FOR INTRACRANIAL ANEURYSMS

STUDENTS Tejank Shah *Materials Science Engineering*
ADVISORS Christopher Bettinger *Materials Science Engineering*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:30

Currently, detachable platinum coils are used in endovascular embolism treatments for intracranial aneurysms. However, there exist significant problems with this material. For example, the material is not well suited for long term use and causes infection and chronic inflammation of blood vessels. Therefore, alternative materials have been extensively studied. One promising material is poly(glycerol-co-sebacate), a biodegradable elastomeric material able to change its confirmation with temperature. This material is able to degrade away within the human body in about four month's time with no negative impact. Research will be conducted on the mechanical properties, geometries, and shape memory characteristics of, as well as cell biocompatibility with, poly(glycerol-co-sebacate).

MECHANICAL ENGINEERING

A FLEXIBLE WIRELESS CAPSULE ENDOSCOPE WITH BIOPSY POTENTIAL.

STUDENTS Douglas Bernstein *Mechanical Engineering*
ADVISORS Metin Sitti *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Wireless capsule endoscopes not only allow for imaging of more of the GI tract than traditional endoscopes, but do so in a non-invasive fashion. However there is far greater potential with a such a technology than has currently been realized. We are in the process of giving wireless capsule endoscopes biopsying potential through the release and collection of magnetic microgrippers, in order make biopsying the GI tract far less invasive.

AN IMMERSED BOUNDARY MODEL TO PREDICT PRESSURE DROP IN A PACKED BED OF PARTICLES

STUDENTS Kayla Aloyo *Mechanical Engineering*
ADVISORS Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Understanding the effect a packed bed of particles has on fluid flow is relevant to a number of fields such as pharmaceuticals, energy production, and medicine. Though it is common in the literature to model all particles as spherical, in reality, this is seldom the case. In this study, a model is developed which has the ability to predict the pressure drop across a bed of non-spherical particles using the immersed-boundary method. This method allows for efficient solutions to three-dimensional, transient flows around complex geometries by the addition of body forces to the Navier-Stokes equations. Complex and non-uniform geometries for the particles are designed in the CAD software SolidWorks and inserted into the in-house computational fluid dynamics (CFD) environment. The results of the current model are compared to the well-known Ergun equation. Attempts to validate are conducted with experiments on the flow around non-spherical particles performed by Li and Ma (Li and Ma, 2011). Finally, the model is used to investigate the flow at the entrance regions of the particle bed where it "stagnates" due to the presence of solid objects in the flow. This region is rarely discussed in the literature and may have an effect on the pressure profile across the bed.

AN INVESTIGATION OF ADAPTIVE, ELECTRICALLY-CONDUCTIVE, SOLID LUBRICANTS IN SLIDING CONTACTS

STUDENTS Cecily Sunday *Mechanical Engineering*
ADVISORS Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Powder lubricants have proven to be an effective replacement for traditional oils under extreme environ-ments, such as those experiencing ultra high or low temperatures, vacuum, and ultra-high loads and speeds. Additional interest in powder lubrication stems from its potentially adaptive capabilities when combined in multi-component powder systems. The purpose of this work is to explore the adaptive performance of powder lubrication specifically for applications involving sliding electrical contacts. For example, a lubricant capable of

both reducing wear and conducting electricity has value in the automotive industry because it may be used to improve the life and performance of electric motors. To investigate this topic, pellets were manufactured using various particle sizes and compositions of molybdenum disulfide and copper powder, in the hopes of constructing a powder lubricant capable of low friction and wear with high electrical conductivity. A pad-on disk tribometer was then used to test the friction performance of the composite film in a sliding contact. The conductive and lubricating properties of the pellets were found to be inversely related, with optimal performance occurring for composites of identical partial sizes. Further, this size effect has implications on the possibility of engineering smart yet passive electrically-conductive solid lubricants.

ANKLE-FOOT ORTHOSIS (AFO)

STUDENTS Matthew Stanton *Mechanical Engineering*
ADVISORS Steven Collins *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

The main focus of this project was to design and produce molds and inserts for a redesigned Ankle-Foot Orthosis (AFO). After the molds and designs were completed, components of the new AFO were created using a combination of carbon fiber, aluminum and PVC from rapid prototyped parts.

AUTOMATED WAREHOUSE STORAGE AND RETRIEVAL SYSTEM USING A LOW COST ROBOT COLONY

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Jonathan Goldman *Computer Science* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*
ADVISORS George Kantor *Robotics Institute*
ROOM/TIME Dowd / 1:40

As robotic capabilities improve and costs decrease, the use of robots in commercial applications is greatly increasing. One emerging application of robotics is warehouse distribution: robots can autonomously store and retrieve physical inventory. The warehouse system can be made safer and more efficient by eliminating human operators. The Colony Scout research team aims to advance the state of the art in this area using distributed robotics: a swarm of robots will divide warehouse tasks among itself and cooperate to move inventory in the least amount of time practical. We intend to overcome the swarm robotics challenges presented by this task, namely navigating the warehouse, responding to a series of tasks, and cooperating efficiently to complete all assigned work.

BIPEDAL WHEELED PLATFORM FOR HYBRID LOCOMOTION

STUDENTS Neil Abcouwer *Electrical & Computer Engineering* | Job Bedford *Undecided* | Cory Chang *Computer Science* | Chad Cole *Electrical & Computer Engineering* | Jitu Das *Computer Science* | Siddharth Dedhia *Electrical & Computer Engineering* | Priyanka Deo *Computer Science* | Connor Dixon *Mechanical Engineering* | Alexander Franchuk *Electrical & Computer Engineering* | Zachary Greenberg *Mathematics* | David Mehrle *Physics* | Corey Sobel *Computer Science* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*

ADVISORS Chris Atkeson *Robotics Institute* | Elliot Rosen *Electrical & Computer Engineering*

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

Most robots are designed to specialize in one task, but at the cost of versatility. In mobile robotics, maneuvering diverse terrain is often difficult for robots with only one form of motion. For example, urban search and rescue robots designed for flat surfaces will fail on rubble, and robots designed for rubble will move slowly on flat surfaces. Our team proposes to solve this problem by creating a robot that can change its method of motion depending on the type of terrain it encounters. We will build a robot that combines wheeled and bipedal motion, allowing it to handle multiple types of terrain. The robot will be able to adapt its motion to the current terrain. Wheels provide benefits such as fast, power-efficient movement on flat terrain, whereas bipedal locomotion allows a robot to handle complicated environments like stairs or rocky terrain. This "hybrid locomotion" has enormous potential to benefit the field of robotics since a successful hybrid gets both the benefits of speed and maneuverability.

COLONY SCOUT: A LOW-COST, VERSATILE PLATFORM FOR AUTONOMOUS SYSTEMS IN COLLABORATIVE ROBOTICS

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*

ADVISORS George Kantor *Robotics Institute*

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

Cooperative robotics is the concept that a group of robots working as a team can solve problems faster and more efficiently than a single robot. In the past, the Colony Project has explored numerous applications of group robotics, from mapping to formation control to cooperative manipulation. As is the case with a group whose stated goal is to be low-cost, past projects have always been hindered by imprecise sensors, faulty hardware components, and limited mobility. We propose to design and develop a new generation of Colony robots, the Colony Scout, to overcome these obstacles and increase performance, consistency, and robustness. Scout will dramatically improve upon the current generation of robots, Colony 3.0, with an innovative design that includes a more powerful drive system, more capable processing, and more reliable sensors. The main innovations of the Colony Scout will be capability to handle rough terrain and the ability to add new components (for example, a forklift) on an enhancement bay at the back of the robot. With more reliable and capable hardware, the Colony Project hopes to embark on more ambitious projects than in the past and to contribute in a more significant way to swarm robotics research.

COOPERATIVE ROBOTIC WATERCRAFT

STUDENTS Christopher Tomaszewski *Mechanical Engineering*
ADVISORS Paul Scerri *Robotics Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

The aim of this research is to develop an affordable multi-agent system to monitor and gather data in aquatic environments. Using existing manual techniques to collect data across a wide geographical area is a costly and time consuming process, which makes it impractical to conduct such monitoring continuously and with high spatial resolution. The proposed Cooperative Robotic Watercraft system uses teams of inexpensive airboats fitted with specialized sensors to autonomously monitor large bodies of water quickly and at low cost. The flat bottom and above water propulsion system of an airboat makes it ideal for navigating shallow, debris-filled, or ecologically sensitive waters, letting the system operate in areas inaccessible by traditional means. The use of a modular design with easily interchangeable components and an Android smartphone to provide the onboard computing and inertial sensors of the platform makes it economically feasible to deploy large fleets of these airboats. These advantages of the Cooperative Robotic Watercraft system have made for successful deployments in diverse marine environments around the world, ranging from the Pittsburgh river system and aquaculture ponds in Ohio to volcanic lakes and flooded streets in the Philippines.

DESIGN AND CONTROL STRATEGY OPTIMIZATION OF AN ELECTRIC VEHICLE WITH A SUPERCAPACITOR-BATTERY SYSTEM THROUGH DYNAMIC PROGRAMMING ALGORITHMS

STUDENTS Paul Kimball Jr. *Mechanical Engineering*
ADVISORS Orkun Karabasoglu *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Plug-in electric vehicles are a promising technology to reduce gasoline consumption, emissions, and foreign oil dependency. They operate either partly or entirely on inexpensive electricity that could be obtained from local, renewable, and less carbon-intensive energy sources, rather than gasoline. Based on the NHTS 2009 survey, approximately 60% of U.S. passenger vehicles driven on the survey day traveled less than 30 miles, a distance that could be convered entirely by a plug-in vehicle's all-electric range. Thus, plug-in vehicles have the potential to offset a substantial amount of gasoline consumption even when charged only once per day. Research has shown that combining batteries with supercapacitors for vehicle implementation might improve the fuel economy of electric vehicles by 10-15% due to higher efficiency of capacitors compared to batteries. Supercapacitors have a lower impedance than batteries, as well as better surface area, and therefore losses due to heating would be minimized. An architecture consisting of a battery pack and supercapacitor bank provides numerous advantages over traditional electric vehicles via increased power density and greatly improved cycle life. However the initial cost of energy storage systems is the major bottleneck for mass adoption for the electric vehicles, as designers make their decisions on the basis of life cycle cost instead of efficiency. In this study, we model an electric vehicle with a battery-supercapacitor system and optimize the size of battery, supercapacitor and motor for minimum life cycle cost. We find that the optimal size of supercapacitors depends on the motor and battery size, as well as the choice of control strategy. Furthermore, optimizing the vehicle for different objectives criteria such as efficiency and life cycle cost results in different designs which are associated with different life cycle costs.

DESIGN AND MANUFACTURE OF HIGH EFFICIENCY HULLS FOR SOLAR POWERED VEHICLES

STUDENTS Jonathan Boerner *Mechanical Engineering* | Zachary Furman *Mechanical Engineering* | Ibuki Kamei *Mechanical Engineering* | Paul Kimball Jr. *Mechanical Engineering* | Nathaniel Krasnoff *Civil and Environmental Engineering* | Jessica Lee *Mechanical Engineering* | Robert Wedler *Electrical & Computer Engineering*

ADVISORS Susan Finger *Civil and Environmental Engineering*

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

Solar-powered aquatic vehicles represent an opportunity to replace nonrenewable energy with renewable energy in a key market. In order to be successful, however, these vehicles need to have well-designed hulls that are appropriate for the specific conditions of a solar-powered boat. The research group plans to design such a hull by taking the most desirable features available in commercial hulls and combining them into a set of possible hulls for a solar-powered boat. A smaller set of the most efficient hulls will be determined through a computational fluid dynamics analysis of the larger set. Lastly, the group plans to verify the results of the CFD analysis by creating scale models, and testing the models in an analysis tank.

ELUCIDATING WEAR AND TRIBO-INDUCED SURFACE TEXTURE IN HARD ON SOFT SLIDING SURFACES AT THE MICRO-SCALE

STUDENTS Daniel Benvegnu *Mechanical Engineering*

ADVISORS Cecil Higgs *Mechanical Engineering*

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

Though often treated as uniform in standard analyses, real contact between two nominally smooth surfaces is thought to be comprised of "asperity" tips interacting with each other at discrete locations. As a result, contact parameters such as electrical resistance, contact stress, and interfacial temperature, will vary drastically at these junctures from those of a truly flat surface.   For wear models, which predict the failure and separation of surface material, these specific contact parameters are especially important in capturing the relevant physics during asperity contact. In this work the microscopic surface asperity collisions that occur during contact between sliding surfaces are simulated by using the explicit finite element package LS-DYNA. These simulations involve a linearly translating Tungsten Carbide (WC) asperity and a cantilevered, deformable Molybdenum Disulfide (MoS2) asperity. The model captures the resulting path that the WC asperity takes as it collides with, and deforms, the softer MoS2 asperity. Overall, the results indicate that explicit finite element method (FEM) is an effective tool for simulating microscopic surface collisions, especially with regards to its ability to numerically determine contact stresses and asperity deformations. This work helps to explain how macro-scale wear and surface texture can actually result from the micro-scale interactions of two surfaces in relative sliding contact.

EVALUATING BUCKET-WHEEL EFFECTIVENESS UNDER MICROGRAVITY

STUDENTS Hahna Alexander *Mechanical Engineering* | Kayla Aloyo *Mechanical Engineering* | Tiffany Bassey *Undecided* | Andrew Sheng *Computer Science*
ADVISORS Krzysztof Skonieczny *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

The excavation of regolith (Lunar soil) is essential to the construction of future off-planet outposts and harvesting of fuel deposits, both of which are vital for prolonged human presence on the moon. The bucket wheel excavator is a machine used for surface mining and digging. The mechanism consists of a large wheel with a continuous pattern of "buckets" used to scoop material as the wheel turns. This method of excavation is useful due to the low resistance forces and lightweight operation. The proposed bucket wheel excavator will be mounted centrally on a Lunar Rover, and runs transverse to the direction of forward rover motion. This setup enables the collection of regolith, which is essential to the success of the excavating concept. The behavior of the bucket wheel mechanism is unknown in low gravity environments. Fundamentally, it is questionable if regolith will even be able to fall out of a bucket on the lunar surface. Bucket functionality must be evaluated in microgravity before bucket wheel implementation is feasible. A microgravity experiment will examine the behavior of the bucket wheel in lunar gravity by testing the amount of regolith gathered after specified rotations of an individual bucket. Buckets will be optimized for ideal aspect ratio, overall size, and shape. Additionally, Lunar soil simulant with similar properties will be used to mimic Lunar regolith. Testing bucket excavator functionality in microgravity is critical to the success of future lunar excavator concepts. The goal of this research is to evaluate bucket wheel effectiveness in a Lunar gravity environment. The team will evaluate if selected design parameters uphold terrestrial bucket wheel theory, thus enabling the implementation of bucket wheel excavators on future Lunar rover missions.

EXPLICIT FINITE ELEMENT MODELING OF GRANULAR COUETTE SHEAR FLOW

STUDENTS Richard Musgrave *Mechanical Engineering*
ADVISORS Cecil Higgs *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

Granular flows can display complex behaviors in nature (avalanches and rock slides) and industrial sectors (pharmaceuticals and food processing). In each setting, multiphase (solid, liquid, and/or gaseous) behavior can be witnessed, leading to a flow that is often unpredictable locally or globally. In tribological applications, solid particulate flows have been proposed as lubricants in sliding contacts where they have advantages in their ability to carry loads under extreme conditions (high pressure and high temperatures), where conventional liquid lubricants tend to break down. My work will present the development and preliminary results of an explicit finite element model of a granular Couette flow using the commercial software, LS-Dyna. Explicit FEM is a detailed modeling approach, which has the ability to accurately model highly complex and non-linear systems. Explicit FEM is able to quantify stress distributions within individual particles inside of the flow. This allows us to understand the true interactions and contact forces that occur during collisions in the shear cell, and to extend that knowledge to interpret the global behavior of the flow. The results of this model will be compared to experimental results and Cellular Automata (CA) modeling of a granular shear (GSC).

FORMULA SAE CAR PROJECTS FOR SPRING 2012

STUDENTS Pronoy Biswas *Electrical & Computer Engineering* | Adam Brecher *Mechanical Engineering* | Anne Dirkes *Mechanical Engineering* | Uriel Eisen *Design* | Margaret Hall *Materials Science Engineering* | Eva Humphrey *Mechanical Engineering* | Brian Langone *Mechanical Engineering* | Derek Miller *Electrical & Computer Engineering* | Jack Moldave *Mechanical Engineering* | Michael Ornstein *Mechanical Engineering* | Mark Sun *Mechanical Engineering* | Gabrielle Williams *Design* | Tom Zhang *Computer Science*

ADVISORS Reinhard Schumacher *Physics* | Satbir Singh *Mechanical Engineering*

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

Formula SAE creates a high performance race car from the ground up every year. We compete against hundreds of other universities around in engineering design, cost analysis, business potential, and vehicle performance. This year is focused on the development of new manufacture techniques for the car's carbon fiber body, implementation of new mass optimization strategies, and instrumentation of vehicle loads and dynamics for future development.

FROM HULL DESIGN TO PATH PLANNING: THE DEVELOPMENT OF AN AUTONOMOUS MULTI-AGENT AIRBOAT SYSTEM

STUDENTS Christopher Tomaszewski *Mechanical Engineering*

ADVISORS Paul Scerri *Robotics Institute*

ROOM/TIME Pake / 12:40

This presentation investigates the results of over a year of robotics research, with an emphasis on the interdisciplinary nature of robotics and the progression of a multi-agent system design across several iterations. The research presented outlines the design, development, and deployment of a multi-agent airboat platform, from the evolution of the propulsion vectoring mechanism to the optimization of path planning algorithms for boat dynamics. Several disparate deployment scenarios on a volcanic lake in the Philippines, a superfund site near New York City, and an aquaculture pond in Ohio are described and the impact of these field tests on various aspects of the system's design are identified.

PASSIVE FLOW CONTROL OF A LIQUID ROCKET PROPELLANT FEED SYSTEM THROUGH A CAVITATING VENTURI

STUDENTS Nicholas Gianopoulos *Mechanical Engineering*

ADVISORS William Whittaker *Robotics Institute*

ROOM/TIME Rangos 1 / 12-2:30

Cavitating venturis are perhaps the simplest device used to regulate flow rates on a flow line. They require no complex flow measuring devices, and the valves have no moving parts. Since the flow rate through a particular venturi is a function of the inlet pressure alone, a cavitating venturi in effect turns a pressure regulator into a flow rate regulator. Furthermore the cavitation in the venturi throat prevents pressure shock waves caused by the water hammer effect and engine pressure dynamics from traveling further upstream through the flow line. This research will demonstrate the ability to design and manufacture a cavitating venturi to meet the design specifications of the proposed propulsion system for the lunar lander of Astrobotic Technology's Google Lunar X Prize team. The venturi was built and then tested via a pressurized water test fixture for both steady state and transient behavior.

PROPERTIES OF FECO MAGNETIC NANOPARTICLE-BASED SOLDER COMPOSITES

STUDENTS Andrea Pickel *Mechanical Engineering*
ADVISORS Michael McHenry *Materials Science Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

In light of environmental and health concerns, use of lead free (Pb-free) solder has grown rapidly in the electronics industry. While Pb-free solder alloys such as Sn-Ag-Cu (SAC) alloys are desirable from an environmental perspective, they have higher reflow temperatures and a longer reflow period as compared to lead-containing solders, both of which are undesirable. When Pb-free solders are used in conventional reflow processes, warpage and other deformation of the printed circuit board (PCB) acting as the substrate can occur. The use of localized heating can prevent such problems from occurring. Localized heating can be achieved by adding magnetic materials, such as magnetic nanoparticles (MNPs), to Pb-free solder paste. When subjected to an AC magnetic field, resultant eddy current losses and hysteric and relaxation losses cause the solder-MNP composite to reflow. Once localized heating is achieved, further investigation of the microstructure, mechanical properties, and reliability is needed to improve the manufacturing process and demonstrate the viability of the solder composite as an interconnection material for industrial applications.

ROBORCHESTRA IX - GUITARBOT II

STUDENTS Job Bedford *Undecided* | Daniel Curhan *Mechanical Engineering* | Jane Threefoot *Undecided*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

GuitarBot is a second year project within RobOrchestra. Last year's GuitarBot project produced a robot which can rhythmically strum a single guitar string while changing its pitch via a sliding fret mechanism and which also has the capability of attaching to a guitar amp to amplify its volume. The plan for this year's GuitarBot project is to expand upon the versatility of the original GuitarBot by adding strings and experimenting with new fretting mechanisms, as well as by developing the necessary software to support this expansion. To develop our new fretting mechanisms, we plan to build off of the conceptual designs of Eric Singer, a local robotic instrument inventor, and experiment with more effective slide mechanisms and even with articulated fingers to produce better string control. Once a more optimized fretting mechanism design has been developed, we plan to build multiple string modules using that mechanism and to develop software which will allow the modules to perform together. Using these improved technologies, GuitarBot will play along with the rest of RobOrchestra and contribute its unique sound to the group.

ROBORCHESTRA: AUTOMATED HARMONICA AND MODULAR DRUM PROJECTS

STUDENTS Jonathan Boerner *Mechanical Engineering* | Andrew Burks *Mechanical Engineering* | Madeline Cramer *Materials Science Engineering* | Rebecca Wells *Chemical Engineering* | Yutong Zeng *Electrical & Computer Engineering*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, RobOrchestra has created a number of robots with specific musical functions and generated meaningful ways for them to play together cooperatively. In previous years, this organization was dedicated to establishing a basis upon which a few instruments could play, but this year we plan to expand the number

of instruments at our disposal and to bring out the "Orchestra" in RobOrchestra. In addition to building more instruments, expanding our reach to both the string and brass sections, we will also investigate creating alternative methods for humans to interact with the robots' performance. In this manner we will expose the connection between science and art by showing the mathematical complexity of music and the artistic possibilities of robotics.

ROBOTIC ARM FOR SIMPLE MANIPULATION

STUDENTS Victor Medina *Mechanical Engineering*
ADVISORS Manuela Veloso *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

As the age of technology progresses engineers have been put to the test to improvise in order to enhance their creations for more advanced objectives. The CoBot is a robot that focuses on its autonomy. My research consists of the designing and creating of a mechanical arm that will be attached to CoBot and also run autonomously in order to pick up items and press elevator buttons.

ROBOTIC MANUFACTURE OF FRACTAL PATTERNS

STUDENTS Joshua Lopez-Binder *Mechanical Engineering*
ADVISORS Dale Clifford *Architecture*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Many robotic manufacture devices use sensors only to ensure proper performance. I propose creating robotic tools, like 3d printers, that use have some level of autonomous behavior involving feedback loops and sensors that gather data about the objects being manufactured. This project explores this concept by modifying a 3d printer to imitate a fractal growth phenomena called Diffusion Limited Aggregation (DLA). While it is possible to simulate and then fabricate models of DLA, this machine 'grows' the objects real time, in a physical space, thus allowing for deviation and unpredictability not easily replicated in purely computational simulations. This deviation is dependent on the conditions of the build process. Thus the machine creates a class of objects that are 'adapted' to the conditions present during manufacture.

SHEAR INDUCED COALESCENCE OF SILICA PARTICLE ARMORED PICKERING EMULSIONS

STUDENTS Mathew Swisher *Mechanical Engineering*
ADVISORS Shelley Anna *Mechanical Engineering*
ROOM/TIME Rangos 1 / 12-2:30

The purpose of this project is to visually study the stability of emulsions of armored droplets against coalescence in response to shear flow. The armored emulsions are created using microfluidic techniques to create monodisperse droplets in terms of both size and particle concentration. The behavior of the droplets in response to shear flow is measured using shear cell to determine the amount of shear necessary to break up the armored droplets. This is done by studying the coalescence mechanics of armored droplets in response to the diameter size of the droplets.

VISION-BASED OBJECT FOLLOWING WITH AN AUTONOMOUS QUADROTOR

STUDENTS Julian Binder *Undecided* | Christian Burchhardt *Electrical & Computer Engineering* | James Church *Chemical Engineering* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Graham Harvey *Electrical & Computer Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Peter McHale *Physics* | Nicolas Mellis *Electrical & Computer Engineering* | Doci Mou *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Matthew Sebek *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Thomas Wucherpfennig *Mechanical Engineering* | Alexander Zirbel *Computer Science*

ADVISORS Sanjiv Singh *Robotics Institute*

ROOM/TIME Class of '87 / 3:40

Robots are becoming a common sight in every aspect of modern life. In aerial robotics, helicopters and other flying platforms are perfect for surveillance in harsh environments where ground-based navigation is extremely difficult or impossible - such as in dangerous military zones or disaster-stricken regions. Aerial robots are also useful for supporting ground vehicles: they can use their increased visual range to scout ahead, extend the range of communication with outside entities, or provide supplies and tactical assistance in emergency situations. However, the challenge of visually tracking and keeping up with an object on the ground is difficult enough that current implementations usually involve a human controller for the vehicle. This symposium presents our efforts to make the tracking of a grounded object both autonomous and robust, so that the robot can provide support for a ground vehicle without human assistance.

UNDECIDED

AUTOMATED WAREHOUSE STORAGE AND RETRIEVAL SYSTEM USING A LOW COST ROBOT COLONY

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Jonathan Goldman *Computer Science* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*

ADVISORS George Kantor *Robotics Institute*

ROOM/TIME Dowd / 1:40

As robotic capabilities improve and costs decrease, the use of robots in commercial applications is greatly increasing. One emerging application of robotics is warehouse distribution: robots can autonomously store and retrieve physical inventory. The warehouse system can be made safer and more efficient by eliminating human operators. The Colony Scout research team aims to advance the state of the art in this area using distributed robotics: a swarm of robots will divide warehouse tasks among itself and cooperate to move inventory in the least amount of time practical. We intend to overcome the swarm robotics challenges presented by this task, namely navigating the warehouse, responding to a series of tasks, and cooperating efficiently to complete all assigned work.

BIPEDAL WHEELED PLATFORM FOR HYBRID LOCOMOTION

STUDENTS Neil Abcouwer *Electrical & Computer Engineering* | Job Bedford *Undecided* | Cory Chang *Computer Science* | Chad Cole *Electrical & Computer Engineering* | Jitu Das *Computer Science* | Siddharth Dedhia *Electrical & Computer Engineering* | Priyanka Deo *Computer Science* | Connor Dixon *Mechanical Engineering* | Alexander Franchuk *Electrical & Computer Engineering* | Zachary Greenberg *Mathematics* | David Mehrle *Physics* | Corey Sobel *Computer Science* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*

ADVISORS Chris Atkeson *Robotics Institute* | Elliot Rosen *Electrical & Computer Engineering*

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

Most robots are designed to specialize in one task, but at the cost of versatility. In mobile robotics, maneuvering diverse terrain is often difficult for robots with only one form of motion. For example, urban search and rescue robots designed for flat surfaces will fail on rubble, and robots designed for rubble will move slowly on flat surfaces. Our team proposes to solve this problem by creating a robot that can change its method of motion depending on the type of terrain it encounters. We will build a robot that combines wheeled and bipedal motion, allowing it to handle multiple types of terrain. The robot will be able to adapt its motion to the current terrain. Wheels provide benefits such as fast, power-efficient movement on flat terrain, whereas bipedal locomotion allows a robot to handle complicated environments like stairs or rocky terrain. This "hybrid locomotion" has enormous potential to benefit the field of robotics since a successful hybrid gets both the benefits of speed and maneuverability.

COLONY SCOUT: A LOW-COST, VERSATILE PLATFORM FOR AUTONOMOUS SYSTEMS IN COLLABORATIVE ROBOTICS

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*

ADVISORS George Kantor *Robotics Institute*

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

Cooperative robotics is the concept that a group of robots working as a team can solve problems faster and more efficiently than a single robot. In the past, the Colony Project has explored numerous applications of group robotics, from mapping to formation control to cooperative manipulation. As is the case with a group whose stated goal is to be low-cost, past projects have always been hindered by imprecise sensors, faulty hardware components, and limited mobility. We propose to design and develop a new generation of Colony robots, the Colony Scout, to overcome these obstacles and increase performance, consistency, and robustness. Scout will dramatically improve upon the current generation of robots, Colony 3.0, with an innovative design that includes a more powerful drive system, more capable processing, and more reliable sensors. The main innovations of the Colony Scout will be capability to handle rough terrain and the ability to add new components (for example, a forklift) on an enhancement bay at the back of the robot. With more reliable and capable hardware, the Colony Project hopes to embark on more ambitious projects than in the past and to contribute in a more significant way to swarm robotics research.

DEVELOPMENT AND DESIGN OF TWO CHEMICALLY POWERED MINIATURE CARS

STUDENTS Katia Bazzi *Chemical Engineering* | Madison Calhoun *Chemical Engineering* | Anusha Chinthaparthi *Chemical Engineering* | Eric Chu *Chemical Engineering* | Jyo Lyn Hor *Chemical Engineering* | Rebecca Lui *Biomedical Engineering* | Harley Montano *Undecided* | Kaitlyn Nowak *Chemical Engineering* | Yijie Qiu *Chemical Engineering* | Anand Sastry *Chemical Engineering* | Stephen Scannell *Chemical Engineering* | Alexander Yoshikawa *Chemical Engineering* | Amy Yuan *Chemical Engineering* | Minghui Zhang *Chemical Engineering*

ADVISORS James Miller *Chemical Engineering*

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

The Chemical Engineering Car Club developed two chemically powered cars that were entered in the regional Chemical Engineering Car Competition. The first car is powered by a home made copper zinc battery and is stopped by a controlled iodine clock reaction. The second car uses the pressure generated by the catalysed decomposition of hydrogen peroxide to operate a piston which powers the car.

I-CONSERVE

STUDENTS Jia Chin *Social & Decision Sciences* | Won Seong Kim *Undecided* | Shivam Naik *Undecided* | Henry Neale *Undecided*

ADVISORS Jeria Quesenberry *Information Systems*

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

Due to the rising prospect of improving sustainability through the use of information systems, we have decided to focus our collective efforts on improving the sustainability of Carnegie Mellon's campus. Universities are generally among the largest and most influential organizations in their communities and thus, the creation of a more sustainable university would be particularly impactful to both students and surrounding locals. In addition, it has been shown that humans typically take around six weeks to build and adopt new habits. Our ultimate goal is to turn Carnegie Mellon University – one of the world's premier institutions of higher learning – into a place where life-long sustainable habits are built. In our project, we discuss two solutions that will improve Carnegie Mellon's sustainability through the use of information systems; the first of these involves the implementation of more efficient lighting systems, while the other involves improving the monitoring and management of the university's energy consumption. Since the project mainly concerns university campuses, our target audience includes students, faculty members, administration, other university staff, as well as private corporations that will be considered as our potential partners. We provide case studies to substantiate our theories. For the lighting system solution, we propose the installation of motion-sensor controlled lighting in order to more efficiently reduce electricity usage. The case studies relevant to this solution include a motion-sensor lighting project done by the University of Colorado-Boulder's Environmental Studies Program, as well as UC San Diego's 2011 lighting retrofit project, which utilized occupancy sensors. For the energy monitoring system, we propose that the current system be improved upon so that the real-time impact of energy consumption can be displayed in more intuitive and meaningful ways. Furthermore, we hope to encourage the practice of sustainable actions and lifestyles among the student body by initiating a campus-wide energy saving competition between residence buildings. For this solution, we looked at Harvey-Mudd College's implementation of a real-time metering system and a similar competition. In conclusion, the two solutions will be most effective if promoted together. Because the two are similar in implementation, doing so would be cost-friendly as well as time-efficient. The projects will not only enhance CMU's sustainability and save money—as shown in case studies—but also create friendly relationships with large corporations, provide exceptional experiences to members of our community and ultimately, improve CMU's reputation.

ROBORCHESTRA IX - GUITARBOT II

STUDENTS Job Bedford *Undecided* | Daniel Curhan *Mechanical Engineering* | Jane Threefoot *Undecided*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

GuitarBot is a second year project within RobOrchestra. Last year's GuitarBot project produced a robot which can rhythmically strum a single guitar string while changing its pitch via a sliding fret mechanism and which also has the capability of attaching to a guitar amp to amplify its volume. The plan for this year's GuitarBot project is to expand upon the versatility of the original GuitarBot by adding strings and experimenting with new fretting mechanisms, as well as by developing the necessary software to support this expansion. To develop our new fretting mechanisms, we plan to build off of the conceptual designs of Eric Singer, a local robotic instrument inventor, and experiment with more effective slide mechanisms and even with articulated fingers to produce better string control. Once a more optimized fretting mechanism design has been developed, we plan to build multiple string modules using that mechanism and to develop software which will allow the modules to perform together. Using these improved technologies, GuitarBot will play along with the rest of RobOrchestra and contribute its unique sound to the group.

VISION-BASED OBJECT FOLLOWING WITH AN AUTONOMOUS QUADROTOR

STUDENTS Julian Binder *Undecided* | Christian Burchhardt *Electrical & Computer Engineering* | James Church *Chemical Engineering* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Graham Harvey *Electrical & Computer Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Peter McHale *Physics* | Nicolas Mellis *Electrical & Computer Engineering* | Doci Mou *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Matthew Sebek *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Thomas Wucherpfennig *Mechanical Engineering* | Alexander Zirbel *Computer Science*
ADVISORS Sanjiv Singh *Robotics Institute*
ROOM/TIME Class of '87 / 3:40

Robots are becoming a common sight in every aspect of modern life. In aerial robotics, helicopters and other flying platforms are perfect for surveillance in harsh environments where ground-based navigation is extremely difficult or impossible - such as in dangerous military zones or disaster-stricken regions. Aerial robots are also useful for supporting ground vehicles: they can use their increased visual range to scout ahead, extend the range of communication with outside entities, or provide supplies and tactical assistance in emergency situations. However, the challenge of visually tracking and keeping up with an object on the ground is difficult enough that current implementations usually involve a human controller for the vehicle. This symposium presents our efforts to make the tracking of a grounded object both autonomous and robust, so that the robot can provide support for a ground vehicle without human assistance.

WIRELESS MONITOR AND CONTROL

STUDENTS Guillermo Manuel Cidre *Undecided* | Brent Strysko *Electrical & Computer Engineering*
ADVISORS James C. Hoe *Electrical & Computer Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Electronic test equipment is both bulky and expensive. Oscilloscopes for example provide the ability to measure a wide variety of frequencies and inputs but an individual unit is large and most units begin with a price range in the thousands of dollars. In a digitally evolving world data no longer needs to be shown on an individual unit

and instead data can be transmitted to a laptop where it can be viewed, analyzed, and stored. This project will consist of designing an adjustable power supply and oscilloscope limited in electrical characteristics that can communicate wirelessly to a client computer. Both the limited scope of the power supply and oscilloscope as well as the lack of high end displays on the units will make the project much more affordable for a typical hobbyist. The device is to be powered off of batteries making it ideal for in-the-field applications where a laboratory is not always accessible. Furthermore, the device will use a processor similar to, if not the ARM processor. For this reason a small linux like kernel will be running on the device allowing both automated testing and advanced monitoring to occur.

COLLEGE OF FINE ARTS

ARCHITECTURE

SPATIAL AND ANALYTICAL STUDY OF STUDENT HOUSING AT CARNEGIE MELLON UNIVERSITY

STUDENTS Shannon Lauricella *Science and Humanities Scholars* | Samuel Lavery *BHA* | Ariel Liu *Computer Science* | Terra Mack *Psychology* | Alejandra Munoz Munoz *Architecture*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Carnegie Mellon is an urban university with many students living off-campus. Finding housing off-campus is generally left up to individual students, who take into account many variables when choosing a house or apartment. We are interested in investigating the possibility of a correlation between where students choose to live and what they choose to study. Our research presentation seeks to answer questions about the dynamics of student housing at CMU. Is there a correlation between address and major? Do students in certain majors cluster together? Which off-campus neighborhoods are most popular with undergraduate students versus graduate students? Our poster provides visual evidence for the statistical correlations found pertaining to these questions.

ART

ABSUCTIVE REASONING

STUDENTS Laurie Shapiro *Art*
ADVISORS Bob Bingham *Art*
ROOM/TIME Connan / 12-2:30

Abductive Reasoning is a cave installation based off of travel experiences which aims to bring the viewer to a meditative center.

BETWEEN US

STUDENTS Elizabeth Brophy *Art*
ADVISORS Ayanah Moor *Art*
ROOM/TIME Connan / 3-5

This series of work is inspired by a trip I took across America in 2001 as well as recent research on contemporary American economic statistics. I aim to depict memories of the interpersonal relationships I experienced with people living on both sides of the socio-economic divide. Through formal compositions I juxtapose abstracted representations of statistics and illustrated fragments of memory.

CRUSHED: STAGES OF GRIEF, MEDIA REPRESENTATIONS, AND PERSONAL CATALYSTS IN OVERCOMING LOSS

STUDENTS Ashley Baker *Art*
ADVISORS M. Stephanie Murray *BHA* | Susanne Slavik *Art*
ROOM/TIME Connan / 3-5

The problem I have addressed with my Surg project is how to use art as a creative vehicle to deal with and overcome grief. The media and medical industry have detached people from death and obscured what the grieving truly experience. Today, death has replaced sex as a social taboo. Not only have their been social shifts in how we view death and grief, but more knowledge is needed when it comes to dealing with the death of a loved one. There are countless books out there on grieving and death. Despite their honorable intentions to console or uplift, most of these books are emotionally (and sometimes economically) exhausting to read in the initial stages of grief. Society is increasingly less sensitive and aware of death and resources for the grieving are diminishing or nonexistent. Those coping with loss are more alone than ever, necessitating new and unique approaches to this issue.

DROWNING IS A QUIET EVENT

STUDENTS Elizabeth Rudnick *Art*
ADVISORS Patricia Bellan-Gillen *Art*
ROOM/TIME Connan / 12-2:30

Just as signs of use acquire on the surface of a wall, table, or page so experiences imbed themselves in the spaces we inhabit. I want to explore the relationships between memory and space...To visualize the ways memory imprints itself on the spaces we occupy and the objects we accumulate. What does the accumulation of dreams and memories look like when applied to the physical space they were experienced in?

I propose to make a body of work that uses the combined languages of printmaking and installation to explore these themes and their relationship to the larger conversation of contemporary art.

FIRST KISS: A SHORT FILM

STUDENTS Stefan Dezil *Drama* | Yulin Kuang *English* | Benjamin Welmond *Art*
ADVISORS Jane Bernstein *English*
ROOM/TIME McConomy Auditorium / 12:30

The objective of this project is to produce a professional-caliber short-film, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of student filmmakers at Carnegie Mellon University while bringing to life the small heartaches and heartbreaks of growing up. The screenplay explores the myth of the First Kiss, through the eyes of a fourteen-year-old romantic, Adam Schoenberger, who finds out that a pretty girl in his class wants to kiss him at his best friend's Spin the Bottle party.

GARFIELD LISTENING PROJECT: AN ORAL HISTORY OF A NEIGHBORHOOD

STUDENTS Hannah Thompson *Art*
ADVISORS Bob Bingham *Art*
ROOM/TIME Connan / 3-5

Garfield became a predominately black neighborhood in the 1950's,due to the dislocation many families from the Hill District. I want to visually survey the changes in the housing and construction. I am surveying residents and past residents about the destruction done in the Garfield community by the closing of the shopping center and introducing mixed income housing and changing availability of public housing. I want to tell this story through interviews.

HORROR CLIMATE

STUDENTS Audra Wist *Art*
ADVISORS Bob Bingham *Art*
ROOM/TIME Connan / 12-2:30

To exhibit and conceal is to be made-up. We all wind up having to hide parts of ourselves, inevitably and magnificently so. It's not tragic, but it certainly isn't ideal. It just is. I think the only really pure things left are those moments where we sadly, carelessly, and lightly accept the unpleasantries of life in order to better understand and accept the origins of our unloved selves.

PRIZE FIGHTING & DOG FIGHTING: A COMPARISON OF BLOOD SPORTS

STUDENTS Ashley Bravin *Art*
ADVISORS Elaine King *Art*
ROOM/TIME Connan / 12-2:30

This proposal is intended to draw a comparison between the intrinsically brutal blood sports of early 20th century prize fighting in the United States and present-day dog fighting in the Middle East. Especially during times of social unrest, both of these sports flourished. It is my belief that the popularity of these sports is a direct response to the social, political, and economic distress of their time and serves as an outlet for the human need of expressing aggression, be it amidst the crowd or in the ring. To illustrate this comparison and the violence these two blood sports represent, I propose to create a series of large-scale, mixed media panel works that highlight the raw aggression present in both highly controversial forms of entertainment. Through a series of larger-than-life works, I intend overwhelm the viewer with a sense of undeniable relation between the two blood sports

RE-SENSITIZING THE DESENSITIZATION OF VIOLENCE

STUDENTS Ashley Bravin *Art*
ADVISORS Mary Weidner *Art*
ROOM/TIME Connan / 3-5

My proposed project for the SURG Grant is intended to draw attention to the desensitizing increases in imagery and information that are abundant on the subject of violence in our society. I believe that, in a culture constantly inundated with tweets, headlines, and video clips, it is difficult to achieve a suitable amount of time to truly contemplate some of the harrowing realities that the news and web offer us on a daily basis. As a society, I feel strongly that we should strive to stop and digest some of this information, so as to truly comprehend its meaning and impact as well as to take future action against the violence that flows in and out of our consciousness from one day to the next. To illustrate this point, I propose to involve myself in research that addresses this desensitization of violence, and to create a series of paintings and drawings that become assemblages of the text and images that so rapidly cycle through the news on the television, in the papers, and on the web.

UNSETTLING SPACE: A STUDY OF THE AMERICAN SUBURBS

STUDENTS Sarah Keeling *Art*
ADVISORS Joe Mannino *Art*
ROOM/TIME Connan / 3-5

I am creating a body of work that critiques the current state of the American Suburbs, with particular emphasis on how the designs and placement of the physical structures that comprise suburbia affect the economic and sociological functioning of a community. This body of work consists of a triptych of large prints, two interactive electronic media pieces as well as a sculptural installation. My work will be exhibited in the FRAME Gallery (located on the corner of Forbes Avenue and Margaret Morrison), from May 4th – 12th 2012.

VESTIGE OF VOLITION: THE BECOMING OF LIFE IN THE SIMULTANEOUS PRESENCE OF THE ARTIFICIAL

STUDENTS Jiyoo Jye *Art*
ADVISORS Lowry Burgess *Art*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

I am creating an installation piece that will be exhibited in the Miller Gallery in the spring semester. The installation is comprised of three large-scale paintings and a hydroponic planter sculpture made of tree trunk slices. The sculpture will be suspended from the ceiling vertically creating an immersive atmosphere for the audience. I will be collaborating with Filip Agren (CMU Bachelor of Architecture 2011) and the Research Assembly Workshop llc., a local mill shop. We will be using a CNC mill to create the sculpture piece. In the presence of these green visuals, I hope viewers can find appreciation in the co-existence between nature and man and the constant harmonization of our temperaments.

DESIGN

BIOFLUX

STUDENTS Christopher Ioffreda *Design*
ADVISORS Mark Baskinger *Design*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

Bioflux is a research project looking into biologically inspired designs and digital fabrication methods. 5 dresses draw their design language from either a texture, structure or movement taken from nature and each employes computer generated, modeled, or fabricated designs.

FORMULA SAE CAR PROJECTS FOR SPRING 2012

STUDENTS Pronoy Biswas *Electrical & Computer Engineering* | Adam Brecher *Mechanical Engineering* | Anne Dirkes *Mechanical Engineering* | Uriel Eisen *Design* | Margaret Hall *Materials Science Engineering* | Eva Humphrey *Mechanical Engineering* | Brian Langone *Mechanical Engineering* | Derek Miller *Electrical & Computer Engineering* | Jack Moldave *Mechanical Engineering* | Michael Ornstein *Mechanical Engineering* | Mark Sun *Mechanical Engineering* | Gabrielle Williams *Design* | Tom Zhang *Computer Science*
ADVISORS Reinhard Schumacher *Physics* | Satbir Singh *Mechanical Engineering*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Formula SAE creates a high performance race car from the ground up every year. We compete against hundreds of other universities around in engineering design, cost analysis, business potential, and vehicle performance. This year is focused on the development of new manufacture techniques for the car's carbon fiber body, implementation of new mass optimization strategies, and instrumentation of vehicle loads and dynamics for future development.

INCREASING THE VISUAL PRESENCE OF BIKE COMMUTERS AT NIGHT

STUDENTS Ethan Frier *Design* | Jonathan Ota *Design*
ADVISORS Stephen Stadelmeier *Design*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

We built a prototype and tested a device that will enhance the visual presence of urban biker commuters at night. Riders, most often, have only a small headlight and taillight to make their presence known to drivers and pedestrians. These small lights leave bikers vulnerable to drivers traveling perpendicular and do little to define the obscured biker; it is not intuitive to identify two blinking lights as a bicycle. We propose to create a system that requires very little maintenance, while increasing the visual footprint of bikers from all directions. We will accomplish this by expanding the surface area of light emitted through the use of LEDs along the rims of the wheels. By illuminating the wheels we hope to increase the overall presence of the bicycle from all directions and create a more intuitive and recognizable form. We intend to use the resources given to us by SURG to prototype a device as well as to test its effectiveness in making bike riders clearer to drivers and pedestrians at night.

LUX: FASHIONABLE TECHNOLOGY

STUDENTS John William Brieger *Computer Science* | Alanna Fusaro *Design*
ADVISORS Mark Stehlik *Computer Science*
ROOM/TIME Connan / 3-5

We think about what we want to wear, but not necessarily how we want to wear it. Through the use of accelerometers, cameras, and other sensors, LUX forces wearers to examine their own motions in the context of their clothing. By displaying real-time feedback in the form of light visualizations, clothing in LUX broadcasts the motions and emotions of the wearer to a larger audience. By playing with the sensitivity and programming of each garment, wearers can be nudged into performing certain actions more or less frequently. LUX seeks to examine the relationship we have with our clothing and our own bodies through wearable electronics, providing insight into our daily routines and habits.

PROJECT NUDGE

STUDENTS Shih-Chieh Chu *Design* | Michelle Reinhold *Design* | Phornpavee Saiyavath *Design* | Stephanie Yim *Human Computer Interaction Inst.*
ADVISORS Karim Kassam *Social & Decision Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Nudge is the action of giving someone a gentle reminder or encouragement. Project Nudge is an attempt to bring about more awareness regarding issues around us by subconsciously promoting positive behavior through fun and play. As Carnegie Mellon students, we are often so immersed in our lives that we become unaware of how our behavior directly impacts our personal well being, the community, and the environment. One such issue that we identified on campus is the lack of recycling. People have the notion of recycling but are not motivated to persistently recycle because of its inconvenience. With a nudge, we intend to promote better recycling habits by building an interactive recycling receptacle that when used, delivers fun audio messages submitted by members of the campus community. These audio messages will turn a mundane task like recycling into an engaging and meaningful experience for members of the campus community. Using SURG, we will build a working prototype of the receptacle and a web interface for message submissions. With a little nudge, we can make a change for the better.

DRAMA

FIRST KISS: A SHORT FILM

STUDENTS Stefan Dezil *Drama* | Yulin Kuang *English* | Benjamin Welmond *Art*
ADVISORS Jane Bernstein *English*
ROOM/TIME McConomy Auditorium / 12:30

The objective of this project is to produce a professional-caliber short-film, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of student filmmakers at Carnegie Mellon University while bringing to life the small heartaches and heartbreaks of growing up. The screenplay explores the myth of the First Kiss, through the eyes of a fourteen-year-old romantic, Adam Schoenberger, who finds out that a pretty girl in his class wants to kiss him at his best friend's Spin the Bottle party.

THE SIDEWALK PREACHER

STUDENTS Urna Biswas *Business Administration* | Anh Bui *English* | Stefan Dezil *Drama* | Brian Pettitt-Schieber *BHA*
ADVISORS Randy Kovitz *Drama*
ROOM/TIME Connan / 3-5

An uninspired painter seeks a romance with a street evangelist who struggles with faith.

MUSIC

LIVING LABORATORY: THE BALKAN BRASS BAND PROJECT

STUDENTS Robert Randazzo *Music* | Annika Socolofsky *Music*
ADVISORS Annabelle Joseph *Music*
ROOM/TIME McConomy Auditorium / 1:00

Research you can dance to! Performing concert-lectures of traditional Balkan dance music and contemporary classical cross-over, The Balkan Brass Band Project is a living research laboratory designed to expand the musical possibilities of the classical genre, and to share a musical tradition through first-hand experience—dance music. Presented, arranged, and composed by Carnegie Mellon Composers Annika Socolofsky and Robert Randazzo.

OPTICAL NAVIGATION FOR SPACECRAFT CRUISE AND ORBIT

STUDENTS Corinne Vassallo *Music*
ADVISORS William Whittaker *Robotics Institute*
ROOM/TIME Class of '87 / 3:00

Autonomous navigation is pivotal for increased landing accuracy and reduced cost of planetary missions. Performing optical navigation during orbit and transit between planets reduces the need for radio

navigation and communication with Earth, therefore increasing autonomy. A technique is presented for determining two- and three-body orbits only using cameras. During cruise, or transit between planets, position and velocity is triangulated from images of two nearby planetary bodies. Then, a time history of spacecraft states are propagated using Encke's perturbation method to predict future states. During orbit, latitude and longitude are determined by matching surface features to pre-existing maps, and then orbital parameters are calculated from these latitude and longitude estimates. Results are presented that demonstrate accuracy of 5km in the length of the semi-major axis for 100km orbits.

UNDECIDED

SUSTAINABUS

STUDENTS Kairavi Chahal *Undecided* | Kevin Chen *Information Systems* | Adrian Lam *Undecided* | Sethu Prakasam *Information Systems* | Linda Zhang *Information Systems*
ADVISORS Jeria Quesenberry *Information Systems*
ROOM/TIME McKenna / 1:00

The city of Pittsburgh in Pennsylvania has a large public transport system which serves many individuals and is integral to their lifestyles. Vast amounts of pollution that is produced could be reduced if buses are dispatched more intelligently and efficiently. In addition, the local buses in Pittsburgh, PA, in most cases, do not always arrive on time. Because of this, people start relying on other methods of transportation. If there was some way to notify bus drivers there may not be people at certain stops, then this problem could be resolved. Nevertheless, on-time transportation is becoming a problem for many people in Pittsburgh. In addition to causing tardiness, buses that pass vacant stops unnecessarily will cause extra pollution. Other problems include notion of dropping the 28x bus the coming year and society's increasing reluctance on using public transit, despite many app offerings such as CMU's Tiramisu. However, these problems can be fixed. Tracking chips such as GPS chips can be put on buses; we can improve current app offerings, and implement check-in system. Solutions aforementioned will benefit our society. In the long term, our projected savings will balance our short term expenses. Our aim is to not only sustain our planet, but also to keep it healthy so that we can reduce our carbon footprint significantly.

CROSS COLLEGE

BCSA

9BILLION: AN ALTERNATE REALITY GAME ON THE CMU CAMPUS

STUDENTS Timothy Sherman *BCSA*
ADVISORS M. Stephanie Murray *BHA* | Paolo Pedercini *Art*
ROOM/TIME Dowd / 12:20

Games have been part of human society for thousands of years. But traditionally, these games have been played in a "magic circle" – a conceptual location where a new reality is created that obeys the rules of the game – which exists outside of the bounds of the rest of the world. The advances in technology, and the prevalence of portable computers have given rise to a new type of game where the "magic circle" is extended to encompass the rest of the world. These are Alternate Reality Games, non- linear, cooperative, narrative games where the players advance and participate in the narrative by solving puzzles in both real and virtual space. My Capstone Project examines the development and dynamic change in relationships of player to player, game, and space in a game where the "magic circle" is expanded. To do this, I designed, produced, and ran an ARG on the Carnegie Mellon campus. This game involves puzzles, exploring locations on the internet and in physical space, theatrical live events, and interaction with computer programs, as well as the management of large groups of people for me. In this way, the creation and management of the game combines my concentrations of Computer Science and Directing & New Media.

COLORCALENDAR

STUDENTS Ju Young Park *BCSA*
ADVISORS Golan Levin *Art* | M. Stephanie Murray *BHA*
ROOM/TIME Dowd / 2:00

The design of this project conveys an online palette of colors where a user chooses 3 colors daily that correspond to the user's moods. This online palette will be developed as an open web-based interface that the general public has access to. The final project requires a record of at least a month's worth of data for each user. When the colors of emotions for those 30 consecutive days are connected into a 3D linear shape, the final result will look similar to the DNA helix molecule. The final 3D linear shape represents individual identity since the collected data is recorded by the user according to his or her unique interpretations of color.

FORM + CODE || APPLYING GENERATIVE DESIGN TO FASHION

STUDENTS Alexandra Wolfe *BCSA*
ADVISORS Golan Levin *Art*
ROOM/TIME Connan / 12-2:30

With the aid of the blogger saturated internet, fashion has become a highly individualized form of personal expression. Trends still have influence, but largely women today work extremely hard at building a completely unique sense of style. However, outside the small and extremely exclusive world of couture, the way fashion is produced in no way reflects this mindset. For the average consumer, clothes are created in bulk, often a copy of someone else's design, and peddled to the masses. With the aid of computational design and generative algorithms, I would like to create a fashion line that wars with this methodology. Each piece will be highly

tailored to the individual wearing it while still retaining the cohesive look of a collection, and a recognizable style of the designer. In order to achieve this, I would like to create software that takes input from the user and combines it with algorithms common to computer vision, computational photography, and generative systems to create the patterns, and then construct the final garment using a combination of digital fabrication, generative textile production and more traditional techniques. The line and software will be my Capstone project, and should elegantly summarize the work I've been doing for the past for years.

GLSL SHADERS: THEORY AND APPLICATION IN NEW MEDIA ARTWORK

STUDENTS Timothy Sherman *BCSA*
ADVISORS Golan Levin *Art* | Mark Stehlik *Computer Science*
ROOM/TIME Peter / 3-5

For my independent study, I am researching GLSL shaders, learning their purpose, the idea behind them, how to write in the GLSL language, and how to implement GLSL shaders in environments such as C++, openFrameworks, Quartz Composer, Max MSP, and more. I am then putting what I have learned into practice in cutting edge new media projects in the STUDIO for Creative Inquiry, including re-photography projects involving mapping RGB data to Point Cloud data.

MODAL: MOTIF DETERMINING AND LOCATING

STUDENTS Robert Kotcher *BCSA*
ADVISORS Roger Dannenberg *Computer Science*
ROOM/TIME Peter / 12-2:30

Traditional musical analysis methods provide ways for notes to be classified individually, as well as in the context of surrounding notes. But these methods rarely provide the analyser with insight into "bigger picture". Furthermore, these methods lack intuitive semantics, adding overhead to the process of understanding a piece of music. MODAL ("motif determining and locating") is a piece of software developed to aid composers in the composition process, and to give musical insight into the coherency of their piece or song. It allows a user to input data in standard midi format, and computes important thematic material using an intuitive new two-step technique. The user can then proceed to select one of these themes and visually map sections of the piece that exhibits its inherent thematic qualities. Finally, this process may be applied to many other suitable pattern-matching situations.

BHA

AUDIO-VISUAL IMMERSION THROUGH SYNESTHESIA: EXPLORING CONNECTIONS BETWEEN THE SENSES

STUDENTS Julie Mallis *BHA*
ADVISORS Lowry Burgess *Art* | Suzie Silver *Art*
ROOM/TIME Connan / 12-2:30

Synesthesia refers to the interconnection of sensory stimuli, a phenomenon by which a sensory perception may respond to stimuli received by other senses. This project is an exploration of my experiences as a synesthete. It seeks to capture the perceptional alterations encountered throughout my daily life, which consequently impacts my interaction with and understanding of the semantics of the world. This video functions as a personal genre piece, portraying how my experience of the mundane is frequently saturated with colors, shapes, lines and movement. These sensations that cover my visual landscape or fill my mind's eye are projected over the image in collage form. These free associations are automatic and occur with each feeling, sound, touch, and smell. Sometimes this experience can be overwhelming, chaotic, and intrusive. Other times the filled canvas of my mind can be meditative and feel profoundly complete, where every input has a perfect output, and place it belongs. The reflective structure I constructed for this video is made of mirrored Plexiglas and reproduces these stimuli in an illusory, recursive manner.

The video is derived from three different sets of overlaid footage. The first set of primarily background imagery was captured while traveling through Europe, such as the scene of seemingly infinite sunflower fields during a train ride, or the festive jousting match on the sea at the beginning. The second set comes from my portfolio of oil, watercolor, and digital paintings, animated and layered over the background to show the hidden associations inherent to the synesthetic worldview. The third set uses a green-screen and performance art to illustrate a character exploring these connections; existing in the pulsing, variegated world of her mind, while trying to navigate the "reality" behind it. The video was created in Final Cut Pro and Adobe Premiere Pro, and then further manipulated using Adobe After Effects. The final version is then projected into a three-dimensional pentagonal dome where the viewer must then navigate through the ensuing phantasm. The live installation of this piece will be on exhibit at the Miller Gallery from May 4 until May 20.

BORDERS: PHOTOGRAPHY AND STORIES FROM BURMA'S INTERNALLY-DISPLACED AND REFUGEE CHILDREN

STUDENTS Courtney Wittekind *BHA*
ADVISORS Susanne Slavik *Art*
ROOM/TIME Connan / 12-2:30

My presentation will consist of three handmade artist's books that display the results of research I conducted during the eight months I spent living at the Thai-Burma border. My research focused on the effects of forced migration on ethnic minority children and engaged two schools on opposite sides of the border through inter-views, art workshops, and arts-based activities. This presentation will display the drawings, photographs, and narratives of participating internally-displaced and refugee children. One book will present the stories and work of children who have migrated across the border into Thailand, while the second book will present the work of

children who have migrated to relocation sites or cease-fire zones in Burma. Both books will include artwork and captions, supplemented by community interviews and background research. A third book is included as introductory to the research settings.

CONSTELLATIONS ON THE FLESH AND BODIES IN THE STARS

STUDENTS Megan Ratliff *BHA*
ADVISORS Elaine King *Art*
ROOM/TIME Dowd / 3:00

This body of work explores allegories between patterns found in body art and the patterning of constellations by drawing on the human figure to create a series of large scale cyanotypes (an early photographic process). This process is a means of pushing the physical and conceptual limitations of the cyanotype process. I am urging the viewer to question the nature of drawing and photography—revealing that they can be one in the same, as well as neither. My images propose new ways of contemplating portraiture, asterisms, tattooing, and the blurry line that separates the subjective from the objective in delineating constellations through drawing on the body. This project was funded by the URO through a Summer Undergraduate Research Fellowship I received for the summer of 2011.

FLORA FEMINISTICA

STUDENTS Alexander de Ronde *BHA*
ADVISORS Patricia Maurides *Art*
ROOM/TIME Connan / 3-5

Floriography was a Victorian-era means of communication in which various flowers and floral arrangements were used to send coded messages, allowing individuals to express feelings which otherwise could not be spoken. The meanings of various plants were often assembled into a Language of Flowers book, a small field guide women used to determine appropriate flowers to gift to friends and family. In these photographs, I attempted to create a visual representation of flower culture and the Victorian-era female. Each dress represents a different flower commonly gifted in a bouquet during the time period. In addition, these hand-made dresses resemble a paper doll, a common children's toy in the 1800s. In order to modernize my project, I paired each dress with an image of that particular flower taken under an fluorescence microscope. The biological imagery was taken in the Mellon Institute and resemble the intricate textiles seen in Victorian fashion. Therefore, by completing this interdisciplinary project, I not only gained a better understanding of photography, but also biology and Victorian culture.

HOW LANGUAGE SHAPES THOUGHT: A DIGITAL EXPLANATION OF LINGUISTIC RELATIVITY

STUDENTS Samantha Zucker *BHA*
ADVISORS Daniel Boyarski *Design* | M. Stephanie Murray *BHA* | Thomas Werner *Philosophy*
ROOM/TIME Pake / 1:20

Linguistic Relativity, or the Whorf-Sapir Hypothesis, is a small and recent theory with large implications across many disciplines, as well as outside of academia. According the the theory, language influences how individuals think, process and react to their environment. The theory is one that resonates with individuals beyond the filed of linguistics. However, without proper explanation, the theory is often treated as overly lofty and

unscientific. Using the skills I have learned in desigm, I hope to better communicate this interdisciplinary idea. By making the theory more accessible, I hope it will be better examined and pursued by others in varying fields.

MODULAR MIGHTY MAGZ

STUDENTS Benjamin Howe *BHA*
ADVISORS Sharon Carver *Psychology* | Dale Clifford *Architecture* | M. Stephanie Murray *BHA*
ROOM/TIME Connan / 12-2:30

Modular Mighty Magz is a truly interdisciplinary project that combines my disciplines of architecture and psychology with education as well. Last summer, I started the research process by traveling to a professional development program between the Harvard Graduate School of Education and Harvard Graduate School of Design to see how educators and architects could work together to change the future of education. I traveled from Boston to Denver looking at children's museums and speaking with the professionals in charge to see what worked and did not work for designing exhibits for children. After preliminary research on museums and designing exhibits for children, I decided to create an educational object of my own out of the research for my dual thesis: the BXA Capstone Project and the H&SS Honors Thesis. I focused on catering to developmental milestones such as working on fine and gross motor skills through manipulation of objects while teaching concepts such as art, math, or physics. I quickly found that I was trying to conquer too much at once and focused on a single concept, that of magnetism. Modular Mighty Magz is designed to be a fun way to teach children about concepts such as magnetic poles, attraction, repulsion, and magnetic fields while adhering to the Pennsylvania Department of Education's Kindergarten Standards. The toy is also designed to foster collaboration, which I have discovered is a big push for the future of education, through the strength of the magnetic wooden blocks and design of the layout of the play space. I conducted a psychology experiment with four to six-year-old children at the Carnegie Mellon Children's School involving all the children receiving a teacher lesson on magnetism followed by a 15 minute opportunity to play with either Modular Mighty Magz or a common magnet toy, specifically Mega Magz. Though all children learned from the lesson, those who interacted with the Modular Mighty Magz learned and collaborated more. This result means that this toy has the potential to be used in schools, museums, or homes across the country for improved learning on teaching concepts about magnets.

MONITORING AND MANAGEMENT OF WATER USE AND WASTE MONITORING AT ASHESI UNIVERSITY COLLEGE, GHANA

STUDENTS Corinne Clinch *Civil and Environmental Engineering* | Julie Mallis *BHA*
ADVISORS Yonina Cooper *Computer Science* | Mary Bernardine Dias *Robotics Institute* | Malcolm Dias *Robotics Institute* | Ermine Teves *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:45

The iSTEP (innovative Student Technology ExPerience) internship program offered by TechBridgeWorld at Carnegie Mellon University brought together an interdisciplinary team of students to perform technology field research in collaboration with developing communities. This year's team is working with Ashesi University College (Ashesi) in Ghana on two environmental sustainability projects: 1) water monitoring and management, and 2) waste monitoring. In order to more efficiently utilize its water sources and handle waste in an environmentally sustainable manner, Ashesi desires the technological tools to track consumption, collection and dispersal of resources throughout the campus. During the spring semester, the team worked on the project's technical and country-specific literature review, as well as management and dissemination strategies. To

prepare for possible project solutions, the team also researched content management systems and relevant sensor options. This summer, the team will continue its research by traveling to Ashesi and performing an in-depth needs assessment to become knowledgeable about the campus' current conditions, systems, behaviors and attitudes toward the issues of water and waste among campus community members. This will be followed by solution brainstorming, prototype development, testing, and evaluation. The team approaches field work from a participatory research framework with Ashesi being an integral partner that can best articulate its priorities. The team's poster presents the project background, completed research, and continuing plans. The iSTEP team draws from the disciplines of anthropology, economics, public policy, civil engineering, computer science, and design to uniquely approach Ashesi's distinct challenges.

MUSIC AND SOCIAL CHANGE: FROM REFUGEES TO URBAN YOUTH

STUDENTS Johanna Soderlund *BHA*
ADVISORS Andres Cardenes *Music*
ROOM/TIME Class of '87 / 1:00

It is a well-known fact that music and the arts can change lives. This project aims to go beyond that idea and confront the question: "How?" What can we do with music to impact people in dire situations? Through several case studies, I examine the needs of the people and their situation, and ask how music can be used in an effective way to equip them for a better future. I present a basic model for an effective program that implements music in a way that meets the needs of the particular demographic of people, be it refugees or urban youth.

MUSIC EDUCATION AND SOCIAL PARTICIPATION: THE STRENGTHENING OF COMMUNITIES IN CHILE AND VENEZUELA THROUGH YOUTH ORCHESTRA PROGRAMS

STUDENTS Amelia Cessna *BHA*
ADVISORS Alberto Almarza *Music* | M. Stephanie Murray *BHA*
ROOM/TIME Class of '87 / 1:20

Children exposed to music education gain the advantages of cultural, social, and cognitive benefits. Music participation can include members of the community in addition to the children whom directly participate. Two Youth Orchestra foundations that promote social change, one in Venezuela and the other in Chile, are studied for impact on community participation. An analysis of differences between the musical programs, along with the cultural and socio-economic differences between the nations, investigates how each program contributes to social change and justice within the communities they service. The effects of youth orchestras in Chile and Venezuela can be applied to music education efforts around the world, including the United States. This study includes testimonies from Chilean and Venezuelan program participants and administrators.

NO AIRBRUSHING ALLOWED: EXAMINING THE NUDE PORTRAIT

STUDENTS Claire Sullivan *BHA*
ADVISORS Patricia Bellan-Gillen *Art*
ROOM/TIME Connan / 3-5

My proposed project for the summer would encompass a focused research of art history, theories, techniques, and anatomical study, as they relate to portraiture and figurative painting, as well as productive, active formal work. The desired result of these studies and executions would be in the form of a series of oil paintings. My objective is to further my own artistic output and experience, improve my technical abilities, and both gather and provide more understanding into the study of portraiture and the nude.

OPEN-ENDED PLAY WITH MAGNETIC UNIT BLOCKS: THE EDUCATIONAL AND COLLABORATIVE IMPACT OF MODULAR MIGHTY MAGZ ON 4-6 YEAR-OLD CHILDREN.

STUDENTS Benjamin Howe *BHA*
ADVISORS Sharon Carver *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The goal of this study was to investigate whether young children's collaborative play and learning about magnetism could be enhanced by open-ended play with an innovative type of magnetic unit blocks that teachers could use in conjunction with an explicit lesson about magnetism. This research was completed as part of a dual thesis: the BXA Capstone Project and the H&SS Honors Thesis. The BXA Capstone Project was dedicated to the design and construction of the toy: Modular Mighty Magz. The H&SS Honors Thesis was dedicated to the experimental evaluation of the educational and collaborative impact of Modular Mighty Magz. The four-year-olds and kindergarten children at the Carnegie Mellon Children's School participated in four different assessments. Children were given a three part pre- and post-test interview that asked questions about magnets and magnetic fields, magnetic poles, and magnetic versus non-magnetic objects. Between the pre- and post-test interviews, the children's teachers did a group lesson about magnetism during circle time and then gave the children time in groups of four to play with either Modular Mighty Magz or a common magnet toy, Mega Magz, in a separate room for 15 minutes. The play time was used to determine the collaborative impact of Modular Mighty Magz versus Mega Magz. A 2 (age [four-year-olds/kindergarten]) x 2 (toy [Modular Mighty Magz/Mega Magz]) mixed design ANOVA was conducted for all four of the dependent measures. Overall the results showed that every child improved, with kindergartners performing better than the four-year-olds, between the pre- and post-test interviews on the magnet and magnetic field questions and magnetic pole questions. This demonstrated the creation of an effective teacher lesson. There was a three-way interaction between age, toy used, and the magnetic versus non-magnetic object questions. It was determined that the four-year-olds did not improve on this test or have any benefit in which toy they used. However, the children who were given Modular Mighty Magz and were in kindergarten had a significant improvement in responses to these questions whereas those who got the Mega Magz did not improve on their scores. Also an independent samples t-test was conducted that compared the time of collaboration with Modular Mighty Magz versus Mega Magz. Children in both age groups spent significantly more time collaborating with the Modular Mighty Magz than with the Mega Magz. In conclusion, overall all the children improved on their understanding of magnetism through an effective teacher lesson. Also, even with only a 15 minute play session, the materials I designed, Modular Mighty Magz, were more effective in improving magnetic concepts for the kindergartners on magnetic versus non-magnetic object questions and in promoting collaboration for all ages.

OUTDOOR STUDIO INSTALLATION: CYERT CENTER FOR EARLY EDUCATION

STUDENTS Francesca Fenzi *BHA*
ADVISORS Larry Cartwright *Civil and Environmental Engineering* | M. Stephanie Murray *BHA*
ROOM/TIME Class of '87 / 4:00

The Outoor Studio Installation is a collaborative design and construction effort between the Cyert Center for Early Education and Francesca Fenzi, a senior fine art and creative writing student at Carnegie Mellon University, to produce a functional outdoor learning space that can be used to promote student creativity and foster tactile learning.

PRESENT PERFECT, PAST TENSE: LEADERSHIP, LANGUAGE, AND THE ART OF THOROUGHLY MODERN MUSIC-MAKING ON HISTORICAL INSTRUMENTS

STUDENTS Maria Raffaele *BHA*
ADVISORS M. Stephanie Murray *BHA*
ROOM/TIME McConomy Auditorium / 1:30

If you asked around the world of mainstream Classical music today, both members and participants see themselves as in danger of extinction. Classical music desperately needs individuals able to bring about productive and positive change—leaders. On the fringes of mainstream classical music sit two specialist genres often ignored by mainstreamers: early music and new music. These two fields are the "true growth industries" in classical music, where productive and positive change has been ongoing, and worries about extinction are the last thing on most professionals' minds. Since the genesis and maintenance of productive/positive change relies upon dynamic and highly effective leadership, it follows that at the heart of the success in new and early music lie individual leaders with strong abilities in the areas of language and rhetoric. As a historical performance specialist and a member of the wider classical music profession, I have a vested interest in determining the source of the new and early music fields' continued success. So I decided to analyze the rhetoric—found in on/off-stage spoken word, paper and online publicity, and supplementary performance materials—of a number of leading professionals and ensembles in one of these two fields (early music), and thus investigate the correlation between these individuals' positions as leaders and their rhetorical and linguistic abilities. At Meeting of the Minds I will apply my analyses in an early music concert-lecture of my own programming, design, and performance.

PRO: EMPOWERING WOMEN OF DIFFERENT CULTURES THROUGH OFF-MARKET FASHION

STUDENTS Anya Weitzman *BHA*
ADVISORS Carol Kumata *Art* | M. Stephanie Murray *BHA* | Dr. Noel Gazzano *Anthropology of Fashion Professor, Lorenzo de' Medici Institute (Florence, Italy)/Marist College (NY)*
ROOM/TIME Dowd / 4:20

PRO is pro-woman, proactive, and professional. PRO is an investigation into which fashion elements women find most empowering, with the end goal of translating anthropological research into the design and fabrication of ensembles expressing strength, power, and true agency. Through interviews and discussions with women from different walks of life in two very different locations, Pittsburgh, PA and Florence, Italy, I have witnessed distinct opinions and frustrations with fashion as an industry and as a social medium. Despite the vast differences between these women, consistent themes emerge. Fashion is a relevant mode of self-expression

that extends beyond brands, and beyond clothing. Women, as human beings, desire and deserve comfort and security in their fashion options, which leads to self-confidence. I have used this research to construct a collection of nine garments, in response to each individual woman's taste, in an attempt to create fantasy outfits promoting empowerment. Through the struggle to make opinion and personality material, I have come to better understand the inherent flaws in mass-produced fashion and high end branding. From this perspective, I am analyzing the flawed ways we look at women.

RESURRECTING THE HOMESTEAD STEELWORKS

STUDENTS Samuel Lavery *BHA*
ADVISORS M. Stephanie Murray *BHA* | Diane Shaw *Architecture*
ROOM/TIME Connan / 12-2:30

How can we apply cutting-edge technology to the traditional practices of historic preservation? Can we recreate buildings that have been demolished for decades or even centuries? Is such an endeavor worth the trouble—does a building that only exists in the memory of some people have any meaning for those who don't know it ever existed? Working with the Rivers of Steel National Heritage Area, my BXA Capstone project will focus on Pittsburgh's industrial legacy, specifically the steel mills in and around Homestead, PA. For better of for worse, these mills have mostly been demolished and replaced with big box stores. The goal of this project is to use technology to recreate a significant piece of Pittsburgh's architectural and economic past. Using QR-code linked web pages, I will present images, videos, and written histories in an accessible format to visitors. Archival documentary footage and pictures will be used to explain the steel-making process to visitors and to portray the significance of this mill to Pittsburgh's history. Tourists and casual shoppers alike will be able to see in their Smartphone web browser what once was, creating a direct link with history. In addition, I will be experimenting with laptop-based augmented reality technology to overlay 3D models of the original industrial buildings. By virtually rebuilding several sections of the mills that have been demolished, I will give visitors a better sense of the size and scale of the industry that once dominated this region.

SENSORY

STUDENTS Tome Saidon *BHA*
ADVISORS Mary Weidner *Art*
ROOM/TIME Connan / 3-5

My work fuses dark and light to create organic forms and amorphous shapes. Elegantly revealing tensions between seemingly simple fragments of life and the ethereal, fusing, eroding and vanishing into smoke-like abstractions. There is a sense of chaos and I strive to create a visceral emotional feeling amongst the viewer. Through these galactic, biological abstract forms I explore the idea of spontaneity of art before the development of representational art. I am exploring art in its development stages. A scribble of an unknown abstract form can be nearly any trace left by a drawing implement that is un-interpretable by anyone other than the scribbler. Scribbles presumably provide the basis upon which a child will build artistic skills and such a basis is necessary for later development. My drawings explore this early developmental stage and how the developmental spontaneity of a scribble stays with us forever.

SOCIETY IN THE SITCOM: A MULTIMEDIA GUIDE TO THE REFLECTIONS OF CONTEMPORARY POLITICS AND CULTURE IN ARRESTED DEVELOPMENT

STUDENTS Christine de Carteret *BHA*
ADVISORS Andrew Masich *History* | M. Stephanie Murray *BHA*
ROOM/TIME Connan / 12-2:30

By combining my skills in research and sociological analysis with my skills in visual and experiential design, I have created an engaging interactive experience proving that cultural richness can be found in levity and entertainment through the examination of comedic semiotics. This multimedia guide demonstrates how the TV show Arrested Development encapsulated the popular culture and political climate of its era (2003-2006). Components include a footnoted video, a graphic timeline illustrating cultural references on the show as compared with their real-world occurrences, and a written article examining the semiotics of the show. I hope through this exhibit to facilitate the use of entertainment in the study of history and society.

SOMALI DIASPORA: CONNECTING REFUGEES FROM THE NETHERLANDS TO PITTSBURGH THROUGH A CREATIVE YOUTH EXCHANGE

STUDENTS Julie Mallis *BHA*
ADVISORS Marie Norman *History*
ROOM/TIME McKenna / 12:20

The last decade has seen an escalation in the Somali Diaspora, with 14% of the population living outside of the country, many refugees now reside in Europe and North America. Using ethnographic methods of interviewing, participating, and observing throughout the Netherlands and Pittsburgh, I have conducted a study and formed an analysis about the assimilation and tolerance of Muslim refugees in secular nations, especially in relation to the experience of youth managing two cultures. Over 75% of the 201 Somali Bantu refugees in Pittsburgh are youth enrolled in an American school. The unique challenges presented by globalization affect how a student can manage two cultures. It is important to consider how this process affects the immigrant on personal, familial, and societal scales. Refugee children are placed in a unique situation transposing them from a developing country rife with intense violence, food insecurity, and political instability to a highly industrialized nation. They are subject to discrimination and intolerance on account of their outward appearance, speech and cultural practices. Assimilation is more than learning the language and understanding social law, but gaining the means to be self-sufficient. This ethnographic account considers two-generations of Somali assimilation over time in the Netherlands and recent one-generation assimilation in America. Through a digital creative arts exchange between youth in both countries, the students used various technology to send letters, drawings, use the GigaPan camera, take photos, and create artwork about their experiences as refugees. The relative accomplishments of the Somali population in the Netherlands show that success is possible in a secular, Western country. If given access to the necessary resources and a receptive ear for their concerns, the prospects for Somalis in the United States are good.

SPATIAL AND ANALYTICAL STUDY OF STUDENT HOUSING AT CARNEGIE MELLON UNIVERSITY

STUDENTS Shannon Lauricella *Science and Humanities Scholars* | Samuel Lavery *BHA* | Ariel Liu *Computer Science* | Terra Mack *Psychology* | Alejandra Munoz Munoz *Architecture*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Carnegie Mellon is an urban university with many students living off-campus. Finding housing off-campus is generally left up to individual students, who take into account many variables when choosing a house or apartment. We are interested in investigating the possibility of a correlation between where students choose to live and what they choose to study. Our research presentation seeks to answer questions about the dynamics of student housing at CMU. Is there a correlation between address and major? Do students in certain majors cluster together? Which off-campus neighborhoods are most popular with undergraduate students versus graduate students? Our poster provides visual evidence for the statistical correlations found pertaining to these questions.

STRANDED ON POETRY ISLAND

STUDENTS Madeleine Barnes *BHA*
ADVISORS Lowry Burgess *Art* | James Daniels *English* | M. Stephanie Murray *BHA*
ROOM/TIME Connan / 3-5

This project examines the effects of technology on the process of writing poetry. I will be presenting handwritten drafts of poems, a manuscript of poems that were written on an electric typewriter, and a book of photographs and poems created using digital software. I will exhibit a poster that shows the processes of creating these manuscripts in different stages. The point is to examine the question of the original: what is the value of writing with your hand? Does technology distance the writer from language or bring them closer? What is the value of having an original work of art, and how does technology alter the aura of a book? Finally, I will be sitting with my work for awhile writing poems on the electric typewriter as an experiment and a way to talk with people about their creative processes and thoughts on writing and reading poetry.

SYMPATHY FOR MEPHISTOPHELES: A VISUAL STUDY OF ALTERNATIVE SPIRITUALITY IN GERMAN LITERATURE

STUDENTS Meagan Trott *BHA*
ADVISORS Stephen Brockmann *Modern Languages*
ROOM/TIME Connan / 12-2:30

Our culture is a tug-of-war between two spiritual extremes. Secularism pulls in one direction, and conservative Christianity pulls in the other. This leads to conflict not only on a national level, but also on a personal level. It is this personal level – the inner conflict – that I aim to remedy. German authors Goethe, Rainer Maria Rilke, and Hermann Hesse introduce us to a middle path. They rejected the dominant religious culture of their times, and yet they remained deeply spiritual people. Their works demonstrate how they achieved this balance. I want to make these authors and their ideas, which I greatly admire, more visible to the American public. To accomplish this, I plan to create an edition of hand-bound books that respond to the spiritual themes in these authors' writings and connect them to my own experiences in 21st-century America. They will contain

both English and German text, as well as reproductions of original oil paintings and drawings. My goal is that these books will inspire others who, like me, seek balance and meaning in our conflicted culture.

THE BODY AND SKY AS SOCIAL FIELDS: A CROSS CULTURAL LOOK AT TATTOOING AND ETHNOASTRONOMY

STUDENTS Megan Ratliff *BHA*
ADVISORS M. Stephanie Murray *BHA* | Judith Schachter *History*
ROOM/TIME Connan / 3-5

The sky and human body are both social fields in which every society imbues with meaning. Tattooing is a means of projecting personal philosophies onto bodily flesh, and ethnoastronomy (the invention of asterisms and constellations) is a means of projecting communal worldviews into celestial flesh. My research juxtaposes these systems in order to make sense of each other as different means of establishing physical and cultural locality. By studying the functional uses of tattooing and skylore within various societies, namely the Maori and Japanese, I have found common ground between two of the most disparate expressive modes. This project was funded by the URO through a Small Undergraduate Research Grant, which I received for the spring of 2012.

THE BRIDGE MAGAZINE

STUDENTS Daniel Lipson *BHA*
ADVISORS Paolo Pedercini *Art*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

My objective with my project is to make a campus-wide video game publication, created with the goal of uniting students from various disciplines with a universal shared interest of games. I want to create something that will spark enough interest to give it a lasting presence on campus, especially with younger students. The project itself combines knowledge I've gained from working in animation and game design in CFA, as well as forming a relationship with GCS (and other campus groups), with the lessons learned both at The Tartan (and other campus publications) and my writing in H&SS. The ultimate goal is to promote interdisciplinary thinking in the larger community through the use of gaming.

THE IMPOSTER

STUDENTS Emma Olsen *BHA*
ADVISORS Richard Pell *Art*
ROOM/TIME Connan / 12-2:30

An art project exploring the perspective of the victim in a superhero story, told through comic book format on canvas.

THE OLD WALLS: THE FUTURE IN ART THAT FEDERAL THEATRE GAVE US

STUDENTS Ismail Smith-Wade-El *BHA*
ADVISORS Michael Chemers *Drama*
ROOM/TIME McKenna / 3:20

The Federal Theatre Project of the Works Progress Administration had a profound effect on the way that we make and fund art in this country, notwithstanding the careers it launched and the theaters for which it developed renown. After losing its funding in 1939, what had the FTP changed about art in America?

THE SIDEWALK PREACHER

STUDENTS Urna Biswas *Business Administration* | Anh Bui *English* | Stefan Dezil *Drama* | Brian Pettitt-Schieber *BHA*
ADVISORS Randy Kovitz *Drama*
ROOM/TIME Connan / 3-5

An uninspired painter seeks a romance with a street evangelist who struggles with faith.

THROW AWAY YOUR FEARS: AN EXPLORATION OF PUBLIC FEAR THROUGH INTERACTIVE ART

STUDENTS Samantha Zucker *BHA*
ADVISORS Daniel Boyarski *Design*
ROOM/TIME Class of '87 / 4:20

theFearbox is an interactive public art-based research piece that has traveled to four locations in the Pittsburgh community. From these locations and an additional blog, over 500 fears were collected by voluntary participants. Statistical analysis combined with historical and scientific research has led to a full gallery exhibit that is comprehensive on the topic of fear.

TRAVELLING IN SALVADOR, BRAZIL: JOURNEYS IN NAVIGATING CULTURES, DIRECTIONS AND IDENTITY

STUDENTS Prisca Ohito *BHA*
ADVISORS Patricia Bellan-Gillen *Art*
ROOM/TIME Connan / 12-2:30

While my primary objective of this SURG Proposal is to illustrate the narratives of how: I came to travel in Salvador, Bahia, Brazil; transition back to American culture; and acquire knowledge of Portuguese, this project will contribute to a variety of scholarly fields. It will incorporate artistic research into the concepts of wayfinding, symbolism/signage, and map making. Additionally, these concepts form a framework to discuss personal and national identity. Finally, the printmaking method – monoprinting -- will make for a boxed limited edition set of my artwork to disseminate at Meeting of the Minds.

UP, DOWN AND AROUND A STAIRCASE: INVESTIGATING THREE-DIMENSIONAL MENTAL REPRESENTATIONS OF SPACE

STUDENTS Rachel Franz *BHA*
ADVISORS Roberta Klatzky *Psychology*
ROOM/TIME Connan / 12-2:30

The installation applies research in spatial cognition to create an interesting and potentially informative experience for viewers. The installation attempts to shed light on viewers' mental representations of space where movement occurs in both horizontal and vertical dimensions by identifying the aspects of the experience that impose spatial cognitive demands. Live video images from digital video cameras placed at various locations in the College of Fine Arts stairwell were manipulated and projected onto a wall above the stairs. Volunteers were asked to indicate the locations of the cameras in a questionnaire. There is evidence to support that we encode spatial information relative to a conceptual "north" which we designate based on views of a space. The project investigates 1) whether the horizontal "north" or vertical "top" is dominant in our mental representations of space where we move horizontally and vertically and 2) whether ground-level perspectives facilitate an understanding of corresponding aerial perspectives of a space. The live video images are oriented to make the horizontal and vertical positions of the cameras ambiguous. Corresponding ground-level views are displayed alongside the aerial views to help the viewer infer the locations of the cameras.

BIOLOGY AND PSYCHOLOGY

BEHAVIORAL RESPONSE TO POSITIVE EMOTIONAL DISTRACTERS DIFFERENTIATE YOUTH WITH ADHD BASED ON FAMILIAL RISK OF BIPOLAR DISORDER

STUDENTS Clare Bozso *Biology and Psychology*
ADVISORS Lori Holt *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Attention deficit hyperactivity disorder (ADHD) is one of the most common co-morbid psychiatric disorders found in pediatric bipolar disorder (BD), and is highly prevalent in youth at familial risk of BD. BD and ADHD include symptoms that reflect deficits in the self-regulation of emotion. Yet little is known about the specificity of such deficits in youth with ADHD at familial risk of BD. In this study, differences in behavioral performance on an emotional working memory task were examined in 47 offspring (8-17 years), including offspring with ADHD having a parent with BD (ADHD-BD), offspring with ADHD having healthy parents (ADHD), and healthy offspring of healthy parents (CONT). Participants completed a 0- and 2-back visual working memory task flanked by emotional distracters (no picture, neutral, negative, positive). ADHD-BD youth showed significantly faster reaction times on the 0-back condition compared to the ADHD and CONT youth. These faster reaction times were also negatively correlated with levels of positive affect and positively correlated with depression symptoms. These preliminary findings suggest that youth with ADHD at familial risk of BD may process positively valenced emotional stimuli differently than those with ADHD but without a familial risk of BD. Neuroimaging data with this task will serve to elucidate underlying neural risk markers that can provide direction for specific treatment of ADHD for those having a family history of BD.

NEWLY FORMED SOUND-ACTION ASSOCIATIONS ELICIT AUDITORY-MOTOR PRIMING

STUDENTS Nicolas Zuniga-Penaranda *Biology and Psychology*
ADVISORS Laurie Heller *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:15

We aimed to study the priming of manual actions by naturally and artificially associated sounds. Previous studies have reported on related cross-modal priming, such as of manual actions by visual stimuli (Brass et al. 2000) (Masson et al. 2011). Castielle et al. (2010) demonstrated that recorded response sounds could be used to elicit affordances for reach-to-grasp actions. In addition, neuroimaging studies (Aziz-Zadeh, 2004) have shown that listening to sounds of human actions activates motor networks in the brain, and suggest that priming a manual action by playing a corresponding sound (i.e. auditory-motor priming) should be possible. This poster presents a series of three experiments that explored auditory-motor priming. In these experiments, subjects were first trained to associate a sound A (sounds varied across experiments) to an action with their left hand, and a sound B to a right-hand action. After training, subjects heard the sound A or B as a prime, followed by a directional command. Subjects would respond with the hand corresponding to the direction "left" or "right". Primes and directions varied independently, so movement accuracy and reaction time were measured as congruent, incongruent, or null (no prime) trials. The presence of auditory-motor priming between these primes and actions was predicted to cause facilitation or shorter reaction time in congruent trials, and inhibition or longer RTs in incongruent trials. Experiment 1 used natural sound-action pairings: scrapes and taps. A priming effect was observed. Experiment 2 determined whether, for priming to occur, the sound-motor association must exist prior to the study or could be learned during the course of the study. This was accomplished by removing the sounds produced by the scrape and tap actions. To test whether it was important that the priming sounds be related to the gestures, Experiment 3 used arbitrary gesture-sound associations by pairing button presses with tones of varying frequencies. Though experiment 1 showed a priming effect by comparing RTs in congruent vs. incongruent trials, experiment 2 evinced no priming effect. Finally, the successful use of artificial sound-action pairings to create the priming effect in experiment 3 demonstrates that auditory-motor priming can be produced by recently learned sound-action pairings.

PRIMING OF MANUAL ACTIONS BY THEIR RELATED SOUNDS

STUDENTS Nicolas Zuniga-Penaranda *Biology and Psychology*
ADVISORS Laurie Heller *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:00

We aimed to study the priming of manual actions by naturally and artificially associated sounds. Previous studies have reported on related cross-modal priming, such as of manual actions by visual stimuli (Brass et al. 2000) (Masson et al. 2011). Castielle et al. (2010) demonstrated that recorded response sounds could be used to elicit affordances for reach-to-grasp actions. In addition, neuroimaging studies (Aziz-Zadeh, 2004) have shown that listening to sounds of human actions activates motor networks in the brain, and suggest that priming a manual action by playing a corresponding sound (i.e. auditory-motor priming) should be possible. This oral presentation discusses a series of three experiments that explored auditory-motor priming. In these experiments, subjects were first trained to associate a sound A (sounds varied across experiments) to an action with their left hand, and a sound B to a right-hand action. After training, subjects heard the sound A or B as a prime, followed by a directional command. Subjects would respond with the hand corresponding to the direction "left" or "right". Primes and directions varied independently, so movement accuracy and reaction time were measured as

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BSA

MUSIC AND THE BRAIN

STUDENTS Michael Chait *BSA*
ADVISORS James Ferla *Music*
ROOM/TIME Class of '87 / 3:20

Music listening, performance, and composition engage every area of the brain and identified neural subsystem. Brain-imaging technologies, neurotransmitter manipulating drugs (dopamine and serotonin) and neural network models have been analyzed to better understand how the brain processes the musical components of pitch, harmony, rhythm, timbre, and dynamics. The latest research on musical meaning and pleasure in cognitive neuroscience studies provides insight into many issues of musical meaning and perception including why the same piece of music affects people differently regardless of personal preference and taste. Research has also shown how music is categorized and how an emotional response is stimulated. A better understanding of how music is processed can ultimately provide insight into individual motives, fears, desires, memories, and even communication methods.

DIETRICH COLLEGE OF HUMANITIES & SOCIAL SCIENCES

ECONOMICS

A POLITICAL SURVEY OF THE CMU COMMUNITY

STUDENTS Dev Doshi *Computer Science* | Emily Gehrels *Science and Humanities Scholars* | William Weiner *Social & Decision Sciences* | Crystal Wray *Economics* | Pavan Yalamanchili *Biological Sciences*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

We are seeking a measurement of each respondent's stance on social, political, economic, and election issues. We will obtain demographic information (age, gender, student/faculty/staff, major/department, QPA) and see if there is a relationship between the demographic information and stance. That is, can we predict a person's political leaning or election behavior given their demographic information? Also, we want to ask how representative of the US population the CMU community is.

ARE LUXURY GOODS PRO-CYCLICAL? STUDYING THE VOLATILITY EFFECTS

STUDENTS Courtney Chin *Economics*
ADVISORS Yaroslav Kryukov *Economics*
ROOM/TIME Dowd / 1:20

Luxury goods are considered to be pro-cyclical by some market analysts, and this is one fact I wish to determine true. American companies that are representative of such goods cater mainly to the top decile of households in the United States, and thus seem representative of the industry. I plan to build a 'luxury' index from luxury company stocks, test its returns and implied volatility against economic factors and the S&P 500, and then examine each individual luxury company's key ratios and profits to confirm. A disproportionate number of stockholders fall into the top twenty percent of wealthiest households – supporting a claim that over 60% of U.S. GDP is funded by less than 20% of citizens. Given this large market share, if we find luxury goods are pro-cyclical, then we can see a "wealth effect" in market changes; the wealthiest will invest more than average during bull markets and less than average in bear markets. Finally, I will model this behavior and see if Modern Portfolio Theory and the Capital Asset Pricing Model are still relevant in today's market, or if any significant volatility patterns emerge.

CENSUS ON PARKING METERS AT CARNEGIE MELLON UNIVERSITY

STUDENTS Nancy Geronian *Economics and Statistics* | Jungmoon Jang *Statistics* | Jeff Lee *Statistics* | Kaylee Makel *Economics* | Victor Wilczynski *Economics*
ADVISORS Mark Friedman *Biomedical Engineering* | Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Coin parking meters are becoming a rarity in today's technologically advanced era, so why at Carnegie Mellon has there not been a technological improvement in terms of parking on its campus since CMU is known for being such a big tech hub? In reality, Carnegie Mellon is in working stages of implementing technological improvements in terms of parking on its campus (i.e. Traffic21, ParkPGH). We want to survey on campus parking meters to determine if there is a high frequency in unpaid meters. To add, we would like to see if there are any correlations between other factors, such as owning an expensive car, time of day, etc. This project is very

interesting for anyone who uses the parking meters on campus, especially those who have been ticketed for parking violations.

CREATING VIRTUAL MARKETPLACES FOR THE COMMODITIZATION OF RENTAL SPACES

STUDENTS Jonathan Francis *Electrical & Computer Engineering* | Zhijun Huang *Economics* | Kenneth Wong *Mathematics*
ADVISORS Carol Goldburg *Economics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:30

Our research team has identified specific difficulties and frustrations that prospective renters and property owners have encountered, whilst transacting over residential entities (i.e., houses, lofts, apartments, garages, parking spaces, etc). We have developed mitigation strategies that may be used to overcome those market challenges and issues that are hereafter mentioned, while still assessing how such variables as "distance from campus", "type of housing", "price", "area", etc. affect user tastes and preferences.

DEVELOPING LEGAL REQUIREMENTS SPECIFICATION LANGUAGE TO ANALYZE SOFTWARE- AND ARCHITECTURE-RELATED REQUIREMENTS

STUDENTS Swati Gupta *Economics*
ADVISORS Travis Breaux *Robotics Institute*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:30

The rising popularity of information systems that store users' personal information has elevated the need to protect and ensure user privacy as well as security. Presently, a wide array of laws and regulations govern these systems, making it difficult for system developers and engineers to manage their products and services. My research involves extending the computational capabilities of the Legal Requirements Specification Language (LRSL) under the guidance of Prof. Travis D. Breaux and his PhD student David G. Gordon. The LSRL allows document authors and software requirements engineers to codify policy and law by enabling them to design, debug, analyze, trace and visualize relationships among requirements from various policies and regulations. My work especially focusses on augmenting the functionality of a java-based parser used for analysis of software- and architecture-related requirements obtained from legal texts.

EFFECT OF FINANCIAL CONSTRAINTS ON INNOVATION RACES AND CLINICAL TRIALS

STUDENTS Swati Gupta *Economics*
ADVISORS Yaroslav Kryukov *Economics*
ROOM/TIME Dowd / 3:40

Heart disease is the number one killer in the United States with more than 800,000 people dying from heart disease each year. This growing burden of cardiovascular diseases represents a multibillion dollar drug market that a number of pharmaceutical companies have been trying to tap into. This paper focuses on the innovation race between several companies to use Ribonucleic Acid interference (RNAi), a process within living cells that moderates the activity of genes, to treat hypercholesterolemia, hyperlipidemia and other cardiovascular diseases related to high cholesterol levels. Press releases, company finances and clinical trial results are analyzed to study the effects of competition and financial constraints on this race to successfully use RNAi technology to knock down cholesterol levels.

INTERNET PIRACY AT CMU: STUDENT BEHAVIOR & OPINIONS

STUDENTS James Bogie *Statistics* | Benjamin Gorman *Economics* | Chelsea Grindle *Mathematics* | Jongwoo Lee *Statistics* | George Nardi *Philosophy* | George Volichenko *Statistics*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Throughout the latter half of 2011 and the early months of 2012, internet piracy and copyright enforcement have been at the forefront of legislative debates, media coverage, and corporate public statements. The harsh reaction from the internet community (online institutions such as Google, Wikipedia; frequent users of social media such as Facebook, Twitter) in response to the proposed SOPA and PIPA bills suggest that there are divergent, strongly held convictions amongst the population on how to deal with copyright enforcement in the information age. We are surveying Carnegie Mellon undergraduates to see how often they engage in internet piracy and what opinions they hold on related copyright enforcement legislation. Our data-collection tool is an anonymous, self-administered online survey sent to a random sample of undergraduate students. The survey contains questions regarding the types of piracy students engage in, their views on the ethics and legality of piracy, and what steps students take to find media entertainment online. Our survey results will hopefully be indicative of the views of high-performing university students nationwide, offering insight into how the most computer-literate segment of the population approaches pirated media. The conclusions we reach will be of interest to politicians shaping copyright enforcement legislation, media companies hoping to tweak their monetization strategies, and citizens wondering how others may judge what is largely a private behavior.

THE DETERMINANTS OF SELF-EMPLOYMENT IN MEXICO AND HOUSEHOLD TRANSITIONS BETWEEN 2002 AND 2005

STUDENTS Ya Qi Niu *Economics*
ADVISORS Rebecca Lessem *Economics*
ROOM/TIME McKenna / 1:40

The study of self-employment has been an intriguing phenomenon in many developing countries. It is, however, difficult to pinpoint the reason for the presence of self-employment. Some argue that it is a matter of choice, in which people utilize their creativity to realize their business ideas. Others argue that it is a form of involuntary unemployment, because the formal labor market sector failed to supply sufficient jobs to meet the work force's needs. In this paper, I analyzed the case of Mexico using Mexican Family and Life Survey found the following results: Asset level, household size, high school education are significant in explaining a household's decision to be self-employed. The number of members per family that is self-employed depends on the household size, high school education, and the asset group of the household. Lastly, the transitions from self-employment to labor market and vice versa is not homogeneous across asset levels.

THE RISING COST OF DIABETES CARE: ANNUAL AND GEOGRAPHIC VARIATIONS IN EXPENDITURES, DECOMPOSED BY PRICE AND UTILIZATION

STUDENTS Ashish Thakrar *Economics*
ADVISORS Martin Gaynor *Economics*
ROOM/TIME McKenna / 3:00

This project aims to analyze health care spending for privately insured individuals with diabetes in the United States. Within anenvironment of rising health care costs for a host of diseases, diabetes is especially costly and pervasive. In 2010, approximately $194 billion was spent on diabetic and prediabetic care—accounting for about 7% of total U.S. health spending. By 2020, annual spending is expected to reach $500 billion, and prevalence is predicted to reach 52% of the U.S. adult population, up from 40% in 2010. Thus there is considerable insight to be gained from analyzing increases in spending for this particular disease, with potential applicability to other chronic illnesses as well.

WHAT'S THE DEAL WITH FREE SHIPPING?

STUDENTS Lyubov Zeylikman *Economics*
ADVISORS George-Levi Gayle *Economics*
ROOM/TIME McKenna / 2:00

In the current Internet era, where roughly 33% of the world population is using the internet, online shopping has become the third most popular Internet activity. Various free shipping schedules are popular and currently close to ubiquitous in today's e-commerce. Utilizing David Bell's 2005 research study, this paper aims to run an experiment testing 6 pricing schedules under varied free shipping thresholds. 40 participants will play a simulated game with 3 periods, a set budget and a payout at the end. We will observe their behavior predicting that they would spend more than the optimal amount in situations where there is a mid-sized threshold to receive free shipping.

ECONOMICS AND STATISTICS

ANALYSIS OF FILM DISTRIBUTOR'S ITUNES PROMOTION

STUDENTS Elizabeth Lorenzi *Statistics* | Joon Su Min *Economics and Statistics* | Laura Patzer *Statistics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

We analyze the success of a promotion run by a major American film distribution company, which, for confidentiality reasons, we refer to as Distributor X. This promotion involved systematically decreasing the price of some of Distributor X's films on iTunes during the holiday seasons of 2010 and 2011. We have sales and revenue data for 389 of Distributor X's films. While iTunes was given permission to choose any of these films for promotion, not all of them were actually placed on promotion. We define the success of the promotion by the presence of an increase in revenue and/or sales while the film was on promotion. We have information regarding the films' genre, International Movie Database (IMDb) ratings, and how many clicks it took to find the film

on iTunes while they were being promoted (for instance, one click means the film was featured on the front page of iTunes). We additionally have promotional Tier information. Each of the films that were qualified to be placed on promotion were categorized as Tier A, B, C or D. A film's tier classification roughly corresponds to the popularity of the film with Tier A films being the most popular. Exploratory data analysis show that while the majority of revenue was brought in by Tier A and B movies, the lower Tier movies were impacted by the promotion the most.

We build a model that will predict the additional revenue an individual film should generate for Distributor X while on promotion. We then also use our exploratory data analysis and model construction to formulate future promotion ideas for Distributor X that could help maximize revenue.

CENSUS ON PARKING METERS AT CARNEGIE MELLON UNIVERSITY

STUDENTS Nancy Geronian *Economics and Statistics* | Jungmoon Jang *Statistics* | Jeff Lee *Statistics* | Kaylee Makel *Economics* | Victor Wilczynski *Economics*

ADVISORS Mark Friedman *Biomedical Engineering* | Brian Junker *Statistics*

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

Coin parking meters are becoming a rarity in today's technologically advanced era, so why at Carnegie Mellon has there not been a technological improvement in terms of parking on its campus since CMU is known for being such a big tech hub? In reality, Carnegie Mellon is in working stages of implementing technological improvements in terms of parking on its campus (i.e. Traffic21, ParkPGH). We want to survey on campus parking meters to determine if there is a high frequency in unpaid meters. To add, we would like to see if there are any correlations between other factors, such as owning an expensive car, time of day, etc. This project is very interesting for anyone who uses the parking meters on campus, especially those who have been ticketed for parking violations.

ESTIMATING THE EMPIRICAL HAZARD FUNCTION OF THE GOAL-SCORING PROCESS IN ICE HOCKEY

STUDENTS Stephen Ma *Economics and Statistics*

ADVISORS Andrew Thomas *Statistics*

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

Much of previous research has assumed that the goal-scoring process in hockey follows Poisson process with a constant hazard rate. This research project uses a myriad of statistical approaches to show the inadequacies of assuming an constant hazard rate, and attempts to find a more fitting function that demonstrates how the goal-scoring rate changes over time.

MEDIATION ANALYSIS: EXPANDING FROM ONE MEDIATOR TO MULTIPLE MEDIATORS

STUDENTS Brittanie Boone *Economics and Statistics*

ADVISORS Howard Seltman *Statistics*

ROOM/TIME Class of '87 / 2:00

Mediation analysis is the process of determining whether or not variables acting as an in-between step, called mediators, are present when looking at the relationship between an independent variable X and a dependent variable Y. An educational study was proposed to analyze the effect of different classroom environments on

students' performance. This study also measured if the student is on-task or off-task, and if off-task what type of distraction is the student distracted by. It is believed that the particular types of distractions are the mediators and act as an in-between step between the type of classroom environment and how well the students perform. This is what motivated the idea of multiple mediators and the question of how to deal with them. However, previous research that has been done has only looked at single mediators. My research is based on the Product of Coefficients approach (Sobel, 1982). Multiple mediators were analyzed separately or used principal component analysis. Simulated data was used to determine how well these tactics accurately detect mediation. It appears that detecting mediation when there are multiple mediators present is very feasible, and this paper will show the results of this analysis. Finally, this paper also compiled the functions into a statistical package in R, making it easier to analyze data with multiple mediators.

REALTIME-FLUID SIMULATION AND RENDERING

STUDENTS Tadas Zolynas *Economics and Statistics*
ADVISORS Kayvon Fatahalian *Computer Science* | Adrien Treuille *Computer Science*
ROOM/TIME Peter / 3-5

We developed a system to simulate and render high resolution water in real-time for targeted for interactive applications and film industry pre-visualizations.

THE STATISTICS OF SOCIAL NETWORKS

STUDENTS Justin Wang *Economics and Statistics*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Statistical analysis of networks is an increasingly growing field. In this project I aim to present data analysis techniques of one type of network, a social network, to primarily an audience with a minimal knowledge in statistics. In doing so, I will use real network data of a particular division of a large corporation gathered by former Heinz College phD student Keith Hunter.

ENGLISH

DONDE CRECE LA PALMA (WHERE THE PALM TREES GROW): AN ORIGINAL FEATURE-LENGTH SCREENPLAY

STUDENTS Noelle Crochet *English*
ADVISORS Jane Bernstein *English*
ROOM/TIME McConomy Auditorium / 12:00

Donde Crece La Palma (Where the Palm Trees Grow) follows the story of Isabel and Enrique Ramirez, a young couple in post-revolutionary Cuba. After they have their daughter shortly after getting married, the they decide to emigrate to America in order to escape the poverty of Cuba and provide for their child. However, Enrique is barred from leaving the country because he has not served in the military. Isabel, their daughter Marisol and Isabel's mother, Adela leave Cuba with the promise that Enrique will join them once his two years of service are completed. But, Enrique is arrested shortly thereafter and the family is separated for eleven years. Enrique eventually escapes from jail and arrives in America, ready to rejoin his family, only to see his wife remarried and his family being cared for by an old friend who stepped in to provide for them. The screenplay continues in the aftermath of these events and examines the ideas of family, duty, and the strength of human love.

This story is partially based on the story of my mother and grandparents' journey to America. While many of the events and characters are compressed and fictionalized, this screenplay at its core comes from a real emotional place: from the stories that I have heard from my family since I was a child. My grandfather died in 2006, so this is also my way of honoring his memory - by inserting his essence into a screenplay that I have really been thinking about since I was five years old.

FIRST KISS: A SHORT FILM

STUDENTS Stefan Dezil *Drama* | Yulin Kuang *English* | Benjamin Welmond *Art*
ADVISORS Jane Bernstein *English*
ROOM/TIME McConomy Auditorium / 12:30

The objective of this project is to produce a professional-caliber short-film, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of student filmmakers at Carnegie Mellon University while bringing to life the small heartaches and heartbreaks of growing up. The screenplay explores the myth of the First Kiss, through the eyes of a fourteen-year-old romantic, Adam Schoenberger, who finds out that a pretty girl in his class wants to kiss him at his best friend's Spin the Bottle party.

HOW DIFFERENT HISTORIANS EMPLOY NARRATIVE THEORY TO RECONSTRUCT THE PAST: THE INCREDIBLE 1913 U.S. OPEN, THE CURIOUS CASE OF MARTIN GUERRE AND THE UNLIKELY FRIENDSHIP OF ABRAHAM LINCOLN AND FREDERICK DOUGLASS

STUDENTS Kristin Castellano *English*
ADVISORS Andreea Deciu Ritivoi *English*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

 The relatively new field titled "historiography" is the study of the history and methodology of history as a discipline or a specialized topic. There are many different ways to approach the study of history methods. Historians each have unique styles of writing or presenting a history of an event, person etc; however, there are certain underlying strategies all historians use when composing these histories or rather these stories. While many may believe narrative theory is limited to literature and fiction, these theories are also the foundation of many important histories. Narrative theory illustrates how historians compile a handful of facts into coherent and authentic representations of a past moment. Historians are constantly using narrative theories and rhetorical devices in order to write non-fiction stories. Historical accounts are not simply a list of facts, such as a chronicle, but rather they are detailed stories about an event that the historian has brought to life.

The three books chosen for this paper are: Mark Frost's "The Greatest Game Ever Played: Harry Vardon, Francis Ouimet and the Birth of Modern Golf," Natalie Zemon Davis's "The Return of Martin Guerr" and James Oakes's "The Radical and the Republican." The three range greatly because each historian faced different challenges. The one underlying aspect consistent throughout these three narratives is the main focus on character development. All three authors chose specific main characters in order to use them as a lens to the past.

IN OUR FATHER'S HOUSE

STUDENTS Caroline Roper *English*
ADVISORS Sharon Dilworth *English*
ROOM/TIME Pake / 1:40

Julia Shaw is the daughter an eccentric loner who believes he's found the presence of God in a nearby patch of woods. Driven to depression by poverty and Julia's disobedience, Jim Shaw creates a sanctuary where he can retreat from the mores of society. Jim's wife Maribel strives to bring him back to the role of husband and father, but Julia resists her mother's efforts to reconcile the two.

IN THE NAVEL OF THE UNIVERSE

STUDENTS Ines Pujos *English*
ADVISORS James Daniels *English*
ROOM/TIME Pake / 3:40

A collection of poems written over the course of my undergraduate career. All poems are connected through a sense of loss, nostalgia, and foreign lands.

STICK A FORK IN ME

STUDENTS Samantha Frank *English*
ADVISORS Jane McCafferty *English*
ROOM/TIME McKenna / 1:20

A collection of eight short stories. My stories explore themes of loneliness, hope, and the life-changing impact of relationships (between friends, lovers, family members, etc). While completely fictional, this collection begs the reader to consider true-to-life dilemmas and to understand that things aren't always what they seem.

THE PROTAGONIST AND THE PATH

STUDENTS Marisa Hughes *English*
ADVISORS Sharon Dilworth *English*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

My presentation will compare the development and content of my project's proposal, a completed feature-length screenplay for a film handling themes concerning human connection in spite of the confounding variables that make love and trust difficult, modern malaise, and synchronicity, to my own unfolding over the course of last summer, when the self-direction facilitated by the SURF program allowed me to explore life and self as I would have been otherwise unable to.

THE SELF-CONSCIOUS IMAGINATION OF WILLIAM CARLOS WILLIAMS

STUDENTS Brian Sherwin *English*
ADVISORS Richard Purcell *English*
ROOM/TIME McKenna / 4:00

In the 1920s work of William Carlos Williams, Williams explores many questions of literary and poetic form. He experiments with a variety of literary forms – prose poetry, the novella, free verse, critical prose. Through his work, he challenges conventional notions of literary genre. Most essentially, Williams blurs the boundaries between criticism and literature, the novel and the poem. Specifically, in texts such as Kora in Hell and Spring and All, Williams uses intrusions of critical prose to comment on the poetic imagination and literary form. The effect of Williams' self-conscious intrusion is an innovative inquiry into literary form and poetic process. In my thesis, I investigate the intersections between Williams' poetic imagination, his self-conscious critical intrusions, and his formal experimentation. Fundamentally, I see Williams as a crucial figure of proto-post-modernism in American poetry. Through his self-consciousness and formal experimentation, he appears at the crossroads between American modernism and post-modernism.

THE SIDEWALK PREACHER

STUDENTS Urna Biswas *Business Administration* | Anh Bui *English* | Stefan Dezil *Drama* | Brian Pettitt-Schieber *BHA*
ADVISORS Randy Kovitz *Drama*
ROOM/TIME Connan / 3-5

An uninspired painter seeks a romance with a street evangelist who struggles with faith.

THE YEAR OF SANTA ROSA

STUDENTS Katherine Dickson *English*
ADVISORS Sharon Dilworth *English*
ROOM/TIME McKenna / 3:40

Novella chronicling a year in the life of an American in Italy. When Cal Benson flees his life in rural New York for a refuge with his great-aunt in central Italy, he suddenly finds himself at the center of city-wide chaos, and must reevaluate the building blocks of his life to decide what he's willing to sacrifice in order to belong somewhere.

ETHICS, HISTORY & PUBLIC POLICY

DELIBERATIVE DEMOCRACY: DEVELOPING A SURVEY ON CLIMATE CHANGE

STUDENTS Margaret Soderholm *Ethics, History & Public Policy*
ADVISORS Robert Cavalier *Philosophy*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

As complex and significant issues such as climate change become increasingly relevant, public feedback is invaluable to policy creation. In order to move forward with possible solutions, the first step is to ascertain some common agreement with regard to the science of climate change. One way to do this is through the development of survey instruments that will measure the various ways that the public agrees or disagrees about scientific consensus regarding the facts and causes of climate change. Such an instrument in the context of a well-structured deliberative environment can be even more useful. In preparation for a large-scale deliberation on climate change to be held in 2012, two pilot studies have been performed in Pittsburgh, and a third will take place in Qatar. For this project, I will analyze the pre and post-deliberation survey results to look for common threads regarding opinions on the science of climate change. The goal is to develop an improved survey instrument for future use in both college and public deliberation on climate change and policy.

FEMALE JUVENILE DELINQUENCY IN LOS ANGELES COUNTY IN THE 1930'S

STUDENTS Linda Timko *Ethics, History & Public Policy*
ADVISORS Steven Schlossman *History*
ROOM/TIME Pake / 3:00

The United States juvenile court system played a central role in monitoring female juvenile behavior since its creation in 1899. Through research I explore rare, original case files of the Los Angeles County Juvenile Court from the 1930's to examine the ways in which the courts dealt with female juvenile delinquents, as well as exactly who these young women were. The court of the time was much more involved in the lives of these women, but for what reason exactly? My research hopes to explain some answers for this question.

RELIGION, DISCRIMINATION AND ASSIMILATION: A COMPARISON OF CONTEMPORARY FRANCE AND UNITED STATES

STUDENTS Huma Ali *Ethics, History & Public Policy*
ADVISORS Donna Harsch *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

This paper will examine how religion and secularism lead to discrimination and serve as barriers to assimilation in France and the United States. Although these two modern Western nations were founded upon similar ideals, their respective histories have resulted in different frameworks for the separation of church and state. In the French case, the nation's culture of exclusive secularism has posed difficulties for the nation's Muslim subpopulation, as demonstrated by the recent headscarves debate. Meanwhile, the United States' culture of religiosity allows for private matters, such as sexual orientation, to become a public concern, as is the case in the ongoing debate surrounding same-sex marriage. In order for either of these affected groups to become accepted, these nations must reconcile religion's role with respect to the distinction between public and private spheres.

HISTORY

@CMUCOBOT

STUDENTS Bryn Loeffler *History*
ADVISORS Joydeep Biswas *Robotics Institute* | Cetin Mericli *Computer Science* | Manuela Veloso *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:45

The Companion Robot, or CoBot, performs tasks for the occupants of the Gates Hillman Center, from delivering items to getting coffee, interacts with people. Despite these accomplishments, CoBot was not able to consciously converse with people. Other robots have Facebook pages and Twitter accounts, but these are all managed by humans acting as puppeteers for the robot. The goal of this research is to allow CoBot to autonomously communicate about its daily activities via social media sites. CoBot now successfully tweets about completed tasks through a ROS node and the Twitter API.

IMAGINED COMMUNITIES: LONDON IMAGERY

STUDENTS Audrey Tse *History*
ADVISORS Karen Faulk *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

Imagined Communities: London Imagery is a photographic project that focuses upon past and present spaces, from both the physical and ideological realms, in which the conception of the 'British identity' is challenged. The project contemplates how the idea of national identity was formed, and transformed, by British Commonwealth migrants in London after the arrival of the SS Empire Windrush on the Tilbury Docks in 1948 – a moment in British history that is commonly thought to mark the advent of 'unwanted' citizens. The project culminates into a book of images supplemented with written discourse contextualized with theories and concepts taught at the courses I took at the University of London's School of Oriental and African Studies during my semester year abroad.

LEARNING FROM LA VARA: SHAPING SEPHARDIC IDENTITY IN NEW YORK CITY AFTER THE SECOND DIASPORA

STUDENTS Kristen Minno *History*
ADVISORS Richard Maddox *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

In New York City, the Sephardic immigrant community had established a strong foothold by the 1930s. However, the children of these immigrants were not learning traditions of their old homelands, or of centuries-old aspects of Sephardic culture. In response to this situation, Albert Levy, editor of the Sephardic newspaper La Vara, recognized that he and his paper could help to build bridges between the first generation immigrants from the Second Diaspora and their American children. Thus, on August 31, 1934, Levy published the first English section page in La Vara, which had previously been printed exclusively in the Ladino language in Hebrew characters. The main goal of this page was to reach out to Sephardic youth who were increasingly primary English speakers. This strategic move to English succeeded in creating an open arena for Sephardic youth to gain access to Jewish, and more importantly Sephardic, issues. These issues led to the ultimate formation of their unique identity, which centered on access to education; the lack of unity among Jews in New York; concerns about anti-Semitism; nationalism; an interest in strong historical ties to other world Jewish communities; cultivating Jewish-American identity; and connections to the Hispanic community in the metropolitan region. This paper will explore the complicated question of the identity of Sephardic American Jews based on the issues raised by La Vara.

MAXIMIZING RENEWABLE ELECTRICITY IN ISRAEL: ENERGY SECURITY, ENVIRONMENTAL IMPACT, AND ECONOMIC DEVELOPMENT

STUDENTS Rebecca Yasner *History*
ADVISORS Laurie Eisenberg *History*
ROOM/TIME Class of '87 / 12:00

The search for energy security and growing concerns over global environmental degradation, juxtaposed against the promise of economic development, has led to increased worldwide attention to the implementation of renewable electricity technologies. For the State of Israel, located amidst a hostile neighborhood of oil-supplying countries, the need for energy security is paramount. In addition, Israel's global obligation to reduce negative environmental impacts has become a major focus of public policy. Moreover, favorable forecasts of economic growth in the Clean Technology industry in Israel are now the driving force behind sustainable innovation. It is in Israel's best interests to make the implementation of renewable electricity in Israel a high priority through public policy initiatives as well as through industry development. The February 2010 Plan for the Integration of Renewable Energy Sources into the Israeli Electricity Sector (PIRES) by Israel's Ministry of Energy and Water Resources, while well intentioned, falls short in both scale and direction of putting Israel on track for large-scale, integrated deployment of renewable electricity technologies. Modifications to this document (Y-PIRES) will not only lead Israel to much needed electricity security, but will also help to reduce harmful environmental pollution and will provide extensive economic development through a more comprehensive implementation of renewable power into Israel's electricity mix.

MY BODY IS A BARREL OF GUNPOWDER: PALESTINIAN WOMEN'S SUICIDE BOMBING IN THE SECOND INTIFADA

STUDENTS Meredith Ebel *History*
ADVISORS Laurie Eisenberg *History*
ROOM/TIME Class of '87 / 1:40

The suicide-bombing by Wafa Idris in an Israeli grocery store on January 27, 2002, killing one Israeli teen, created excitement in the media over the perceived new phenomenon of Palestinian female suicide bombers. Palestinian women's political and even violent participation in the national campaign is not, however, new. In fact, Palestinian female suicide bombing falls within the continuum of women's political participation in the Palestinian struggle against Zionism and Israel since 1916.

Many scholars have put forth gendered theories to explain the emergence of Palestine female suicide bombing. One holds that women are trying to prove their equality with men and seeking to elevate women's place in Palestinian society in general. Evidence shows that even as their participation reaches the level of suicide bombing, however, the women win social praise but there are no structural changes in Palestinian society for the betterment of women. Another explanation is the theory of individual redemption, which argues that the Palestinian women who become involved in suicide bombing do so because they are divorced, widowed, barren, adulterers or otherwise shamed or undesirable and their traditional patriarchal society gives them no alternatives for redeeming themselves. Contrary to this popular Western and Israeli belief, however, most Palestinian female suicide bombers do not fall into any of these categories of disgrace. I argue that the response by Palestinian society to Palestinian female suicide bombing and the backgrounds of many of the women show that, in fact, Palestinian women are not driven so much by a desire to advance women's societal gains or individual redemption, but rather by the same nationalistic motivations driving Palestinian male suicide bombers fighting against Israeli occupation and the suffering and stagnation of Palestinian society. Continuing to use gendered based theories to explain why Palestinian women become female suicide bombers can limit our understanding of the phenomenon and crucially inhibit our thinking about how to overcome it.

THE CONGRESSIONAL SPACE CAUCUS, 1981-1989

STUDENTS Jacqueline Cortese *History*
ADVISORS Steven Schlossman *History*
ROOM/TIME McKenna / 12:00

The Congressional Space Caucus, co-founded in 1981 by Congressman Daniel Akaka (D-HI) and Congressman Newt Gingrich (R-GA), boasted impressive membership statistics throughout much of the 1980s, peaking at over 170 members. Members were from all points across the political spectrum, from space-related and non-space-related committees, and from states with seemingly little investment in space.

The caucus is a topic that has not been seriously researched or written about despite its large membership list and its relevance to the broader concerns about the American space program circulating at the time. While Gingrich and Akaka had different reasons for their individual interests in space, both acted as spirited proponents of a strong space program in Congress. Despite unsteady first impressions of the Caucus in both the National Aeronautics and Space Administration (NASA) and the House Science and Technology Committee, the Caucus successfully developed working relations with both organizations and put forth an active consciousness-raising effort within the House of Representatives.

Using primary source documents from the NASA History Office archives, interviews with relevant actors,

and a variety of secondary sources, I trace the evolution of the Space Caucus starting with the events that led to its birth in November 1981 and concluding with the confounding variables that contributed to its dissolution in the late 1980s.

VOTING FOR VICHY: CAREERS OF FRENCH LEGISLATORS, 1940-1958

STUDENTS Amanda Russell *History*
ADVISORS Katherine Lynch *History*
ROOM/TIME Pake / 4:40

In this project, I follow the careers of 570 French legislators whose vote authorized the collaborationist Vichy state from their vote in 1940 through the postwar purges, explaining what particular types of legislators were re-admitted to national political life.

WOMEN ATHLETES, GOLF, AND THE CURTIS CUP MATCH: BRITISH AND IRISH PERSPECTIVES, 1932-1962

STUDENTS Stephen Rosnick *History*
ADVISORS Steven Schlossman *History*
ROOM/TIME Class of '87 / 4:40

Women are often underrepresented in historical research. An examination of the Curtis Cup Match – a biennial competition that started in 1932 between the top women amateur golfers of the U.S. versus Great Britain and Ireland -- and the backgrounds of the participating women provides an opportunity to examine both the role of women in the development of golf, and the social and cultural climate that permitted such a phenomenon to occur. Focusing on the period of 1932-1962, this research project will use both primary and secondary sources, with a heavy emphasis on contemporary newspapers. In analyzing the Curtis Cup as an event itself, as well as the women who were deemed good enough to be selected to compete on the international level, this project can provide new insights into both the history of women and the history of sports.

INFORMATION SYSTEMS

CMU CONNECT

STUDENTS Ryan Billings *Self-defined* | Sean Chin *Information Systems* | Salim Peshawaria *Information Systems* | Jonghyun Thom *Self-defined*

ADVISORS Jeria Quesenberry *Information Systems*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:15

CMU Connect offers a platform for university students to meet in social, professional, or academic settings. By combining video chat and instant messaging technologies, this application aims to provide a new way for Tartans to get to know one another, and stay updated on campus life.

CONSCIOUSQ

STUDENTS Jonathan Bender *Information Systems* | Scott Dombkowski *Information Systems* | Christian Reyes *Information Systems* | Michael Wang *Information Systems*

ADVISORS Randy Weinberg *Information Systems*

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

Every day students wait in numerous lines and waste time that could be spent on more worthwhile activities. Our team designed an online system which allows students to monitor both line lengths and wait times at various locations around campus. This is done by utilizing an array of sensors hidden in a carpet that measure how many people are in line at a particular point of time. This information is updated continuously from the sensors to our online application, which then displays the line information via the Internet. From the queue information displayed, users are able to decide for themselves whether they want to spend the time to wait in line. This problem (and solution) can be extended to many types of businesses, including restaurants and theme parks, where lines can have negative implications for both the customer and the business.

EDUMATE: A FREE AND PERVASIVE MOBILE APPLICATION IN INSTRUCTIONAL CONTENT CROWDSOURCING;

STUDENTS Varun Arora *Information Systems*

ADVISORS Matthew Kam *Human Computer Interaction Inst.*

ROOM/TIME Dowd / 3:20

Edumate is a free and pervasive Android application that allows educators across the world to record and upload instructional video, thus enabling crowdsourcing of educational content. This can become a boon for teachers in rural regions who have access to a cheap 3G internet connection from their mobile operator, but do not have local capacity building training. This platform can be leveraged by projects such as DigitalGreen and DigitalStudyHall which primarily depend on participatory video. The Edumate backend leverages Google and YouTube infrastructure to provide cloud services, thus being available to users at no cost.

EFFORTLESS EMBEDDED ENGINEERING

STUDENTS Nathaniel Barshay *Computer Science* | Tomer Borenstein *Electrical & Computer Engineering* | Brandon Kase *Computer Science* | Dylan Koenig *Electrical & Computer Engineering* | Evan Shapiro *Computer Science* | Nisha Singh *Psychology* | Leonard Sokol *Information Systems*

ADVISORS David Kosbie *Computer Science*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:30

The availability of tools for the software programmer has made it easy for amateurs to build world changing companies in a day. Until now, this productivity has remained trapped inside the computer. We are providing an easy interface between hardware and software, so the next generation of innovators will be be free to hack the physical world.

GUMBO: AN APPLICATION TO SUPPORT IMPROMPTU COLLABORATIVE WORKSPACES ON CAMPUS

STUDENTS Molly Samuels *Information Systems*

ADVISORS Larry Heimann *Information Systems*

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

Gumbo is a web application that supports the creation of impromptu collaborative workspaces on the Carnegie Mellon University campus. The application prompts students to share information about what they are working on and where on campus they are working. Students may join others in a workspace for the purpose of maintaining focus and productivity, collecting feedback on a creative project, or collaborating on group work. This project describes the creation of Gumbo, from early user research through the development of a final prototype.

IDENTIFYING RISK FACTORS FOR DEPRESSION IN THE FIRST YEAR OF COLLEGE

STUDENTS James Colmar *Psychology* | Leonard Sokol *Information Systems*

ADVISORS Gordon Weinberg *Statistics*

ROOM/TIME Pake / 1:00

Studies have shown that a negative relationship exists between class year and depression level among the college population. We believed certain sociological factors to influence the risk for developing depression during the freshmen year and to differ depending on the home college. A survey was administered during the fall and spring to first-year students from each of the colleges within Carnegie Mellon University. This study measured potential risk factors for depression, and explored if these factors differ between colleges. Results aim to better equip advisers, college counseling center staff, students, and parents in the process of staving off depression early in one's college career.

IMPROVING TASK PERFORMANCE IN AN AFFECT-MEDIATED COMPUTING SYSTEM

STUDENTS Vivek Pai Information Systems

ADVISORS Raja Sooriamurthi Information Systems

ROOM/TIME Pake / 2:00

Computing systems have traditionally relied on purely quantitative means of assessing users. Software may

record facts about users such as their click behaviors, their accuracies, and their rates of recurrence, and may then use this acquired data to make predictions about their behaviors and preferences. However, users' inputs into a machine, sequences of key presses and mouse movements, do not capture all of their desires and needs. The machine may never know that a particular user enjoys the glow of a button and its placement among others elements of an interface. Furthermore, it cannot perceive a user's discomfort during accomplishing a task; it may simply translate the user's high accuracy in hitting various steps of a process into a mastery of the task. The machine, which might be intelligent, may not sense the user's uncertainty of his or her actions, expressed by widened eyes, a stutter in voice, and a hand clasped behind the neck. In this project, we explore how an affect-mediated system, a computing system that adapts its actions and behavior to the emotional state of its users, can improve their abilities to complete tasks and meet their goals. In particular, we apply facial expression recognition, one method for estimating a human's emotional state, to a children's game, giving it the ability to adjust its difficulty based on its player's perceived unease. Through experimentation with this game, we determine whether affect-mediation helps users achieve their goal of winning the game, and whether in general affect-mediated systems can aid in user task completion.

OPTIMAL DECISION MAKING IN INTERDEPENDENT NETWORK SECURITY

STUDENTS Alan Nochenson *Information Systems*
ADVISORS Larry Heimann *Information Systems*
ROOM/TIME Wright / 4:20

Although system administrators are frequently urged to protect the machines in their network, the fact remains that the decision to mandate protection is far from universal. To better understand this decision, we formulate a model of interdependent network security where there is a system administrator responsible for a network of size n against attackers attempting to penetrate the network and infect the machines with viruses or other exploits. We introduce numerous techniques and interpretations of this scenario. Through the application of these techniques to interdependent network security scenarios, we conclude that the decision is dependent upon a number of factors including external and internal vulnerabilities, the types and likelihoods of different amounts of loss, the degree of autonomy of the attacker, and others. Through this analysis, we form a model for decision-making that is simple to understand and applicable to many other interdependent security scenarios.

RESEARCH IN QUESTION ANSWERING

STUDENTS John Montgomery *Information Systems* | Kevin Schaefer *Information Systems* | Shane Smith *Electrical & Computer Engineering*
ADVISORS Eric Nyberg *Language Technologies Inst.*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:15

Throughout the semester our team worked with Dr. Eric Nyberg and the OAQA 2.0 team in the Language Technologies Institute. The main goal of the OAQA 2.0 initiative is to create a question answering system in the biomedical domain. Our team explored the early stages of data mining and the Apache UIMA annotation process. Additionally, we contributed several modules to the OAQA annotation pipeline.

SUSTAINABUS

STUDENTS Kairavi Chahal *Undecided* | Kevin Chen *Information Systems* | Adrian Lam *Undecided* | Sethu Prakasam *Information Systems* | Linda Zhang *Information Systems*
ADVISORS Jeria Quesenberry *Information Systems*
ROOM/TIME McKenna / 1:00

The city of Pittsburgh in Pennsylvania has a large public transport system which serves many individuals and is integral to their lifestyles. Vast amounts of pollution that is produced could be reduced if buses are dispatched more intelligently and efficiently. In addition, the local buses in Pittsburgh, PA, in most cases, do not always arrive on time. Because of this, people start relying on other methods of transportation. If there was some way to notify bus drivers there may not be people at certain stops, then this problem could be resolved. Nevertheless, on-time transportation is becoming a problem for many people in Pittsburgh. In addition to causing tardiness, buses that pass vacant stops unnecessarily will cause extra pollution. Other problems include notion of dropping the 28x bus the coming year and society's increasing reluctance on using public transit, despite many app offerings such as CMU's Tiramisu. However, these problems can be fixed. Tracking chips such as GPS chips can be put on buses; we can improve current app offerings, and implement check-in system. Solutions aforementioned will benefit our society. In the long term, our projected savings will balance our short term expenses. Our aim is to not only sustain our planet, but also to keep it healthy so that we can reduce our carbon footprint significantly.

THE PRISONER'S DILEMMA: TECHNOLOGY SUPPORTED INSTRUCTION FOR INDIVIDUALS VS. PAIRS

STUDENTS Lauryn Brown *Information Systems*
ADVISORS Carolyn Rose *Language Technologies Inst.*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Collaborative learning is an excellent way for students to learn amongst themselves through facilitating discussion, sharing ideas, and voicing opinions. My research group focuses on automating means of mediating collaborative learning through the use of computerized chat tutors that work to respond to students' questions, provide support when they are unable to figure out answers, and intervene when it detects needs for support in real-time.

Prior comparisons of individual and collaborative learning have shown students benefiting as much from working with a partner as they do from intelligent tutoring style support, and even more when they have both. In this work I explore a specific type of learning support in the context of a unit on game theory and how it functions differently with individual instruction versus collaborative learning.

My specific focus is on knowledge imbalances. With individual learning, a detected knowledge gap can be assumed to be an opportunity for intervention. But in collaborative learning, the goal is for students to offer support to each other when one has knowledge that the other lacks. However, this may not always Toccur. Knowledge-imbalanced teammates working together are sometimes unable to collaborate effectively because of the information gap shared between team members. By building a tutor that is able to identify this knowledge gap during the discussion, we will be able to better intervene aiding students with prompts to better address the knowledge gap and help narrow it in order to better facilitate student learning through collaboration.

UNIVERSITY ECOLOGICAL FOOTPRINT CALCULATOR

STUDENTS Raphael Astrow *Information Systems* | Mallory Hayase *Self-defined*
ADVISORS Randy Weinberg *Information Systems*
ROOM/TIME McKenna / 4:40

The University Ecological Footprint Calculator calculates an estimate of a college or university's ecological footprint based on consumption data.

LINGUISTICS

A COMPARATIVE ANALYSIS OF NATURALISTIC AND SCRIPTED CONVERSATION

STUDENTS Enrica Rosato *Linguistics*
ADVISORS Thomas Werner *Philosophy*
ROOM/TIME Dowd / 12:40

In this paper, I am analyzing naturalistic one-on-one spontaneous conversation between close friends in comparison with similar scripted one-on-one television dialogue as it is written by authors and interpreted by actors. I break this analysis into two main parts; I analyze the conversations' structures as well as the meaning that is present in the interlocutors' utterances. My analysis of meaning is limited to how these interlocutors observe, flout, violate, and opt out of the Gricean maxims of conversation. My analysis is both quantitative and qualitative, and my primary goal is to compare these two forms of conversation to attain more insight into the relationship between actual naturalistic conversation and how it is replicated for the purpose of television entertainment. This paper was written as a final project for a class in Pragmatics and Second Language acquisition, taught by Dr. Naoko Taguchi in the Spring of 2011.

MODERN LANGUAGES

FACT AND FICTION: PORTRAYALS OF THE MEIJI RESTORATION IN ANIME

STUDENTS Stephanie Guerdan *Modern Languages*
ADVISORS Yasufumi Iwasaki *Modern Languages*
ROOM/TIME Pake / 12:20

Looking at the shows Peacemaker Kurogane and Rurouni Kenshin, I identify and discuss the ways they present, interpret, and reimagine history as well as the way they appealed to contemporary audiences.

HEALTH CARE ACCESS FOR UNDOCUMENTED HISPANIC IMMIGRANTS IN NEW YORK CITY AND THE UNITED STATES

STUDENTS Nancy Brown *Modern Languages*
ADVISORS Therese Tardio *Modern Languages*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

The purpose of this report is to illustrate the need for better health care access for undocumented Hispanic

immigrants living in the United States. The undocumented Hispanic population faces a variety of social and economic obstacles that obstruct their ability to obtain either private or public health insurance. This makes this population a vulnerable population, meaning their health care access is limited. Because undocumented Hispanic immigrants are a vulnerable population, they are more likely to be unhealthy and face health problems than those who have regular access to health care and have health insurance.

For the purposes of this report, New York City will be used as a case study to analyze what can and what needs to be done in order to address the needs of the undocumented Hispanic population. New York City has an extensive Hispanic population in general and more specifically a large undocumented Hispanic population. NYC already has services dedicated to providing affordable health care for its residents. However, many undocumented Hispanic immigrants are afraid to come forward to claim these services due to the fear of deportation; this leads to poorer health for undocumented Hispanic immigrants.

PHILOSOPHY

FRAMING A PICTURE: THE LANGUAGE OF IMGUR.COM

STUDENTS Emily Forney *Philosophy*
ADVISORS Thomas Werner *Philosophy*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Imgur.com is an image hosting website where users may leave comments or "captions" describing or commenting on the image. The language of these comments shows interesting elements of youthful language, Internet language, and intriguing stylistic choices in framing, vocabulary, and playfulness in language. Comments may be "upvoted" or "downvoted," leaving the comments ranked by popularity. This poster and the corresponding senior thesis for a BA in Linguistics seeks to discover what language makes a top-ranked comment on Imgur.com.

INTERNET PIRACY AT CMU: STUDENT BEHAVIOR & OPINIONS

STUDENTS James Bogie *Statistics* | Benjamin Gorman *Economics* | Chelsea Grindle *Mathematics* | Jongwoo Lee *Statistics* | George Nardi *Philosophy* | George Volichenko *Statistics*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Throughout the latter half of 2011 and the early months of 2012, internet piracy and copyright enforcement have been at the forefront of legislative debates, media coverage, and corporate public statements. The harsh reaction from the internet community (online institutions such as Google, Wikipedia; frequent users of social media such as Facebook, Twitter) in response to the proposed SOPA and PIPA bills suggest that there are divergent, strongly held convictions amongst the population on how to deal with copyright enforcement in the information age. We are surveying Carnegie Mellon undergraduates to see how often they engage in internet piracy and what opinions they hold on related copyright enforcement legislation. Our data-collection tool is an anonymous, self-administered online survey sent to a random sample of undergraduate students. The survey contains questions regarding the types of piracy students engage in, their views on the ethics and legality of piracy, and what steps students take to find media entertainment online. Our survey results will hopefully be indicative of the views of high-performing university students nationwide, offering insight into how the most computer-literate

segment of the population approaches pirated media. The conclusions we reach will be of interest to politicians shaping copyright enforcement legislation, media companies hoping to tweak their monetization strategies, and citizens wondering how others may judge what is largely a private behavior.

LOANWORDS IN JAPANESE

STUDENTS Mao Hayashi *Philosophy*
ADVISORS Thomas Werner *Philosophy*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

The prevalence of loanwords in the Japanese language has only increased as time passes. This paper seeks to investigate the loanword borrowings into Japanese from the mid-16th century until the modern day. More importantly, the assimilation of loan words into the Japanese language will be investigated. What linguistic, cultural, and social factors are involved in the assimilation of loanwords into Japanese? The long-term impact of loanword assimilation into the language – seen both now and in the future, is also a concern. This paper also looks to describe the phenomenon of loanword assimilation, especially those of English loanwords. Gairaigo, foreign loan words, classified as such in Japanese, will be the primary target for investigation.

PREDICTIVE PATTERNS OF SEX TRAFFICKING ONLINE

STUDENTS Emily Kennedy *Philosophy*
ADVISORS Jay Aronson *History* | Artur Dubrawski *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

In the past 10-15 years, the internet has become a popular tool which traffickers use to easily advertise and sell their victims. There are thousands of posts each month selling sex on the common classifieds website Backpage.com. I will extract this publicly available data from major U.S. cities represented on Backpage. com. I will then use software developed at Carnegie Mellon's Auton Lab to find out if it is possible to detect patterns emerging from the data available in sex ads, such as patterns of travel that traffickers use. To help identify which posts are more likely to be cases of trafficking, I will rely on individuals who have expertise on this subject. If this research is successful in tracking movement of similar posts—and therefore, similar pimps or victims—across the country over time, this predictive research could be a valuable missing piece for law enforcement to use to prosecute traffickers and rescue victims.

PSYCHOLOGY

AFFECTIVE INTERPRETATION OF MUSIC IN INFANTS

STUDENTS Christine Pak *Psychology*
ADVISORS Erik Thiessen *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

Previous studies conducted with infants have shown that they are able to distinguish different genres of music (Rock et al., 1999). They have also shown that infants have a preference for happy visual stimuli, such as positive facial expressions (Nawrot, 2003). However, there has been very limited research done on whether infants are able to have the same affective response as adults to music labeled as "happy" or "sad". In this study, we are exploring whether infants are able to not only distinguish between happy and sad sounds, but also if they can determine the emotional expression that is conveyed in the musical pieces. During training, infants will be exposed to either happy sounds with happy faces, happy sounds with sad faces, sad sounds with sad faces, or sad sounds with happy faces. Then in the test trials, we will determine if infants prefer looking at the familiar stimulus or the novel stimulus. If infants understand the different emotional aspects of music, we would expect learning to be easier for familiar pairings (happy face happy sound; sad face sad sound).

BILINGUALISM AND STATISTICAL LEARNING

STUDENTS Hae Sung Kim *Psychology*
ADVISORS Erik Thiessen *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Past studies using artificial language speech streams showed that adults can use statistics to correctly segment words. However, these studies mostly used only a single stream input and monolingual populations. Given the number of bilinguals and the prevalence of exposures to multiple languages, how do monolinguals and bilinguals compare in speech segmentation task given multiple inputs? Speech segmentation becomes challenging with multiple inputs when learners combine input across languages. The statistics of particular units that overlap different languages may change and hinder correct segmentation. Current study addresses this question by using two interleaved artificial language streams and an indexical accent cue. In the study, participants were asked to segment two artificial language streams with or without an accent cue. Our results indicate that in the absent of the accent cue, bilinguals and monolinguals performed similar, while monolinguals' performance was weakened compared to those of bilinguals in the presence of the accent cue. This study, expanding Weiss et al. (2009) and bilingualism research, informs us that the level of difficulty of languages may play a role in segmenting multiple language streams.

BOTH WORK AND PLAY MAKE JOHNNY GOOD AT FRACTIONS: MOTIVATING LEARNING ON A FRACTION COMPARISON TASK WITH GAME INTERLUDES: PRESENTATION

STUDENTS Luke Davis *Psychology* | Christopher Reid *Social & Decision Sciences* | Yueran Yuan *Computer Science*
ADVISORS Albert Corbett *Human Computer Interaction Inst.*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

We investigate the effect of one of the motivational tools we implemented in an original educational game that helps students practice fractional reasoning. We present the results of an experiment looking at the effect of game interludes between fraction practice blocks on students' motivation and subsequent learning on fraction comparison tasks. We vary the relationship between the fraction task and the game task. In one condition, students' performance on the fraction task influences their performance on the game task. In a second condition, the students' performance on the fraction task has no impact on the game task. Motivation, game performance, and transfer to a standard fraction task are compared across conditions.

EFFECT OF ASSOCIATIVE AND SEMANTIC PRIMING ON INDUCTIVE GENERALIZATION IN CHILDREN

STUDENTS Siyan Zhao *Psychology*
ADVISORS Anna Fisher *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

Prior research found interesting patterns of inductive generalization in preschool-age children: most children were able to perform the task well when it involved labels that co-occurred in child-directed speech (e.g. bunny-rabbit), but not when labels did not co-occur (e.g., lamb-sheep). One possible explanation for these findings is associative priming – facilitation of a response from a preceding stimulus for words that are frequently used together in daily life. To test this hypothesis I will conduct a study which will examine the relationship between children's performance on a priming task and an induction task. I will use E-Prime research software to design my study and collect data. I expect approximately 40 participants (both adults and children) to take part in the study.

EFFORTLESS EMBEDDED ENGINEERING

STUDENTS Nathaniel Barshay *Computer Science* | Tomer Borenstein *Electrical & Computer Engineering* | Brandon Kase *Computer Science* | Dylan Koenig *Electrical & Computer Engineering* | Evan Shapiro *Computer Science* | Nisha Singh *Psychology* | Leonard Sokol *Information Systems*
ADVISORS David Kosbie Computer Science
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:30

The availability of tools for the software programmer has made it easy for amateurs to build world changing companies in a day. Until now, this productivity has remained trapped inside the computer. We are providing an easy interface between hardware and software, so the next generation of innovators will be be free to hack the physical world.

HOW ADULTS UNDERSTAND AND REASON ABOUT FRACTIONS

STUDENTS Melissa Dewolf *Psychology*
ADVISORS Robert Siegler *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

We investigated what strategies people use to compare magnitudes of fractions, and how the strategies vary with overall mathematical knowledge. Because little is known about how people think about fractions, prior research has attempted to assess the extent to which people think of fractions compared to how they think about whole numbers (Bonato, Fabbri, Umilta & Zorzi, 2007; Scheider & Siegler, 2010; Meert, Gregoire, Noel, 2009). In particular, Bonato et al. (2007) has examined the degree to which fractional magnitude comparisons can yield an understanding of the mental representation of fractions. Scheider & Siegler (2010) argue that these assessments cannot be made independently from understanding the strategies for comparison that a particular pair of fractions elicits. The current study extends prior research by comparing strategies that Carnegie Mellon University students, with high math proficiency, use to compare fraction magnitudes to the strategies that Community College of Allegheny County students, with lower math proficiency, use to compare fraction magnitudes. The goals of this thesis were to enumerate, explain and define the strategies that are used in fraction magnitude comparisons by adults, investigate how these strategies vary with the overall math proficiency of the adults and evaluate whether adults who do not consistently use desirable strategies recognize desirability of good alternative strategies. Our findings indicate that strategy use and consistency of using good and poor strategies varies with overall math knowledge and performance on our magnitude comparison task; the lower performing participants more frequently used strategies that would yield incorrect results compared to the high performing participants who selected more successful strategies.

IDENTIFICATION OF THE CAUSES OF SOUNDS: EQUATING ACTIONS AND MATERIALS

STUDENTS Jayant Bhambhani *Psychology*
ADVISORS Laurie Heller *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:00

Listeners spontaneously identify the cause of a sound (Gaver, 1993; Lemaitre et al. 2010). While most of behavioral research has studied how listeners identify the properties of objects causing sounds (see for instance Carello, Wagman, and Turvey, 2005), neuroscientists have recently been studying the neural correlates of perceiving sounds identified as caused by human actions. Lewis et al. (2004) reported a typical example of such a study. Using functional magnetic resonance imagery, they showed that very different cortical areas were activated by human-manufactured tool sounds and animal vocalizations, and argued in favor of specific cerebral pathways processing sounds made by human actions. A related question is to identify the differences in cortical activation produced when listeners identify either the actions or objects causing the same sound, since listeners appear to identify both causal properties (Houix et al, in press). In order to be able to test this idea, the present study sought to establish a set of sounds in which the two causal properties were systematically varied while being easily and accurately determined. The problem is not trivial, for Lemaitre and Heller (2010) have shown that action is in general identified more accurately and rapidly than material proper-ties. This poster outlines three experiments that led to the creation of a set of sound stimuli that conveyed their causal actions and materials equally well to naïve listeners.

IDENTIFYING RISK FACTORS FOR DEPRESSION IN THE FIRST YEAR OF COLLEGE

STUDENTS James Colmar *Psychology* | Leonard Sokol *Information Systems*
ADVISORS Gordon Weinberg *Statistics*
ROOM/TIME Pake / 1:00

Studies have shown that a negative relationship exists between class year and depression level among the college population. We believed certain sociological factors to influence the risk for developing depression during the freshmen year and to differ depending on the home college. A survey was administered during the fall and spring to first-year students from each of the colleges within Carnegie Mellon University. This study measured potential risk factors for depression, and explored if these factors differ between colleges. Results aim to better equip advisers, college counseling center staff, students, and parents in the process of staving off depression early in one's college career.

ILLNESS PERCEPTIONS AMONG ADULTS WITH AND WITHOUT DIABETES

STUDENTS Jennifer Major *Psychology*
ADVISORS Vicki Helgeson *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Diabetes (type 1 and type 2) is a chronic illness that is characterized by high blood glucose levels as a result of the body's inability to use or produce insulin (American Diabetes Association, 2011). There are many things that people with diabetes can and must do in order to effectively control their blood glucose. This includes adjusting their diet, adhering to an exercise regimen, and taking medication (insulin or oral medication). Illness perception research focuses on how people's view of their illness might influence how well they take care of their diabetes. In the present study, the goal is to answer the following: (1) Is there a difference between the way adults with type 1 and type 2 diabetes perceive their illness and the way others perceive their illness? (2) How do others perceive diabetes compared to how adults "think" others perceive diabetes? (3) Are dimensions of illness perceptions related to self-care behavior among adults with type 1 and type 2 diabetes?

MEDIA INFLUENCES ON SELF-DISCLOSURE IN CLOSE MALE FRIENDSHIPS

STUDENTS Charles McKain *Psychology*
ADVISORS Brooke Feeney *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

In the past, much of the research on friendships between men has argued that such friendships focus on shared activities and involve less self-disclosure and emotional support than friendships among women. However, recent popular media depictions of male friendships (colloquially termed as "bromances") contradict this research. The present study aims to determine if these popular media depictions represent a change in how men act in their friendships. 39 male friendship dyads were recruited for this study. Participants were randomly assigned to watch a modern, non-gender-stereotyped video depiction of a male friendship, a gender-stereotyped video depiction of male friendship, or no video clip (control condition). Participants were then asked to discuss a stressor bothering one of the dyad members. I predict that participants shown the non-gender-stereotyped clip will self-disclose more and receive more emotional support from their friends. This study represents an improvement upon previous research in this area because it is the first study of male friendship to use both observational and questionnaire data.

MOTION AND PART DEDUCTION IN INFANTS

STUDENTS Jillian Brinberg *Psychology*
ADVISORS David Rakison *Psychology*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Research has shown that infants at 26 months of age can infer an unseen correlation between an object's part and its motion path. For example, infants infer that features A and C are correlated when presented with correlations between features A and B and B and C. The current research plans to investigate if infants at a younger age are able to make the same inferences when presented with 3D toy stimuli rather than 2D images on a computer screen. The results will provide developmental scientists with a better understanding of how infants begin to learn about the complex interconnected features of objects and entities around them.

SPATIAL AND ANALYTICAL STUDY OF STUDENT HOUSING AT CARNEGIE MELLON UNIVERSITY

STUDENTS Shannon Lauricella *Science and Humanities Scholars* | Samuel Lavery *BHA* | Ariel Liu *Computer Science* | Terra Mack *Psychology* | Alejandra Munoz Munoz *Architecture*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Carnegie Mellon is an urban university with many students living off-campus. Finding housing off-campus is generally left up to individual students, who take into account many variables when choosing a house or apartment. We are interested in investigating the possibility of a correlation between where students choose to live and what they choose to study. Our research presentation seeks to answer questions about the dynamics of student housing at CMU. Is there a correlation between address and major? Do students in certain majors cluster together? Which off-campus neighborhoods are most popular with undergraduate students versus graduate students? Our poster provides visual evidence for the statistical correlations found pertaining to these questions.

STATISTICAL APPROACHES TO MAPPING PERCEPTUAL SOUND CATEGORIES AND ACOUSTIC PROPERTIES

STUDENTS Clara Baron-Hyppolite *Psychology*
ADVISORS Laurie Heller *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

This experiment was created in order to see if it was possible to predict the psychological group that a sound belongs to simply by knowing its acoustic features. Prior literature suggests that individuals may be readily able to categorize sounds based on the action that created it (e.g. Gaver 1993, Heller and Skerritt 2009, 2010). Being able to identify the event that caused a sound, especially an everyday sound, can provide us with more information about our surroundings than simply knowing the object responsible for the sound. We hypothesize that the perceptual groups relating to the causal origin of the sound will be strongly dependent on the acoustic properties of the sound. In order to identify the individual acoustic features that are most heavily weighted in these judgments of causality we compared the effectiveness of a series of statistical analyses.

THE EFFECTS OF PARENTING AND DISCIPLINE ON THE DEVELOPMENT OF INHIBITORY CONTROL

STUDENTS Brandee Feola *Psychology*
ADVISORS Anna Fisher *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:45

Inhibitory control is the ability to suppress undesirable responses; this ability has been related to a number of important aspects of cognition such general intelligence, attention, problem solving and planning. Past research has shown that "Supportive" parenting promotes the development of inhibitory control and "Negative" parenting hampers the development of inhibitory control (Mischel, Shoda, Rodriguez, 1989). However, prior research has not examined the influence of discipline strategies on the development of inhibitory control. The present study will examine whether parenting styles and discipline strageties are related to the development of inhibitory control during the preschool years. This study will examine whether there are specific types and levels of discipline as well as other aspects of that may be related to the development of inhibitory control in 3- and 4-year-old children. The parents will be asked to complete a parenting and discipline survey. The child will participate in four different tasks to assess inhibitory control as well as other cognitive processes, namely working memory and task switching. The four tasks include a Card Sorting Task, a Go-No-Go Task, a Day and Night Task, and a Forward Picture Memory Task. The knowledge gained from this study will further our understanding of the development of inhibitory control.

THE INFLUENCE OF CONSTITUENT FAMILIARITY ON THE ABILITY TO BIND ASSOCIATIONS

STUDENTS Alexander Keinath *Psychology*
ADVISORS Lynne Reder *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Previous findings have suggested that there maybe be an influence of familiarity on the ability to encode memories. Specifically, it may be easier to encode associations when the constituent pieces are familiar. However, an experimental demonstration of this is lacking. To demonstrate this effect, subjects were differentially exposed to character-like stimuli during a training phase, after which ability to form associations was tested. The hypothesized effect was found, contingent upon training, as expected. A connectionist modeling of this familiarity effect, as well as of the results of various previous failed experimental attempts, will also be explored.

THE POROUS NATURE OF IDENTITY: EXPERIENCES OF MUSLIM-IDENTIFIED WOMEN LIVING IN THE UNITED STATES

STUDENTS Sara Mouhktar *Psychology*
ADVISOR Andrew Walters, *Northern Arizona University*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

The Muslim population in the United States has increased substantially over the past ten years, largely a function of migration of Muslims from other areas of the globe to North America. Substantial research either about or from Muslim-identified persons burgeoned after 9/11/2001. Some cross-disciplinary research has documented rates and outcomes of displayed prejudice/discrimination against Muslims. Because many persons identifying with Islam have migrated to the US they have, by definition, lived a segment of their lives in

another area, often a country with a large Muslim population. Thus, research has also focused on what are referred to as the "hybrid identities" of Muslim-identified persons in the US (Hutchison & Rosenthal, 2011; Mishra & Shirazi, 2010). There are social and psychological consequences from living under the sphere of suspicion, and this also is represented in the literature. Our study sought to examine how Muslim-identified women experience the plurality of worlds in the US, 10 years after 9/11 and immediately after the "Arab Spring." The current study used a qualitative-quantitative mixed-design to explore the experience of Muslim women. Thirteen community-dwelling women were included in a purposive sample. Quantitative data included completion of established family scales (e.g., System of Belief Inventory, Islamic Reflection Scale, Perceived Ethnic Discrimination Questionnaire) as well as demographic information. Informants also completed a qualitative interview. Questions focused on the porous nature of living in separate worlds (i.e., as a religious minority in a society often scornful of the Islam) and of the experience of living in the United States. Interviews were transcribed verbatim and transcripts were then interrogated using principles of grounded theory (Glaser & Strauss, 1967). Results are discussed in terms of the informants' experiences and focus on the informants' perception that individual Americans are overwhelmingly positive persons toward others, including themselves, but also living under a valence of anti-Muslim sentiment.

THE ROLE OF VIRTUAL VS. PHYSICAL INSTRUCTION MATERIALS

STUDENTS Emma Adair *Psychology*
ADVISORS David Klahr *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

The increasing availability of computers as instructional media in elementary school classrooms is generating an exciting range of new possibilities to support learning. Along with this trend research into the learning differences between virtual and physical manipulation has arisen. Unique learning advantages offered through physical manipulation have been difficult to identify. In this study 4th and 5th grade children used virtual or physical materials to learn about designing simple unconfounded experiments. In alignment with previous research the two types of instruction were equal in both domain general and domain specific learning objectives.

THE TRANSITION FROM THE PEDIATRICIAN TO THE ADULT PHYSICIAN FOR ADOLESCENTS WITH TYPE 1 DIABETES

STUDENTS Tiona Jones *Psychology*
ADVISORS Vicki Helgeson *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

The experience of transitioning from the pediatric health care system to the adult health care system for adolescents with Type 1 Diabetes can vary based on the readiness and preparedness of the patient. This study aimed to describe the average transition experience of patients. Participants (n=26) completed a phone interview that included questions and scales that measured items such as the amount of preparation they received, how involved their parents are in their diabetes care, and how comfortable they feel with their old and new physicians. Results showed that participants felt somewhat prepared for the change and preparation was related to more satisfaction with the adult physician than with the pediatrician. It was reported that more than half of the participants' parents attended the adult physician with the patient and were involved in the decision making process. Those who also favor the adult physician would like to be more involved in their treatment than they are.

UNCONSCIOUS NEURAL REACTIVATION IN ASSOCIATIVE LEARNING

STUDENTS James Bursley *Psychology*
ADVISORS John Creswell *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Our recent work (Creswell, Bursley, & Satpute, under review) has demonstrated a novel neural mechanism supporting unconscious cognitive processing of information relevant to complex decision making. Termed unconscious neural reactivation (UNR), this process occurs outside of conscious awareness, during the performance of a distractor task unrelated to the decision problem. Extending these findings to a new domain, the current research aims to characterize the role of UNR in learning and memory in humans. Building on our previous work, we adapted two associative learning tasks, whose initial encoding periods differentially recruit hippocampal-cortical and hippocampus-independent neural networks, for use in two experiments: A behavioral laboratory study and a studying using functional MRI. In both studies, the initial encoding periods of the learning tasks were followed by an unrelated number-memory distractor task that occupied conscious working-memory resources, forcing any processing relevant to the learning task to proceed outside of conscious awareness. We demonstrate that performing the distractor task leads to performance benefits on the associative learning tasks, suggesting a more general role for UNR than one restricted to complex decision making. We also identify and characterize the neural underpinnings of UNR in these associative learning paradigms and argue that they are evidence that UNR is a domain-general property of brain function and is not restricted to a single modality.

SELF-DEFINED

A WALK IN (HER) MY SHOES

STUDENTS Alesia Etinoff *Self-defined*
ADVISORS Michael Chemers *Drama*
ROOM/TIME Dowd / 12:00

A Walk in Her (My) Shoes is a solo performance that I, Alesia Etinoff, plan to write and perform. This performance will portray various women of color and their experiences. I plan to explore females' self conception and self-esteem as shaped by social pressures from family, peers, and the media. Through anthropological, psychological, and historical research, A Walk in Her (My) Shoes will be informed by a discourse that will best create an interview method to generate material for the show. I also propose doing research on gender performance to provide information on how to best portray women theatrically. The material for the performance will be based on a culmination of the interviews to best represent the women in the community that I want to impact.

CMU CONNECT

STUDENTS Ryan Billings *Self-defined* | Sean Chin *Information Systems* | Salim Peshawaria *Information Systems* | Jonghyun Thom *Self-defined*
ADVISORS   Jeria Quesenberry Information Systems
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:15

CMU Connect offers a platform for university students to meet in social, professional, or academic settings. By combining video chat and instant messaging technologies, this application aims to provide a new way for Tartans to get to know one another, and stay updated on campus life.

UNIVERSITY ECOLOGICAL FOOTPRINT CALCULATOR

STUDENTS Raphael Astrow *Information Systems* | Mallory Hayase *Self-defined*
ADVISORS Randy Weinberg *Information Systems*
ROOM/TIME McKenna / 4:40

The University Ecological Footprint Calculator calculates an estimate of a college or university's ecological footprint based on consumption data.

SOCIAL & DECISION SCIENCES

A POLITICAL SURVEY OF THE CMU COMMUNITY

STUDENTS Dev Doshi *Computer Science* | Emily Gehrels *Science and Humanities Scholars* | William Weiner *Social & Decision Sciences* | Crystal Wray *Economics* | Pavan Yalamanchili *Biological Sciences*

ADVISORS Brian Junker *Statistics*

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

We are seeking a measurement of each respondent's stance on social, political, economic, and election issues. We will obtain demographic information (age, gender, student/faculty/staff, major/department, QPA) and see if there is a relationship between the demographic information and stance. That is, can we predict a person's political leaning or election behavior given their demographic information? Also, we want to ask how representative of the US population the CMU community is.

ASSOCIATION BETWEEN ANTICIPATORY GRIEF AND SOCIAL PROBLEM SOLVING AMONG CAREGIVERS OF PERSONS WITH COGNITIVE IMPAIRMENT

STUDENTS Alexandra Hansen *Social & Decision Sciences*

ADVISORS Baruch Fischhoff *Social & Decision Sciences* | Nicole Fowler *University of Pittsburgh*

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

The objective was to determine if anticipatory grief is associated with social problem solving among caregivers of older patients with mild cognitive impairment or dementia.

Methods: The retrospective analysis used baseline data from a clinical trial that was conducted in a large urban medical center and was designed to test a caregiver self-management intervention. Data included scores from the Anticipatory Grief Scale (AGS), Social Problem-Solving Inventory–Revised: Short Form (SPSI-R:S), and NEO Five-Factor Inventory (NEO-FFI). Tests for associations used a multivariable regression model that adjusted for sociodemographic and NEO-FFI personality traits. Results: Of the 73 caregivers, most were female (78.1%), had some college (79.5%), and were married to the patient (75.3%). Mean age was 64.9($\pm$ 11.28), mean AGS score was 70.1($\pm$ 14.8), and mean standardized SPSI-R:S score was 110.2($\pm$ 9.8). Low SPSI-R:S scores were associated with the following: high AGS scores (regression coefficient, –6.95; P=0.03), low openness to experience scores (–5.77; P=0.048), and low conscientiousness scores (–7.23; P=0.01).

Discussion: Anticipatory grief appears to negatively affect problem-solving skills of caregivers for cognitively impaired patients. Efforts to engage caregivers in medical decision making may benefit from explicit attention to their emotional state.

BOTH WORK AND PLAY MAKE JOHNNY GOOD AT FRACTIONS: MOTIVATING LEARNING ON A FRACTION COMPARISON TASK WITH GAME INTERLUDES: PRESENTATION

STUDENTS Luke Davis *Psychology* | Christopher Reid *Social & Decision Sciences* | Yueran Yuan *Computer Science*

ADVISORS Albert Corbett *Human Computer Interaction Inst.*

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

We investigate the effect of one of the motivational tools we implemented in an original educational game that helps students practice fractional reasoning. We present the results of an experiment looking at the effect of

game interludes between fraction practice blocks on students' motivation and subsequent learning on fraction comparison tasks. We vary the relationship between the fraction task and the game task. In one condition, students' performance on the fraction task influences their performance on the game task. In a second condition, the students' performance on the fraction task has no impact on the game task. Motivation, game performance, and transfer to a standard fraction task are compared across conditions.

I-CONSERVE

STUDENTS Jia Chin *Social & Decision Sciences* | Won Seong Kim *Undecided* | Shivam Naik *Undecided* | Henry Neale *Undecided*
ADVISORS Jeria Quesenberry *Information Systems*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Due to the rising prospect of improving sustainability through the use of information systems, we have decided to focus our collective efforts on improving the sustainability of Carnegie Mellon's campus. Universities are generally among the largest and most influential organizations in their communities and thus, the creation of a more sustainable university would be particularly impactful to both students and surrounding locals. In addition, it has been shown that humans typically take around six weeks to build and adopt new habits. Our ultimate goal is to turn Carnegie Mellon University – one of the world's premier institutions of higher learning – into a place where life-long sustainable habits are built. In our project, we discuss two solutions that will improve Carnegie Mellon's sustainability through the use of information systems; the first of these involves the implementation of more efficient lighting systems, while the other involves improving the monitoring and management of the university's energy consumption. Since the project mainly concerns university campuses, our target audience includes students, faculty members, administration, other university staff, as well as private corporations that will be considered as our potential partners. We provide case studies to substantiate our theories. For the lighting system solution, we propose the installation of motion-sensor controlled lighting in order to more efficiently reduce electricity usage. The case studies relevant to this solution include a motion-sensor lighting project done by the University of Colorado-Boulder's Environmental Studies Program, as well as UC San Diego's 2011 lighting retrofit project, which utilized occupancy sensors. For the energy monitoring system, we propose that the current system be improved upon so that the real-time impact of energy consumption can be displayed in more intuitive and meaningful ways. Furthermore, we hope to encourage the practice of sustainable actions and lifestyles among the student body by initiating a campus-wide energy saving competition between residence buildings. For this solution, we looked at Harvey-Mudd College's implementation of a real-time metering system and a similar competition. In conclusion, the two solutions will be most effective if promoted together. Because the two are similar in implementation, doing so would be cost-friendly as well as time-efficient. The projects will not only enhance CMU's sustainability and save money—as shown in case studies—but also create friendly relationships with large corporations, provide exceptional experiences to members of our community and ultimately, improve CMU's reputation.

INCREASING THE EFFICIENCY OF THREONINE METHYL LABELING WITH CARBON-13 FOR NMR STUDIES ON PROTEIN-DNA INTERACTIONS

STUDENTS Meghan Nahass *Social & Decision Sciences* | Lindsey Pherribo *Chemistry*
ADVISORS Gordon Rule *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:45

We investigated methods to increase the efficiency of labeling the methyl group in the amino acid Threonine (Thr) with carbon-13 for NMR studies on protein-DNA interactions. Using a T7 expression system in Escherichia coli we changed two conditions to see how labeling was affected - 1. increasing the labeled concentration of CO_2 in the growth media and 2. blocking pathways in the Krebs cycle that cause the loss of the C-13 label. The extent of labeling was obtained through the use of nuclear magnetic resonance (NMR) spectroscopy.

MODERN SAUDI ARABIA: THE ECONOMICS OF TERRORISM

STUDENTS Ian Epperson *Social & Decision Sciences*
ADVISORS Silvia Borzutzky *Social & Decision Sciences*
ROOM/TIME Class of '87 / 12:40

This paper takes a multidimensional approach to understanding Saudi Arabia and its relationship with terrorism. It begins with a political history of Saudi Arabia with an emphasis on tracking discontent, followed by a synopsis of Saudi international relations in order to situate them in the international system. The current Saudi terrorist threat as well as the nation's economic conditions will also be addressed. The paper concludes with a set of recommendations regarding how to combat terrorism in Saudi Arabia.

In brief, this paper argues that the roots of Saudi terrorism are to be found in the nature of its economic system and that the prevention of terrorism requires a dramatic change in the Saudi Arabian economic system. Critical to the paper is the emphasis on a more organic form of prevention rooted in understanding the economic workings of both global terrorism and the Kingdom itself as opposed to championing current counterterrorist measures. The economic transformation of Saudi Arabia is according to the analysis presented in this paper the requirement to eliminate the terrorist support base and monetary pipeline, and to creating a more stable Saudi Arabia.

POLITICAL ATTITUDES AND ACADEMIC MAJOR OF CARNEGIE MELLON UNDERGRADUATE STUDENTS

STUDENTS Movses Musaelian *Statistics* | Matthew Vela *Social & Decision Sciences*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Political attitudes can be observed at the heart of nearly every contentious issue, and they can be assessed in even more meaningful ways. One such assessment involves the relationship between a student's college major and their political beliefs. It would be interesting to know if certain areas in academia draw people with certain political leanings or if such distinctions do not exist at all. Breaking and reinforcing long thought stereotypes is an inherently interesting task for any discipline. For example, will the stereotype hold that students studying art or music are more left wing when it comes to political and social issues? Which major has the most relatively right wing students, and what if any information can be derived from the subject itself and its relationship to political attitudes? In all, this survey seeks to provide a diagnostic of our community, similar to how various

polls are conducted on the US population regarding political, social and economic issues of interest, in the hopes of revealing any implications that would provide insight into how people think politically, and the various relationships that are formed between academia and politics.

PREDICTING WORLDWIDE NUCLEAR ENERGY ATTAINMENT

STUDENTS Peter Hendrickson *Social & Decision Sciences*
ADVISORS Paul Fischbeck *Social & Decision Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:15

Prior to the Fukushima reactor disaster in March 2011, there was discussion of a "nuclear revolution" in energy policy throughout the world. Facing rising energy costs, countries throughout the world publicly declared their interest in or plan to develop civilian nuclear energy programs. This potential growth of nuclear states raises serious security issues for both the United States and the rest of the world. There is a direct and strong connection between the development of civilian nuclear energy programs and weapons programs. Current and past research fails to address this relationship and the implications in a quantifiable manner. This paper seeks to understand better the development of these civilian nuclear energy programs by focusing on the socioeconomic statuses of nuclear countries at the time they acquired nuclear energy. Using this data, we develop several models that can provide insight on the likelihood of non-nuclear nations to develop nuclear energy in the future. Our results include preliminary rankings of the probability of non-nuclear states developing nuclear energy. This project provides exploratory research involving the development of nuclear energy internationally and will aid in further research that could improve national and international security policies in the near and long-term future.

STATISTICS

ANALYSIS OF FILM DISTRIBUTOR'S ITUNES PROMOTION

STUDENTS Elizabeth Lorenzi *Statistics* | Joon Su Min *Economics and Statistics* | Laura Patzer *Statistics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

We analyze the success of a promotion run by a major American film distribution company, which, for confidentiality reasons, we refer to as Distributor X. This promotion involved systematically decreasing the price of some of Distributor X's films on iTunes during the holiday seasons of 2010 and 2011. We have sales and revenue data for 389 of Distributor X's films. While iTunes was given permission to choose any of these films for promotion, not all of them were actually placed on promotion.

 We define the success of the promotion by the presence of an increase in revenue and/or sales while the film was on promotion. We have information regarding the films' genre, International Movie Database (IMDb) ratings, and how many clicks it took to find the film on iTunes while they were being promoted (for instance, one click means the film was featured on the front page of iTunes). We additionally have promotional Tier information. Each of the films that were qualified to be placed on promotion were categorized as Tier A, B, C or D. A film's tier classification roughly corresponds to the popularity of the film with Tier A films being the most popular. Exploratory data analysis show that while the majority of revenue was brought in by Tier A and B

movies, the lower Tier movies were impacted by the promotion the most.

We build a model that will predict the additional revenue an individual film should generate for Distributor X while on promotion. We then also use our exploratory data analysis and model construction to formulate future promotion ideas for Distributor X that could help maximize revenue.

ANALYSIS OF PITTSBURGH BUS SCHEDULE AND DATA

STUDENTS Shirui Hu *Mathematics* | Eliot Knudsen *Statistics* | I-Ta Yang *Mathematics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

The Port Authority of Allegheny County has been gathering data about bus related events for over a decade. Each bus has a computer that logs events about passenger flows, time stamps and bus stops. For our project, we are using a four-month subsample of this data, 27 million bus events. Facing a budget crisis, the Authority is looking for innovative way to cut costs and improve service. We have been asked to suggest data-driven improvements to make the bus service more efficient and reliable.

In this research project, we study two phenomena that cause uncertainty in the bus schedule: heterogeneity in departure from the schedule and bus clustering patterns. Buses arrival-time variances change significantly depending upon time of day, bus stop location, traffic conditions and many other factors. Additionally, buses group together because of delays at bus stops and passenger load delays. We use bus location, passenger flow, and time to identify and predict these phenomena for important bus routes. With our model, the Authority can make strategic changes to its schedule and bus system in order to improve service. Our results include specific patterns and potential factors contributing to bus variance and clustering.

ANTI-PIRACY LAWS AND BOX OFFICE SALES: A CASE STUDY IN FRANCE

STUDENTS Brandon Ngiam *Mathematics* | Carl Sturges *Statistics* | Anna Svirsko *Mathematics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Piracy has been a serious threat to the film industry due to the rise of file sharing clients such as BitTorrent, which have greatly increased the accessibility of illegal content online. Attempts at legislation to prevent piracy have been discussed often but few effective measures have been realized. France's graduated response law HADOPI aims to curb piracy through punitive measures for repeat offenders and methods to increase aware-ness among users who may not know they are downloading copyrighted material. Rather than studying the effect of online piracy on displacing digital content, this paper attempts, through rigorous statistical analysis, to determine HADOPI's effect on French box office sales and whether it is successful in increasing box office revenue.

By comparing weekly time series of box office sales in France against a control group com- prising of UK, Spain, Italy and Belgium, we are investigating whether there is a significant increase in French sales relative to the control group during periods of intense media scrutiny, which are reflected by data from Google Trends. Also, we are studying whether there has been a change in the rate of decline in individual movie sales across weeks due to the effects of HADOPI.

CAMPUS SENTIMENT AND SUGGESTIONS FOR ON-CAMPUS PARKING

STUDENTS Silvia Manolache *Business Administration* | Nicholas Thieme *Statistics* | Shu Wang *Mathematics* | Yijia Zhou *Business Administration*

ADVISORS Brian Junker *Statistics*

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

The city of Pittsburgh has recently increased the rates at the parking meters on Frew and Tech Streets. They have also increased the hours at which the meters must be paid: until 10pm on all days except Sunday. However, this has created a lot of problems for the users of these spaces – the students, staff, and faculty at CMU. We have implemented a survey, which will soon be analysed for trends, in order to understand what is the effect of this policy on the community at CMU. It is possible that there are better, more efficient ways for the parking on Frew and Tech Streets to be handled, either by CMU or by the city of Pittsburgh. For instance, if no-body parks behind on these streets any longer, the city loses revenue instead of gaining revenue as expected.

CENSUS ON PARKING METERS AT CARNEGIE MELLON UNIVERSITY

STUDENTS Nancy Geronian *Economics and Statistics* | Jungmoon Jang *Statistics* | Jeff Lee *Statistics* | Kaylee Makel *Economics* | Victor Wilczynski *Economics*

ADVISORS Mark Friedman *Biomedical Engineering* | Brian Junker *Statistics*

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

Coin parking meters are becoming a rarity in today's technologically advanced era, so why at Carnegie Mellon has there not been a technological improvement in terms of parking on its campus since CMU is known for being such a big tech hub? In reality, Carnegie Mellon is in working stages of implementing technological improvements in terms of parking on its campus (i.e. Traffic21, ParkPGH). We want to survey on campus parking meters to determine if there is a high frequency in unpaid meters. To add, we would like to see if there are any correlations between other factors, such as owning an expensive car, time of day, etc. This project is very interesting for anyone who uses the parking meters on campus, especially those who have been ticketed for parking violations.

INTERNET PIRACY AT CMU: STUDENT BEHAVIOR & OPINIONS

STUDENTS James Bogie *Statistics* | Benjamin Gorman *Economics* | Chelsea Grindle *Mathematics* | Jongwoo Lee *Statistics* | George Nardi *Philosophy* | George Volichenko *Statistics*

ADVISORS Brian Junker *Statistics*

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

Throughout the latter half of 2011 and the early months of 2012, internet piracy and copyright enforcement have been at the forefront of legislative debates, media coverage, and corporate public statements. The harsh reaction from the internet community (online institutions such as Google, Wikipedia; frequent users of social media such as Facebook, Twitter) in response to the proposed SOPA and PIPA bills suggest that there are divergent, strongly held convictions amongst the population on how to deal with copyright enforcement in the information age. We are surveying Carnegie Mellon undergraduates to see how often they engage in internet piracy and what opinions they hold on related copyright enforcement legislation. Our data-collection tool is an anonymous, self-administered online survey sent to a random sample of undergraduate students. The survey contains questions regarding the types of piracy students engage in, their views on the ethics and legality of piracy, and what

steps students take to find media entertainment online. Our survey results will hopefully be indicative of the views of high-performing university students nationwide, offering insight into how the most computer-literate segment of the population approaches pirated media. The conclusions we reach will be of interest to politicians shaping copyright enforcement legislation, media companies hoping to tweak their monetization strategies, and citizens wondering how others may judge what is largely a private behavior.

POLITICAL ATTITUDES AND ACADEMIC MAJOR OF CARNEGIE MELLON UNDERGRADUATE STUDENTS

STUDENTS Movses Musaelian *Statistics* | Matthew Vela *Social & Decision Sciences*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Political attitudes can be observed at the heart of nearly every contentious issue, and they can be assessed in even more meaningful ways. One such assessment involves the relationship between a student's college major and their political beliefs. It would be interesting to know if certain areas in academia draw people with certain political leanings or if such distinctions do not exist at all. Breaking and reinforcing long thought stereotypes is an inherently interesting task for any discipline. For example, will the stereotype hold that students studying art or music are more left wing when it comes to political and social issues? Which major has the most relatively right wing students, and what if any information can be derived from the subject itself and its relationship to political attitudes? In all, this survey seeks to provide a diagnostic of our community, similar to how various polls are conducted on the US population regarding political, social and economic issues of interest, in the hopes of revealing any implications that would provide insight into how people think politically, and the various relationships that are formed between academia and politics.

PORTRAIT PHOTOGRAPHS AND PHOTOGENICITY

STUDENTS David Zimmerman *Statistics*
ADVISORS George Loewenstein *Social & Decision Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:30

Often during social gatherings that require photographs people will claim, "I am not very photogenic, I shouldn't be in this", and use this standard excuse to avoid being in photographs. This research looks into the personal ratings of how photogenic people consider themselves to be. The specific definition of photogenic used is, the level of attractiveness that a photograph captures. Through this definition we try to tease out the differences between inherent attractiveness, that must be judged in person and what a photograph can convey.

REDUCING COSTS FOR THE PORT AUTHORITY

STUDENTS Michael Pane *Statistics* | Nicholas Rock *Science and Humanities Scholars* | George Volichenko *Statistics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The Pittsburgh Port Authority runs a substantial deficit. In times of such economic hardship, it is absolutely essential for them to find feasible cost reduction solutions. For the last few years the Port Authority has collected various information from each of its buses' trips (e.g. scheduled stops, geographic coordinates, passenger entry and exiting, and et cetera). The accessible data contains all records for April 2009 and October

2010 and includes over 20 million such events. Our ultimate goal is to use this data to find efficient ways to reduce costs with minimal sacrifice. We first take steps to establish the reliability and the accuracy of the provided data set. Elementary data exploration and information received from the Port Authority reveals that several aspects of the data are inaccurate, particularly passenger flow and route ID. We devise an algorithm to minimize passenger flow error and another to reclassify trips by the best-fit route ID. After refining the data we focus our data analysis on studying the passenger fluctuation for certain routes at various times of the day and week. Based on these findings we can then determine which routes should be limited, eliminated or turned into "express routes" (much fewer stops). This will ultimately lead to reducing costs for the Port Authority.

UNDECIDED

EVALUATING BUCKET-WHEEL EFFECTIVENESS UNDER MICROGRAVITY

STUDENTS Hahna Alexander *Mechanical Engineering* | Kayla Aloyo *Mechanical Engineering* | Tiffany Bassey *Undecided* | Andrew Sheng *Computer Science*
ADVISORS Krzysztof Skonieczny *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

The excavation of regolith (Lunar soil) is essential to the construction of future off-planet outposts and harvesting of fuel deposits, both of which are vital for prolonged human presence on the moon. The bucket wheel excavator is a machine used for surface mining and digging. The mechanism consists of a large wheel with a continuous pattern of "buckets" used to scoop material as the wheel turns. This method of excavation is useful due to the low resistance forces and lightweight operation. The proposed bucket wheel excavator will be mounted centrally on a Lunar Rover, and runs transverse to the direction of forward rover motion. This setup enables the collection of regolith, which is essential to the success of the excavating concept. The behavior of the bucket wheel mechanism is unknown in low gravity environments. Fundamentally, it is questionable if regolith will even be able to fall out of a bucket on the lunar surface. Bucket functionality must be evaluated in microgravity before bucket wheel implementation is feasible. A microgravity experiment will examine the behavior of the bucket wheel in lunar gravity by testing the amount of regolith gathered after specified rotations of an individual bucket. Buckets will be optimized for ideal aspect ratio, overall size, and shape. Additionally, Lunar soil simulant with similar properties will be used to mimic Lunar regolith. Testing bucket excavator functionality in microgravity is critical to the success of future lunar excavator concepts. The goal of this research is to evaluate bucket wheel effectiveness in a Lunar gravity environment. The team will evaluate if selected design parameters uphold terrestrial bucket wheel theory, thus enabling the implementation of bucket wheel excavators on future Lunar rover missions.

I-CONSERVE

STUDENTS Jia Chin *Social & Decision Sciences* | Won Seong Kim *Undecided* | Shivam Naik *Undecided* | Henry Neale *Undecided*

ADVISORS Jeria Quesenberry *Information Systems*

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

Due to the rising prospect of improving sustainability through the use of information systems, we have decided to focus our collective efforts on improving the sustainability of Carnegie Mellon's campus. Universities are generally among the largest and most influential organizations in their communities and thus, the creation of a more sustainable university would be particularly impactful to both students and surrounding locals. In addition, it has been shown that humans typically take around six weeks to build and adopt new habits. Our ultimate goal is to turn Carnegie Mellon University – one of the world's premier institutions of higher learning – into a place where life-long sustainable habits are built.

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SUSTAINABUS

STUDENTS Kairavi Chahal *Undecided* | Kevin Chen *Information Systems* | Adrian Lam *Undecided* | Sethu Prakasam *Information Systems* | Linda Zhang *Information Systems*

ADVISORS Jeria Quesenberry *Information Systems*

ROOM/TIME McKenna / 1:00

The city of Pittsburgh in Pennsylvania has a large public transport system which serves many individuals and is integral to their lifestyles. Vast amounts of pollution that is produced could be reduced if buses are dispatched more intelligently and efficiently. In addition, the local buses in Pittsburgh, PA, in most cases, do not always arrive on time. Because of this, people start relying on other methods of transportation. If there was some way to notify bus drivers there may not be people at certain stops, then this problem could be resolved. Nevertheless,

on-time transportation is becoming a problem for many people in Pittsburgh. In addition to causing tardiness, buses that pass vacant stops unnecessarily will cause extra pollution. Other problems include notion of dropping the 28x bus the coming year and society's increasing reluctance on using public transit, despite many app offerings such as CMU's Tiramisu. However, these problems can be fixed. Tracking chips such as GPS chips can be put on buses; we can improve current app offerings, and implement check-in system. Solutions aforementioned will benefit our society. In the long term, our projected savings will balance our short term expenses. Our aim is to not only sustain our planet, but also to keep it healthy so that we can reduce our carbon footprint significantly.

THE NEW DRAGON: CHINA'S EMERGING FASHION CULTURE

STUDENTS Nicole Lee *Undecided* | Paul Zuker *Undecided*
ADVISORS Timothy Haggerty *Humanities Scholars Program*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

After considering the interplay of influences in fashion design and undertaking the design and construction of our own, we plan to showcase a small set of six clothing designs. These designs take inspiration from traditional and contemporary Chinese fashion elements, incorporating them into more modern designs not exclusively based on Chinese fashion, but largely influenced by it. By exploring the influence of these design elements, we consider the future role China will play in the unfolding international fashion industry. This past season especially, influential designers have begun to explore the new export of ideas and elements from East Asia, and by participating in our own small way in the changing direction of the flow of influence, we can gain a more involved perspective of the way in which China's growing economy and indigenous fashion industry are changing the modern fashion world.

MELLON COLLEGE OF SCIENCE

BIOLOGICAL SCIENCES

A FLUOROGEN-ACTIVATING PROTEIN BIOSENSOR FOR PROTEIN-PROTEIN AND CELL-CELL INTERACTIONS

STUDENTS Lianne Cohen *Biological Sciences*
ADVISORS Jonathan Jarvik *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:00

The ability to study interactions between different components in a biological system is essential for research. In order to aid in the imaging and analysis of these types of interactions, we have developed a biosensor that detects protein-protein and cell-cell contacts. This biosensor will help to understand the nature of protein interactions and could be used to screen for molecules that affect the interactions. Current methods for studying protein-protein interactions, like FRET, require specific knowledge of protein structure and have high background levels. Additionally, most cell-cell contact assays are irreversible, preventing dynamic studies. To avoid these issues our biosensor is based on fluorogen-activating protein (FAP) technology: small organic dyes, which are not fluorescent in solution, become constrained by binding a FAP and emit fluorescent signal. In order to create this biosensor, HeLa cells were virally transduced with two different protein constructs. The first contains a FAP, scFv1, expressed extracellularly connected through a transmembrane domain to the protein FKBP, in the cytoplasm. The second construct has a single-chain avidin outside of the cell and the protein FRB, inside. FKBP and FRB are proteins that bind together in the presence of rapamycin. A reagent was developed to detect proximity of these two extracellular domains, avidin and scFv1; it consists of a biotin molecule connected via a PEG linker to DIR, a fluorogen dye. Presence of this reagent in low concentrations is not sufficient to obtain signal from the scFv1-FKBP protein alone. However, when avidin binds biotin with a high affinity, the local concentration of DIR increases around the scFv1 expressed on the surface of the cell and the reagent is able to bind, producing a strong fluorescent signal that is also reversible. Furthermore, we will also use these constructs in adjacent cells to analyze cell-cell contacts via time-lapse microscopy.

A POLITICAL SURVEY OF THE CMU COMMUNITY

STUDENTS Dev Doshi *Computer Science* | Emily Gehrels *Science and Humanities Scholars* | William Weiner *Social & Decision Sciences* | Crystal Wray *Economics* | Pavan Yalamanchili *Biological Sciences*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

We are seeking a measurement of each respondent's stance on social, political, economic, and election issues. We will obtain demographic information (age, gender, student/faculty/staff, major/department, QPA) and see if there is a relationship between the demographic information and stance. That is, can we predict a person's political leaning or election behavior given their demographic information? Also, we want to ask how representative of the US population the CMU community is.

CANDIDA ALBICANS ADHERENCE REGULATOR ACE2 IS A PIVOTAL TARGET OF SNF5

STUDENTS David Huang *Biological Sciences*
ADVISORS Aaron Mitchell *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:15

The diploid fungus Candida albicans is a major human fungal pathogen. One critical factor that allows Candida albicans to cause many health complications is its ability to form surface-bound microbial communities called biofilms. Biofilm causes severe impacts for human health by providing both an entry to the body and a sanctuary for invasive pathogens. Biofilm formation is thought to start with the adhering of yeast-form cells onto a substrate, such as a catheter or an implanted medical device. Thus, identifying C. albicans adherence regulators provides potential therapeutic targets. I screened transcription factor insertion mutants for adherence defects in a Fluxion flow cell-based assay. This screen revealed that Snf5 (orf19.5871), a subunit of the SWI/SNF chromatin remodeling complex, is necessary for adherence. A snf5/ mutation caused severely reduced cell-substrate adherence, defective cell wall metabolism, increased yeast-form cell aggregation, defective hyphal morphogenesis and inability to form biofilms on silicone substrates both in vitro and in vivo. All phenotypic defects in the snf5/ mutants were restored by complementation of a wild type copy of SNF5, confirming that the pleiotropic defects were caused by the loss of SNF5. Gene expression profiling with 293 reporter genes using nanoString revealed that the snf5/ mutation caused a broad impact on gene targets of known biofilm regulators, including those of Ace2. ACE2 expression was also reduced in a snf5/ background. It was therefore hypothesized that the defects observed in the snf5/ mutants resulted from decreased ACE2 expression. To test this model, an ACE2 over-expression allele was introduced in the snf5/ background. ACE2 over-expression significantly reversed many defects from the SNF5 deletion, including cell-substrate adherence, cell aggregation, cell wall integrity, hyphal morphogenesis and biofilm formation in vitro and in vivo. In addition, ACE2 over-expression substantially reversed many of the gene expression changes observed in the snf5/ background. These results indicate that ACE2 is a key downstream target gene of SNF5 that mediates adherence as well as diverse morphological and cell wall-related functions.

CARDIAC-SPECIFIC KNOCKDOWN OF THE SODIUM DEPENDENT GLUCOSE COTRANSPORTER 1 (SGLT1) ATTENUATES THE CARDIOMYOPATHY CAUSED BY A MUTATION IN PRKAG2

STUDENTS So Jung Lee *Biological Sciences*

ADVISORS Mary Braun *Biological Sciences* | Dr. Ferhaan Ahmad *UPMC*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 11:00

Background: PRKAG2 encodes the cardiac-specific gamma 2 subunit of 5'AMP-activated protein kinase (AMPK). AMPK regulates energy generating and consuming pathways in response to cellular needs. The T400N mutation in PRKAG2 triggers inappropriate activation of AMPK, which leads to glycogen storage cardiomyopathy, characterized by increased cardiac myocyte glucose uptake, excess glycogen deposition, and hypertrophy. We previously discovered a novel cardiac glucose transporter, SGLT1, that contributes to cardiac glucose uptake and is upregulated in a transgenic mouse model of PRKAG2 cardiomyopathy, TGT400N.

Hypothesis: Increased glucose uptake by cardiac SGLT1 leads to the phenotype of PRKAG2 cardiomyopathy.

Methods: Two lines of transgenic mice expressing shRNA targeting SGLT1 were constructed (1) using a cardiac myocyte-specific alpha MHC promoter that causes cardiac specific SGLT1 knockdown (TGaMHCKD), and (2) using the ubiquitous U6 promoter that causes universal SGLT1 knockdown (TGU6KD). The SGLT1 knockdown mice were then crossed with TGT400N mice to create two lines of double transgenic mice: TGT400N/TGaM-HCKD and TGT400N/TGU6KD.

Results: Relative cardiac mRNA expression of SGLT1 was decreased from 1.00 ± 0.18 in TGT400N to 0.629 ± 0.15 in TGT400N/TGaMHCKDmice ($p<0.05$, n 3/group). Cardiac glycogen content (ug glycogen/g heart) was decreased from 103.72 ± 12.89 in TGT400N to 83.02 ± 23.55in TGT400N/TGaMHCKD mice. Heart weight / body weight ratio (in mg/g) was significantly decreased from 16.52 ± 0.72 in TGT400N to14.22 ± 0.50 in TGT400N/TGaM-HCKD mice ($p<0.005$, n 5/group). There were no significant differences between TGT400N/TGU6KD andTGT400N mice.

Conclusions: The alpha MHC promoter is a feasible approach to produce cardiac specific knockdown, and is superior to the U6 promoter. Knockdown of SGLT1 using the alpha MHC promoter resulted in a decrease in mRNA expression of SGLT1, cardiac glycogen content, and cardiac hypertrophy.

CHARACTERIZING THE ROLE OF NUCLEOLAR PROTEIN NOP12 IN RIBOSOME ASSEMBLY

STUDENTS Anna Park *Biological Sciences*

ADVISORS John Woolford *Biological Sciences*

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

To further expand our knowledge of eukaryotic ribosome biogenesis, I will be studying protein Nop12 and its role in the intricate ribosome assembly pathway in the yeast, Saccharomyces cerevisiae. Ribosomes are essential, complex cellular machines that synthesize proteins for the cell. Since they are essential to the survival of the cell, they can be targeted for destruction in cancer cells. Nop12 is one particular protein involved in the processing of pre-ribosomes and may direct binding of rRNA during pre-rRNA processing. It is believed that Nop12 functions within a subcomplex with five other proteins – Brx1, Ebp2, Pwp1, L18, and L15. This project uses methods in molecular biology and genetics such as epitope tagging, TAP purification, and yeast two-hybrid. Uses these approaches, we can characterize the ability of Nop12 in binding to pre-ribosomes and can generate a map of protein-protein interacts between Nop12 and other ribosomal proteins and assembly factors.

CORTICAL REPRESENTATION OF TEMPERATURE SENSATION IN MOUSE

STUDENTS Hannah Wirtshafter *Biological Sciences*
ADVISORS Alison Barth *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:30

While temperature has been mapped to the insular cortex in primates, the exact cortical representation in rodents has remained elusive. The hope is to develop the thermal response as a tool to manipulate neural circuits so that experience dependent neuronal firing can be examined. This experiment uses c-Fos levels, as determined using immunohistochemistry, as a marker of neuronal activity to locate the cortical representation of temperature sensation. Initial findings have shown increased c-Fos levels in the insular cortex in mice whose paws have been stimulated with cold water or menthol, both of which activate the cold-sensing TrpM8 channels. The mice exhibit increased c-Fos expression in layers 2/3 and 5/6 of the insular cortex, an area that has been previously linked to temperature sensation in other mammals.

DETERMINING THE WAYS IN WHICH APC2 CORTICALLY LOCALIZES

STUDENTS Paige Davison *Biological Sciences*
ADVISORS Brooke McCartney *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:30

Adenomatous polyposis coli (APC) proteins regulate the actin and microtubule cytoskeletons, and negatively regulate the Wnt signaling pathway. Disruption of APC function initiates colorectal cancer in humans. While APC's role in Wnt signaling and microtubule function are well studied, the mechanisms by which APC proteins interact with and regulate the actin cytoskeleton are not well understood. APC2 localizes to actin in the Drosophila syncytial embryo, where together with the formin Diaphanous, it is required for the extension of actin pseudocleavage furrows that form during metaphase. To understand how APC2 promotes actin furrow extension, we are investigating the mechanisms that affect the localization of APC2 to the actin cortex. Previously the McCartney lab reported that the N-terminal Armadillo (Arm) repeats and the C-terminal 30 amino acids (C30) together are necessary and sufficient for the cortical localization of APC2. Deletion of C30 alone resulted in loss of cortical localization in the syncytial embryo and defects in furrow extension. Within C30 is a 15 amino acid sequence (amino acids 1048-1063) that is highly conserved within Drosophila species suggesting functional significance. Computational structural analysis of this conserved region predicted a coiled-coil. We found that the 15 amino acid conserved region together with the Arm repeats are necessary and sufficient for cortical localization of APC2 in S2 cells. Mutating all three key hydrophobic residues in the predicted coil to proline abolished cortical localization, confirming that the coiled-coil is necessary for APC2 localization to the actin cortex. Because the Arm repeats of APC2 promote its self-association and cortical localization, we predict that self-association of APC2 via the Arm repeats may be necessary for cortical localization. We are currently testing whether the self-association of APC2 is required for C30 function.

EFFECT OF "PRE-EXISTING" INFLAMMATORY ENVIRONMENT ON PROGENITOR DIFFERENTIATION

STUDENTS Eun Hwa Lee *Biological Sciences*
ADVISORS Phil Campbell *ICES*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:45

Four different condition media, control, LPS, IL-10 and LPS and IL-10 would be produced using JJ774a.1 (mouse macrophage cell line) to induce pro-inflammatory and anti-inflammatory conditions on C2C12 (mouse myoblast cell line). The effect of myoblast differentiation after extended exposure on pro-inflammatory environment was studied. The response to secondary IL-10 treatment and differentiation of C2C12 cells after extended period of LPS exposure was also studied. Lastly, it was confirmed whether IL-10 treatment "rescue" differentiation response even after extended periods of LPS exposure.

HSP27 AND ITS EFFECT ON CASPASE ACTIVITY DURING SPERM DIFFERENTIATION IN DROSOPHILA

STUDENTS Janice Lyu *Biological Sciences*
ADVISORS Jonathan Minden *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:15

Apoptosis (programmed cell death) occurs in all multicellular organisms as a means to both remove unwanted and/or defective cells and aid in tissue formation and morphogenesis. The ability of the organism to activate an apoptotic program is a vital mechanism to prevent cells from uncontrollable growth, which can lead to cancer if left alone. Apoptosis also functions as a natural developmental program that sculpts developing tissues by removing excess cells after differentiation. Moreover, the enzymes responsible for this process (caspases) have been shown to also be involved in additional non-death related processes, such as spermatid development in Drosophila, indicating that the actions of caspases are more versatile, and complex, than originally though. Therefore, a clear understanding of how the signaling pathway that leads to caspase activation is activated and regulated in cells is crucial. To address this, our lab performed a proteomic screen to identify proteins that are involved in early apoptosis and thus caspase activation. An isoform of a small heat shock protein, Hsp27, was seen in greater abundance in correlation with increased levels of apoptosis. Preliminary analyses indicate that Hsp27 plays a pro-apoptotic role, and is required for activation of caspases in the developing Drosophila epithelium, a tissue which exhibits a robust amount cell death. Interestingly, a particular allele of Hsp27 exhibits sterility in males. Therefore, to investigate whether Hsp27 also plays a role during Drosophila spermatogenesis I examined the morphology and the caspase activity of wild-type and Hsp27 mutant testes to better understand the role of Hsp27 during sperm differentiation in Drosophila.

HUMAN TEAR LIPOCALIN FOR IMAGING CELL SURFACE PROTEINS

STUDENTS Minju Kim *Biological Sciences*
ADVISORS Gordon Rule *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:30

Human single chain variable fragments (scFv) can be utilized as a biosensor platform called a fluorogen activating protein (FAP). scFv consists of variable regions of heavy and light chain of an antibody, which is known to be made in mammalian organisms that has high specificity in binding to proteins, carbohydrates,

and small molecules. In the case of FAPs, the scFv binds to the fluorogenic dye, malachite green causing it to fluoresce. When binding to the dye, fluorogen activating protein, scFv, usually emits fluorescence on the surface of cells, such as yeast cell surface. This technique of imaging the cells is developed to determine and study the protein of interest on the cell surface. When the scFv is genetically linked to the protein of interest, it can be expressed on the cell surface and determine the localization of the protein of interest. Therefore, scFv is a great candidate for monitoring and studying the process of surface proteins. However, when scFv is produced intracellularly, the disulfide bonds, which stabilize the tertiary structure of scFv, is no longer stable and loses its function in the cytosol inside the cell. This raises challenges of using scFv as an intracellular FAP due to losing its function when exposed to the cytosol. Therefore, One of the objectives of the project is to find a replacement of scFv that is more stable in cell environment. Human tear lipocalin (TLC) is another binding protein that has can replace the role of scFv. Lipocalin is a protein with single domain that looks similar to scFv. Since Lipocalins do not have disulfide bonds, the unfolding inside cell is unlikely to happen. My focus of the research is to test if the human tear lipocalin protein can be genetically modified in a small plasmid DNA and expresses it on yeast cells.

IDENTIFICATION AND ANALYSIS OF PATIRIA MINIATA GENE GCM CIS-REGULATORY MODULE

STUDENTS Margaret Libonati *Biological Sciences*
ADVISORS Veronica Hinman *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:00

The purpose of this project is to identify and analyze the unknown cis-regulatory modules (CRMs) of the Patiria Miniata (sea star) gene, glial cells missing (gcm). Gcm is responsible for activating expression of pigment synthesis genes such as pks and fmo in Strongylocentrotus purpuratus (sea urchins). The expression of pigment cells in sea urchins is an example of the evolution of novel cell types. Novel cell types are those of new function or morphology; there are many ways a novel cell type can arise within an organism, including through gene duplication, mutation or by a change in gene regulation. Because the sea star and other basal larvae lack pigment cells, embryonic pigment cells must have evolved in sea urchins. Cells expressing gcm originate from the sea star ectoderm; however in the sea urchin, gcm is expressed in the mesoderm. We propose that a change in the cis-regulation of gcm leads to the expression of gcm in the sea urchin mesoderm and results in a novel cell type. Therefore, the objective of this research is to determine regulatory events that might lead to the change in the expression of gcm. The CRM is a segment of the DNA containing clusters of transcription factor (TF) binding sites that regulate the expression of the target gene. The first goal of this research was to locate the previously unknown CRM of sea star gcm. This was accomplished by isolating regions upstream from the translation start site and within the first intron of the sea star gcm DNA that could potentially contain CRMs. The putative CRM regions were analyzed using a program called ClusterBuster in order to find potential transcription factor binding sites. Secondly, progressively smaller cloned regions of sea star gcm containing the putative CRM were injected into the sea star embryo. Specific expression within the ectoderm was then analyzed using in situ hybridization. By comparing the previously identified sea urchin gcm CRM (Ransick et al., 2006) with that of the sea star, it will be possible to determine how a change in cis-regulation of gcm results in a gain of expression of gcm in the mesoderm and pigment synthesis gene expression in sea urchin. This work will lead to further research on TFs involved in gcm regulation and expression in addition to expanding the known gene regulatory network.

IDENTIFICATION OF CIS REGULATORY SEQUENCES OF EFFECTOR GENES IN THE SEA URCHIN SKELETOGENIC GENE REGULATORY NETWORK

STUDENTS Stephanie Guerra *Biological Sciences*
ADVISORS Charles Ettensohn *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:15

The purpose of this project is to identify and analyze cis regulatory sequences in the sea urchin genome that are responsible for the differential expression of key genes expressed in the primary mesenchyme cells (PMCs). This is important because an outline of connections has been determined in the PMC gene regulatory network (GRN) and this project could assist in further refinement of this network. Many gene interactions have been identified in this GRN, but in most cases it is not known whether these interactions are direct or indirect. One way to identify direct interactions is to dissect the cis-regulatory modules that direct the spatial and temporal expression of a given gene and then identify the proteins that bind to those modules. Since many cis regulatory sequences are upstream of the gene of interest, this will be my starting point of exploration. My project will consist of a general screen in which I will take sequences of DNA that are located from -1 to -2000 relative to the transcriptional start sites of the genes of interest. These sequences will be cloned from sea urchin genomic DNA and then integrated into plasmid vectors upstream of a GFP reporter sequence. These plasmids will then be linearized and injected into fertilized sea urchin embryos. After subsequent development to appromixately the mesenchyme blastula stage, the embryos will be examined by fluorescence microscopy to determine if the GFP protein has been expressed. If the embryos show specific GFP protein expression in the PMC population, this indicates that the upstream 2000 base-pair sequence is sufficient to initiate expression of its target gene specifically in the PMCs. This experiment will be performed on 15-20 different genes that are expressed specifically by PMCs, with the hope that positive cis regulatory sequences will be identified. These genes were initially chosen because the mechanism for their direct activation in the PMC GRN is unknown.

INFANTS' PERCEPTION OF CAUSAL CHAINS

STUDENTS Areej Ali *Biological Sciences*
ADVISORS David Rakison *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

A crucial milestone in infant cognition is the perception of causality and movement. What causes movement? What makes animates self-propelled and in-animates static? Are there specific features of objects that are correlated with movement? How and when infants gain an understanding of causality is thus an important aspect of child development research. Studies have uncovered a developmental trend in infants' perception of causality, with 10-month old infants possessing a simple understanding of agents versus recipients and infants at 15 months understanding that the first object in a causal chain can cause a third object to move. The research proposed will build upon previous studies by investigating 18- and 22-month-old infants' knowledge of the features of objects in a causal chain; that is, whether they expect agents to have dynamic parts and recipients to have static parts. Although previous work by Dr. Rakison has shown that infants cultivate an expectation at 22 months that agents in a causal chain should have a dynamic part, this research cannot be further interpreted without additional validation from infants' response to non-causal chains. Only after confirming, through habituation studies, that infants have the same expectations about the features of objects in a non-causal chain that they do in a causal chain can one conclude that infants understand part-causal relations that are consistent with real world principles at 22 months. Such findings would contribute towards cementing a developmental

timeline for infants' understanding of causal chains, and they would help to add to a growing body of data about U-shaped curves and their underlying mechanism.

INSPIRED: COMMON THEMES IN SCIENCE

STUDENTS Mridula Nadamuni *Biological Sciences*
ADVISORS Mary Braun *Biological Sciences*
ROOM/TIME Pake / 3:20

My SURG project consists of a series of interviews with mostly science and some engineering faculty about their research and teaching experiences. In my conversations with interviewees, I found that scientists across disciplines touched on similar themes, such as collaboration, the importance of failure, and most interestingly, the value of opinion and personality in science. In this presentation, I explore some of these themes further and present my findings.

INVESTIGATING THE BIOLOGICAL FUNCTION OF A NON-EXONIC RECURSIVE SPLICE SITE IN THE POLYCHAETOID GENE OF DROSOPHILA

STUDENTS Siping He *Biological Sciences*
ADVISORS A. Javier Lopez *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:45

Recursive splice sites (RSSs) are found exlusively within long introns and are highly conserved during insect evolution (Burnette et al 2005). Deletion of a non-exonic RSS in the Ultrabithorax (Ubx) gene of Drosophila did not result in obvious RNA processing defects but led to partial loss of gene function and a distinctive genetic interaction with mutants of RNA polymerase II that have impaired processivity. The current hypothesis resulting from the Ubx deletion experiment is that non-exonic RSSs may play a role in increasing RNA polymerase processivity through interactions between the splicing machinery and elongation or processivity factors. In order to support this finding as a general function for all non-exonic RSSs, the role of a non-exonic RSS on the polychaetoid gene is being investigated. For this purpose I am deleting a RSS in the endogenous polychaetoid gene using a multistep strategy for Ends-In-Homologous Recombination.

INVESTIGATING THE ROLE OF APC2 IN ASYMMETRIC DIVISION OF DROSOPHILA NEUROBLASTS

STUDENTS Nicholas Delrose *Biological Sciences* | Allyson Koyen *Biological Sciences*
ADVISORS Brooke McCartney *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:00

Wnt signaling is one biological pathway that regulates cell-cell interactions during the development of multi-cellular organisms, including Drosophila. Disruptions of the Wnt pathway are known to cause developmental defects as well as promote tumorigenesis. Adenomatous polyposis coli (APC) was rst discovered to be a tumor suppressor, as mutations in human *APC* lead to colon cancer. It is now known that APC is a negative regulator of Wnt signaling. In the absence of Wnt ligand, APC, together with Axin, GSK3ß, and CK1, forms a destruction complex that targets the transcription factor ß-catenin for proteasomal degradation and keeps Wnt signaling off.

In the developing *Drosophila* brain, the asymmetric inheritance of cell fate determinants establishes distinct fates in the daughters of neural stem cells. Brain tumor (brat) is one asymmetrically partitioned cell fate determinant that promotes the differentiation of type II neuroblast lineages. Mutations in *brat* resulted in over-proliferation of type II neuroblasts, and the loss of differentiating neurons, resulting in a tumorous phenotype. Preliminary data suggest that APC2 may also play a role in the regulation of asymmetric neuroblast division in the Drosophila brain. We have previously shown that APC2 is enriched in a cortical basal crescent in larval brain neuroblasts. Brat mutants exhibit a reduction of cortical APC2 in type II neuroblasts, and over-expression of APC2 in *brat* mutants using the Gal4-UAS system rescues the over-proliferation phenotype. Surprisingly, loss of APC2 alone has no effect on neuroblast divisions or neural fate.

To understand the relationship between APC2 and Brat during neuroblast divisions and neural differentiation, we are asking which domains of APC2 are required for the suppression of the *brat* mutant phenotype. This is accomplished by introducing various transgenes expressing both wild type and targeted mutants of APC2 under the endogenous *APC2* promoter into the genome of brat mutants, and subsequently quantifying the number of type II neuroblasts for each genotype. The targeted mutants are designed to specifically disrupt either APC2's destruction complex function, or APC2's cortical localization. In the *Drosophila* embryo, the cortical localization of APC2 is completely dispensable for destruction complex function. These experiments will allow us to define which functions of APC2 are required for proper regulation of neurogenesis in the *Drosophila* brain. Our preliminary results suggest that Wnt signaling function and the cortical localization of APC2 are both necessary for this process.

MODELING CELL SHAPE DYNAMICS

STUDENTS Ling-Yi Kung *Biological Sciences*
ADVISORS Joshua Kangas *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:15

Knowing the subcellular location of a protein may be important to understanding its function, especially if the location changes over a cell's life cycle. Therefore, the ability to model protein distribution within a cell over time is necessary to create computational simulations of cell behaviors. Previously, two- and three-dimensional models were able to capture cell and nuclear shape as well as multiple subcellular location patterns for a single time point. In order to begin to understand the dynamics of subcellular location patterns, we started by learning a shape space model for cell and nuclear shape of a single NIH 3T3 cell line with GFP tagged alpha actinin 4 and then characterized the trajectories of single cells within that shape space from time series data.

PHYLOGENETIC RECONSTRUCTION OF DOMAIN SHUFFLING IN THE MAGUK PROTEIN FAMILY

STUDENTS Katherine Siewert *Biological Sciences*
ADVISORS Dannie Durand *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:30

Proteins involved in cell signaling and adhesion often have complex, modular architectures, but little is known about how these multi-domain proteins evolve. A protein domain is a peptide sequence that encodes a specific three-dimensional shape and is found in the context of many different proteins. The domain content of a protein can change over time due to deletions, insertions and duplications of domains within the protein's architecture, a process called domain shuffling. As domains are shuffled over time, their sequences mutate, providing evidence of their evolutionary history. To obtain a better understanding of evolution by domain-shuffling, I am studying the history of domain shuffling in the membrane-associate guanylate kinases (MAGUK) protein family, which is involved in the formation and regulation of cell junctions. To do this, I am using standard phylogenetic techniques, as well as algorithms developed in the Durand laboratory that infer relationships between domains found in different proteins and species. Using this approach, I have developed a hypothesis for the co-evolutionary history of domains found in the MAGUK protein family. To provide further evidence for these histories, I have also compared intron/exon structures in MAGUK proteins and performed statistical testing on the phylogenetic trees of individual domains. Because of its role in cell-to-cell interactions, understanding the evolutionary history for this family can ultimately contribute to our understanding of neural development and help uncover the history of multicellularity.

PHYLOGENOMIC ANALYSIS OF TUMORIGENESIS USING BREAST CANCER CELLS

STUDENTS Titas Banerjee *Biological Sciences*
ADVISORS Russell Schwartz *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:00

The aim of this project is to gain better insight into potential treatments and diagnostics of cancers. For the year 2011 alone, the American Cancer Society predicted that more than 1.5 thousand Americans would lose their lives to cancer per day and about 1.6 million cases would be diagnosed throughout the year. These statistics are strikingly high and a great cause for concern. Early detection and treatments are still the best measures against cancer. As such, it is important to refine our methods for properly identifying, classifying, and treating

cancer. Although many distinct combinations of mutations can in theory lead to the phenotype of tumor growth, genetic studies of tumors have suggested that there are actually a few roughly equivalent sequences of mutations, known as progression pathways, which most cancers follow. One hope of better identifying the common progression pathways is to apply phylogenetics, or the inference of evolutionary trees, to tumor cells at various stages of progression. This project is aimed at analyzing functional classes of genes appearing in tumor phylogenies to better understand their roles in terms of modeling tumor development and to facilitate statistical analysis of tumor phylogenies. These methods were applied to a study of breast cancer tumor data. Raw data was processed to detect tumor progression markers and organize them into phylogenies. The resulting tumor phylogenies were analyzed for common patterns of tumor progression to determine the key mutational events that may lead to cancer progression. The results so far seem to indicate that although each tumor acquires different mutations, they so do from a few common categories of mutations.

STRUCTURAL DETERMINATION OF BRANCHED RNA BY SINGLE MOLECULE FLUORESCENCE RESONANCE ENERGY TRANSFER

STUDENTS Priyanka Nandakumar *Biological Sciences*
ADVISORS Linda Peteanu *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:15

The work this semester was a continuation of that from last semester. Determining the structure of a branched RNA construct using Single Molecule Fluorescence Resonance Energy Transfer (smFRET) is the overall goal, in order to gain information about the debranching enzyme involved in lariat structure intron splicing. The splicing mechanism studied involves the 2'OH in an adenosine in the intron as a nucleophile, which attacks the 5'splice site of the neighboring exon to form a lariat structure. To determine the structure of the branched RNA, smFRET in Professor Peteanu's lab will be used; a donor dye will be placed on the branch, and an acceptor dye will be placed on the main chain. The donor dye will absorb light, and then be excited; this energy will then be transferred to and in turn excite the acceptor dye, which emits energy and can be used to determined the FRET efficiency. The distance between the donor and acceptor dyes can then be determined.

THE EFFECTS OF AMPHETAMINE ON THE REGULATION OF INTRACELLULAR SIGNALING BY REWARD-PREDICTIVE CUES

STUDENTS Oliver Ruiz *Biological Sciences*
ADVISORS Edda Thiels *Neurobiology, University of Pittsburgh*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 3 / 10:15

One of the hallmarks of drug addiction is uncontrolled reward-seeking. Sufferers of addiction will often pursue a substance of abuse to a maladaptive degree, and this tendency can be driven by the presence of environmental or social cues previously paired with the substance of abuse. The ability of these so-called conditioned cues to drive pursuit of the reward (e.g., a substance of abuse) depends on the function of the nucleus accumbens (NAc) and, more specifically, on increased activation of extracellular signal-regulated kinase (ERK) in the NAc. Previous research has shown that amphetamine treatment after daily exposures to cue-reward pairings causes enhanced cue-evoked ERK activation in the NAc and cue-facilitated reward seeking after drug treatment has been discontinued. The focus of this project is to determine whether the close temporal relation between cue-reward conditioning and amphetamine treatment is necessary for the amphetamine effect on

cue-evoked NAc ERK signaling. If daily amphetamine treatment causes a general modification in the circuitry that underlies reward seeking, rather than a specific enhancement of the cue-reward association, then the amphetamine treatment should be similarly effective when administered at a delay relative to the daily cue-reward conditioning session. The findings will have implications for our understanding of the mechanisms that underlie the effect of psychostimulant exposure on conditioned cue-modulated reward seeking.

THE RELATIONSHIP BETWEEN ATTENTIONAL AND STATISTICAL LANGUAGE LEARNING PROCESSES IN PRESCHOOL CHILDREN.

STUDENTS Veronika Biskis *Biological Sciences*
ADVISORS Erik Thiessen *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

Attentional processes are crucial for the accurate perception of our environment, and have yet been studied relatively sparsely in 4-year olds. Selective sustained attention can specifically be used as a gage in cognitive function, as children are able to filter out external stimuli, and stay present at the task at hand. Meanwhile, these children are also using statistical learning to determine to what degree do stimuli appear together, and if so, if they typically belong together (i.e, two sounds making a word, what voice belongs to what face). It has been seen in previous research that children as young as a few months old are very skilled at such tasks. To delve into the relationship between these two learning processes, children were first tested on tasks that required their continuous attention to a visual stimulus. As they watched an object move about the screen, and their eye movements were followed and computed by the Track-it program. It was determined that children were typically better when following a stimulus with fewer distracters, requiring relatively low executive function. The preschoolers were also presented with a 4-word language, and it was expected that children who could better sustain their attention to a task would also be better at using statistics to pick out words in speech. However, no such correlation was seen suggesting the two processes aren't as related as originally thought.

THE ROLE OF DIAPHANOUS IN ACTIN ASSEMBLY IN THE DROSOPHILA SYNCYTIAL EMBRYO

STUDENTS Cindy Zhu *Biological Sciences*
ADVISORS Brooke McCartney *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 11:30

The regulation of actin and microtubules is essential for many cellular processes, such as cell division, cell locomotion, and changes in cell shape. Adenomatous polyposis coli (APC) is a tumor suppressor that acts in the Wnt signaling pathway, and regulates both the actin and microtubule cytoskeletons. APC promotes the assembly of actin filaments alone, and in cooperation with the formin Diaphanous (DIA). However, the physiological relevance of this cooperation is not known. In addition, APC and Dia cooperate to stabilize microtubules in cultured cells. To investigate the functions of the APC-DIA complex in the context of a whole organism, we are using the *Drosophila* syncytial embryo as our model system. Here, the first 14 rounds of nuclear division occur without cytokinesis. During the last of these syncytial divisions, the nuclei lie under the cortex and a "cap" of cortical actin is associated with each one during interphase. As the nuclei progress into prophase, the actin caps expand and where they meet actin extends with plasma membrane into the embryo as furrows to separate adjacent dividing nuclei during metaphase. Thus, these pseudocleavage furrows help to maintain mitotic fidelity. Our lab has previously shown that APC2 and DIA strongly colocalize during furrow extension, and loss of APC2 or dia leads to significant defects in furrow formation. Because the Drosophila

syncytial embryo does not contain stabilized microtubules, and APC2 mutant embryos do not exhibit defects in microtubule organization or dynamics, we predicted that the APC2-DIA complex functions exclusively in actin assembly. To test this hypothesis more directly, we created point mutations in DIA that specifically disrupt its actin nucleation activity by interfering with actin assembly directly (I690A and K841A), or with its ability to dimerize (W616A). If DIA's actin assembly activity is required for actin furrow extension, we predicted that these mutant forms will fail to rescue the furrow extension defects in the dia mutant embryos. We expressed these DIA mutants and a wild type form of DIA in Drosophila deficient for endogenous DIA. All of the DIA transgenes express nearly wild type levels of DIA. Surprisingly, none of the transgenes were capable of rescuing the lethality of the homozygous dia5 mutants to the adult stage, with lethality occurring primarily during the 3rd instar larval stage. We are currently assessing the impact that these transgenes have on cytoskeletal rearrangements and pseudocleavage formation in the syncytial embryo.

THROMBIN BIOSENSORS AND CHARACTERIZATION OF THE FLUOROGEN-ACTIVATING PROTEIN (FAP) PLATFORM

STUDENTS Andrew McCoy *Biological Sciences*
ADVISORS Peter Berget *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

Proteases are proteins that cleave peptide bonds in other proteins and play a significant role in normal and pathological physiology. Thrombin is a serine protease involved at multiple steps in the blood coagulation pathway including activation of Factors V, VIII and XI, cleavage of fibrinogen and of Protease Activated Receptors (PARs). New technologies that are specific and can measure protease activity directly are needed for research and clinical studies. Using a fluorogen activating protein (FAP) platform, thrombin biosensors were designed with cleavage sites from PAR-1 and with various linker lengths separating the fluorogen activating component from the signal blocking component of the biosensor. These constructs were expressed in Escherichia coli (E.coli) and the cleavage activity of the purified biosensors was assayed in vitro using fluorometry and SDS-PAGE analysis. The biosensors with PAR-1 sequences were cleaved with thrombin and fluorogen was activated following cleavage. A control sequence was not cleaved. Kcat/Km and fluorometry results indicate that the length of the cleavage sequence and the length of the linker impacted the cleavage of the biosensor. Further studies of structure, specificity and functionality will characterize the biosensors and allow for the development of general design specifications.

TRUNCATION, CLONING, AND EXPRESSION OF DEBRANCHING ENZYME

STUDENTS Diane Koeller *Biological Sciences*
ADVISORS Mark Macbeth *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

During pre-mRNA splicing, introns can form a loop, known as a lariat. Debranching enzyme (DBR) is a 45kDa, Mn2+ dependent protein that cleaves the 2'-5' phospodiester bond at the branch point of intron lariats, linearizing the introns. Studying DBR is important because introns cannot be processed or degraded in the lariat form, debranching is necessary for the processing of snoRNA and miRNA, and the protein plays an important role in retrotransposition. A greater understanding of the structure of DBR could lead to a better understanding of the debranching mechanism and the high substrate specificity of the enzyme. X-ray crystallography of DBR would provide a large amount of information on the structure of the enzyme. Generally, the smaller the protein, the

easier it is to crystallize. Therefore, several PCR-mediated truncations of yeast DBR were made and expressed in bacteria. Different truncations were made at different locations based on sequence homology between the DBR gene sequences of different yeast species. However, the proteins appeared to misfold and aggregate, making them difficult to purify because they would pellet out of solution. There were several attempts made to decrease misfolding and increase yield of the protein including tagging the truncated protein with GST, which is a large protein that is easily expressed in bacteria, and modifying the induction procedure. Currently, the research is focusing on expressing DBR from different species in yeast instead of bacteria in hopes of increasing the yield of the protein.

USING ANALOGICAL COMPARISON TO IMPROVE MINERALOGY SITE IDENTIFICATION

STUDENTS Neha Chaurasia *Biological Sciences*
ADVISORS David Klahr *Psychology*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

Analogical comparison – the process of abstracting category-defining features of from structurally similar exemplars – is a powerful learning mechanism in humans (Gentner, 2010). However, still little is known about the types of comparisons that lead to optimal learning and generalization. While it seems that analogous connections are used everyday to make complex concepts understandable or to memorize concepts in preparation for an exam, it is essential to determine if analogical thinking is actually the most effective method for learning. In the present study, we assess the relative benefits of studying comparisons that vary on their structural (same category vs different category) and superficial (similar-looking vs dissimilar-looking) similarity. Specifically, undergraduates were taught how to identify mineral species through one of four comparison types: similar-looking, same type minerals (near analogs), similar-looking, different-type minerals (near contrasts), dissimilar-looking, same type minerals (far analogs), or dissimilar-looking, different-type minerals (far contrasts). By varying the structural (analog vs. contrast) and superficial (near vs. far) similarity of presented examples, we seek to determine the comparison types that optimize acquisition of expertise in mineralogy site identification, as well as in perceptual categories more broadly.

VISUALIZATION OF GFP-TAGGED PROTEINS IN NEURONAL-FATED MES

STUDENTS Belle English *Biological Sciences*
ADVISORS Margaret Fuhrman *Biological Sciences* | Jonathan Jarvik *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:00

The purpose of this project was to use confocal light microscopy to visualize the localization of GFP-tagged target proteins in differentiating mouse embryonic stem (mES) cells. Prior to this project a retroviral vector was used to introduce a GFP tag into the mES genome; and cells were sorted for fluorescence with Fluorescence-activated cell sorting (FACS). The clones used in the current project include GFP-tagged dynein, kinesin, and Basp1. These cells were pressured toward a neuronal cell-fate. The goal was to visualize the localization of these proteins as cells differentiated towards a neuronal cell-fate.

CHEMISTRY

A STOP-FLOW LIQUID/MEMBRANE/LIQUID INTERFACE FOR THE IMPROVED ANALYSIS OF SMALL ORGANICS IN WATER BY MASS SPECTROMETRY

STUDENTS Stephanie Goldfein *Chemistry*
ADVISORS Mark Bier *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:30

The pervaporation purification technique has been used for decade to introduce organic molecules into a mass spectrometer using a liquid/membrane /pervaporate system. This experiment builds off of a membrane inlet mass spectrometry (MIMS) probe that used a heated liquid/membrane/liquid interface using a polydimethyl-siloxane (PDMS) membrane for the analysis of semi-volatile organics in water by electrospray ionization (ESI) mass spectrometry. The unique aspect of the original design was the incorporation of a second liquid mobile phase that allowed the analyte to leave the membrane and diffuse into an ideal receiving liquid phase for improved MS performance. The focus of the current work is to characterize the new probe and to target molecules used in the Marcellus Shale drilling and fracturing process. The new MIMS system uses a heated PDMS membrane, which forms the loop of a standard six-port injector valve. In normal operation the internal mobile phase is kept stationary while the water sample flows outside the membrane capillary. Analyte permeates thru the membrane and is concentrated into the internal solution.   This procedure allows for a stop/flow technique to be used. Aniline was primarily used to characterize the membrane system. The external mobile phase was HPLC-grade water containing analyte while one internal mobile phase used contained 99.9% acetonitrile (ACN), 0.1% formic acid and allowed for heating of the membrane to 75C. Trials were implemented to vary the load time of the analyte into the inner solution injection.

Using the data from this mechanism showed that a diffusion rate pattern can be seen based off the different loading times and the detection of the aniline samples. This is extrapolated from the data by correlating the signal of the peak versus the amount of time the sample was allowed to flow in the load position. This assures the samples follow a progression, which allow for lower detection of aniline as the loading time for the sample is increased.

DEVELOPMENT OF A MEGADALTON MASS SPECTROMETER

STUDENTS Stephen Tjader *Chemistry*
ADVISORS Mark Bier *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Mass Spectrometry (MS) is a powerful analytical technique with a wide range of applications. However, most conventional modern mass spectrometers use ionization type detectors like microchannel plates (MCP) have a poor response at higher mass (m/z) ranges. It is not normally possible to analyze particles in the MegaDalton range by matrix-assisted laser desorption ionization (MALDI) time of flight (TOF) mass spectrometry for this reason. A bottom-up MS approach is often used to break up smaller fragments of the molecule by chemical means before further analysis. In the Bier lab we are developing a new mass spectrometer based on a cryodetector rather than a conventional microchannel plate. This should allow for measurement of molecules in the MegaDalton range, such as virus particles, with much greater sensitivity. My contributions included adding additional interface features to the instrument control screen, such as a peak labeling and automated scanning

features using the National Instruments Labview programming language. Several experiments were also run which involved tuning and steering the ion beam with the overall goal of improving signal.

EFFECTS OF AGGREGATION ON THE EMISSION PROPERTIES OF OPPV7 AND OPPV13

STUDENTS Jiyun Hong *Chemistry* | Janice Kim *Chemistry*
ADVISORS Linda Peteanu *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Organic light emitting diode (OLED) technology has been increasingly developed in recent years due to its various potential advantages over the conventional light emitting diodes (LEDs). The key component of OLED is the emission layer composed of a conducting polymer. When the polymer is processed into thin films for OLED devices, it typically forms aggregates. While the aggregation provides benefits, such as good stability towards photo oxidation and improved charge transport, it also has downsides, including red-shifted and weak emission. MEH-PPV is one conducting polymer that is considered as a good candidate for OLEDs. Better understanding of the consequences of aggregation for the emission properties of MEH-PPV is thus crucial in improving the OLED technology. To study the effect of aggregation on MEH-PPV, the effects of aggregation on the photophysical properties of the 7-unit oligomer, OPPV7, and 13-unit oligomer, OPPV13 are studied in bulk solution. Studying aggregates of oligomers provides an advantage of separating spectral and dynamical effects due to aggregation from those due to structural defects and/or multiple conjugation lengths such as are typically found in the polymer. Aggregates of OPPV7 and OPPV13 are formed via reprecipitation in a mixture of tetrahydrofuran (THF) and water in different ratios. UV/Vis spectroscopy, fluorescence spectroscopy, lifetime measurement, and Dynamic Light Scattering (DLS) are used to study the oligomer aggregates.

INCREASING THE EFFICIENCY OF THREONINE METHYL LABELING WITH CARBON-13 FOR NMR STUDIES ON PROTEIN-DNA INTERACTIONS

STUDENTS Meghan Nahass *Social & Decision Sciences* | Lindsey Pherribo *Chemistry*
ADVISORS Gordon Rule *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:45

We investigated methods to increase the efficiency of labeling the methyl group in the amino acid Threonine (Thr) with carbon-13 for NMR studies on protein-DNA interactions. Using a T7 expression system in Escherichia coli we changed two conditions to see how labeling was affected - 1. increasing the labeled concentration of CO_2 in the growth media and 2. blocking pathways in the Krebs cycle that cause the loss of the C-13 label. The extent of labeling was obtained through the use of nuclear magnetic resonance (NMR) spectroscopy.

KINETIC DATA FROM THE OXIDATION OF NADH BY HYDROGEN PEROXIDE IN THE PRESENCE OF FE-TAML CATALYST

STUDENTS Dylan Mori *Chemistry*
ADVISORS Alexander Riabov *Chemistry*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

In order to address the issue of water purification on the micro-scale, the Collins research group at CMU has developed novel iron catalysts based on iron(III)-containing tetra-amido macrocyclic ligands (Fe-TAML), in order to assist in the oxidation of pollutants. The catalysts have been used in oxidation reactions of biological

molecule NADH by hydrogen peroxide. The reaction rates of NADH oxidation were measured at different concentrations of NADH and hydrogen peroxide. The rate constants for a series of reaction steps involved in the oxidation were calculated, allowing us to propose a reaction mechanism for the oxidation. To further characterize the mechanistic details of the oxidation reaction, an NADH model was investigated labeled with a deuterium isotope. NADH labeled with deuterium is difficult to synthesize, so a mimetic of NADH, 2,6-dimethyl-3,5-diacetyl-1,4-dihydropyridine, and its deuterium-labeled form were used in the oxidation. Knowing how the Fe-TAML is involved in the oxidation of these organic compounds will make it more useful to assess the catalyst's effectiveness at oxidizing more harmful compounds in water.

MODIFICATION OF -PNA FOR ANTI-SENSE DNA TARGETING

STUDENTS Calvin Lin *Chemistry*
ADVISORS Danith Ly *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:45

Peptide nucleic acids (PNA) are synthetic analogues to DNA and RNA that have many biotechnical applications. Instead of a sugar phosphate backbone, the PNA backbone is made up of N-(2-aminoethyl) glycine units, similar to a peptide backbone. Although unmodified single stranded PNA's form globular structures in solution, past research has shown that a simple addition at the -position sterically induces a right-handed helical conformation similar to that of a PNA-DNA complex, confirmed by circular dichroism experiments (CD). These modified PNA's, termed -PNA, can bind sequence specifically to DNA and RNA with a higher affinity for RNA. In the interest of increasing binding selectivity for anti-sense DNA over RNA, further modifications where made at the -position. Monomers with increasingly bulky groups at the -position where successfully synthesized in an attempt to increase selectivity in binding for anti-sense DNA

PHOTOSTABILITY OF FLUOROGEN ACTIVATING PEPTIDE - FLUOROGEN COMPLEXES

STUDENTS Victor Mann *Chemistry*
ADVISORS Marcel Bruchez *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

Fluorescence microscopy is a technique used for imaging living cells, but due to the nature of the method, the longer observations are the less there is to see. This is primarily due to a process called photobleaching. This degradation is the major limiting factor for the timescale of cell-imaging experiments, so any improvement in the photostability is essential to improve biological microscopy experiments. This venture will investigate the photochemical characteristics of an important class of compounds called fluorogen activating peptide - fluorogen complexes. These molecules have shown promise is the field of biological imaging as a means to image live cells while damaging them very little in the process. The goal of the research is to better understand how these molecules respond to photobleaching agents and, from this information, develop derivative molecules of this class that have increased photostability. By using spectroscopic laboratory techniques, single molecules of the complex will be examined when attached to a glass substrate. The knowledge gained by these methods can be applied to further research with commercial dyes.

PHYSICAL THERAPY: DIFFERENCES IN ROMANIAN AND AMERICAN PRACTICES

STUDENTS Alyssa Montanaro *Chemistry*
ADVISORS Justin Crowley *Biological Sciences*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The process of rehabilitating from a disease or injury is aided by physical therapy. Physical therapists work to rehabilitate people with illnesses, injuries, and medical conditions that prohibit them from being able to move and function in their daily activities. Because it is known that the practice of medicine changes drastically based upon geographic location and socioeconomic conditions, the question arises as to whether physical therapy also changes in this way. In this project, the differences in physical therapy practices will be assessed in both the Romanian and American cultures. This will be accomplished by means of shadowing numerous practicing physical therapists in both Romania and the United States. The exercises prescribed, the amount of therapy completed for a certain type of injury, the other resources besides the body used in therapy, and the consistency of treatment will be compared between the two cultures. Key differences were discovered and understanding these are important in order for practicing therapists to become stronger and more well-rounded.

REDOX DRIVEN TRANSLOCATION MECHANISM OF COPPER IN PEPTIDE NUCLEIC ACID (PNA)

STUDENTS Yookyung Bae *Chemistry*
ADVISORS Catalina Achim *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 11:00

Peptide Nucleic Acid (PNA) has shown vast advantages in the research field due to its neutral and flexible backbone, which lends it great specificity for binding to DNA. In this research project, PNA was modified with 8-hydroxyquinoline (Hq) and Bipyridine (Bpy) ligands and the binding of copper(II) to these two ligand sites was analyzed by UV-Vis titration. The thermal stability of the ligand-modified PNA duplexes was studied by variable temperature UV spectroscopy. CD spectroscopy was used to study the chirality of the PNA duplexes. These studies provided the stoichiometry of metal binding to the ligands and the stability constants of the complexes formed between copper and the ligand-modified PNAs. We are currently using the understanding of how copper binds to these ligand sites in PNA to design a molecular switch. Metal-containing, PNA-based design nano-systems may have applications in nanotechnology and medicine. For example, the PNA can serve as template for the construction of molecular electronics circuits or as "glue" in the construction of synthetic, multiprotein systems.

SYNTHESIS AND CHARACTERIZATION OF DIETHYLENE GLYCOL-CONTAINING ALPHA, GAMMA-PNA TO FAVOR RECOGNITION OF DNA OVER RECOGNITION OF RNA

STUDENTS Fermin Liang *Chemistry*
ADVISORS Danith Ly *Chemistry*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 5 / 10:15

As reported by Nielson and colleagues, peptide nucleic acids (PNA) have shown to be able to invade double-stranded DNA and act as antigene reagents using Watson-Crick base-pairing rules, but those oligomers have problems with water solubility. To remedy this, Danith Ly and colleagues at Carnegie Mellon University (CMU) synthesized conformationally preorganized gamma-PNA to improve water solubility and hybridization with DNA and RNA. However, PNA and gamma-PNA cannot discriminate between RNA and DNA due to similar binding

affinities. With the help of the Ly group at CMU, alpha, gamma-PNA was synthesized to favor binding with DNA over RNA to improve specificity of PNA oligomers.

SYNTHESIS AND CHARACTERIZATION OF SELECTIVE CELL PERMEABLE FLUOROGENIC CYANINE DYES

STUDENTS Katherine Chong *Chemistry*
ADVISORS Bruce Armitage *Chemistry*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Fluoromodules are complexes of non-covalently bound fluorogenic dyes and their fluorescence activating protein partners. Previously, fluorogenic unsymmetrical cyanine dyes were used to sort a diverse protein library to obtain protein partners and create a library of fluoromodules that span the visible spectrum. The dyes were designed for easy modification for favorable spectral properties and binding specificity. Non-specific interactions with nucleic acids are minimized through the incorporation of sterically bulky or negatively charged groups, which are electrostatically repelled by the anionic phosphate backbone of DNA and RNA. However, the addition of charged groups decreases the cell permeability of dyes. In the interest of cytoplasmic imaging studies, modifications to the library of dyes were explored in order to allow for cell permeability and subsequent cytoplastmic fluoromodule formation. Replacement of previously used sulfonate groups with hydrolyzable acetoxymethyl esters was found to allow for cell permeability while maintaining the protein binding-affinity and specificity of the dyes.

SYNTHESIS OF BLOCK COPOLYMERS USING ATRP AND LCP

STUDENTS Bernard Parker *Chemistry*
ADVISORS Krzystof Matyjaszewski *Chemistry*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Block copolymers are polymers that contain two or more blocks of different polymers that can be synthesized using a variety of different techniques. Different polymers generally do not mix, but synthesizing block copolymers forces them to, which can given them new properties that are difficult to get otherwise. They can also be used to create other macromolecular structures, other functionalized polymeric materials, as precursors to carbon nanostructures, or as specialty coatings and materials themselves.

Living polymerization systems that produce polymers with a narrow molecular weight distribution and preserve chain-end functionality are particularly valuable in the synthesis of block copolymers and other macromolecular structures. Atom transfer radical polymerization (ATRP) was developed by Krzysztof Matyjaszewski in 1995, and is a controlled radical polymerization technique. Living cationic polymerization (LCP) was first performed in the mid 1980s, and can be used to produce other polymers using a cationic mechanism. The one-pot synthesis of the block copolymer poly(methyl methacryalate)-block-poly(isobutyl vinyl ether), or PMMA-b-PiBVE, was attempted using ATRP to produce the first block and LCP to produce the second block. The two different reactions are necessary because the two different blocks cannot be produced using any one polymerization method alone.

MATHEMATICS

ANALYSIS OF PITTSBURGH BUS SCHEDULE AND DATA

STUDENTS Shirui Hu *Mathematics* | Eliot Knudsen *Statistics* | I-Ta Yang *Mathematics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

The Port Authority of Allegheny County has been gathering data about bus related events for over a decade. Each bus has a computer that logs events about passenger flows, time stamps and bus stops. For our project, we are using a four-month subsample of this data, 27 million bus events. Facing a budget crisis, the Authority is looking for innovative way to cut costs and improve service. We have been asked to suggest data-driven improvements to make the bus service more efficient and reliable.

In this research project, we study two phenomena that cause uncertainty in the bus schedule: heterogeneity in departure from the schedule and bus clustering patterns. Buses arrival-time variances change significantly depending upon time of day, bus stop location, traffic conditions and many other factors. Additionally, buses group together because of delays at bus stops and passenger load delays. We use bus location, passenger flow, and time to identify and predict these phenomena for important bus routes. With our model, the Authority can make strategic changes to its schedule and bus system in order to improve service. Our results include specific patterns and potential factors contributing to bus variance and clustering.

ANTI-PIRACY LAWS AND BOX OFFICE SALES: A CASE STUDY IN FRANCE

STUDENTS Brandon Ngiam *Mathematics* | Carl Sturges *Statistics* | Anna Svirsko *Mathematics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Piracy has been a serious threat to the film industry due to the rise of file sharing clients such as BitTorrent, which have greatly increased the accessibility of illegal content online. Attempts at legislation to prevent piracy have been discussed often but few effective measures have been realized. France's graduated response law HADOPI aims to curb piracy through punitive measures for repeat offenders and methods to increase aware-ness among users who may not know they are downloading copyrighted material. Rather than studying the effect of online piracy on displacing digital content, this paper attempts, through rigorous statistical analysis, to determine HADOPI's effect on French box office sales and whether it is successful in increasing box office revenue.

By comparing weekly time series of box office sales in France against a control group com- prising of UK, Spain, Italy and Belgium, we are investigating whether there is a significant increase in French sales relative to the control group during periods of intense media scrutiny, which are reflected by data from Google Trends. Also, we are studying whether there has been a change in the rate of decline in individual movie sales across weeks due to the effects of HADOPI.

BIPEDAL WHEELED PLATFORM FOR HYBRID LOCOMOTION

STUDENTS Neil Abcouwer *Electrical & Computer Engineering* | Job Bedford *Undecided* | Cory Chang *Computer Science* | Chad Cole *Electrical & Computer Engineering* | Jitu Das *Computer Science* | Siddharth Dedhia *Electrical & Computer Engineering* | Priyanka Deo *Computer Science* | Connor Dixon *Mechanical Engineering* | Alexander Franchuk *Electrical & Computer Engineering* | Zachary Greenberg *Mathematics* | David Mehrle *Physics* | Corey Sobel *Computer Science* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*

ADVISORS Chris Atkeson *Robotics Institute* Elliot Rosen | *Electrical & Computer Engineering*

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

Most robots are designed to specialize in one task, but at the cost of versatility. In mobile robotics, maneuvering diverse terrain is often difficult for robots with only one form of motion. For example, urban search and rescue robots designed for flat surfaces will fail on rubble, and robots designed for rubble will move slowly on flat surfaces. Our team proposes to solve this problem by creating a robot that can change its method of motion depending on the type of terrain it encounters. We will build a robot that combines wheeled and bipedal motion, allowing it to handle multiple types of terrain. The robot will be able to adapt its motion to the current terrain. Wheels provide benefits such as fast, power-efficient movement on flat terrain, whereas bipedal locomotion allows a robot to handle complicated environments like stairs or rocky terrain. This "hybrid locomotion" has enormous potential to benefit the field of robotics since a successful hybrid gets both the benefits of speed and maneuverability.

CAMPUS SENTIMENT AND SUGGESTIONS FOR ON-CAMPUS PARKING

STUDENTS Silvia Manolache *Business Administration* | Nicholas Thieme *Statistics* | Shu Wang *Mathematics* | Yijia Zhou *Business Administration*

ADVISORS Brian Junker *Statistics*

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

The city of Pittsburgh has recently increased the rates at the parking meters on Frew and Tech Streets. They have also increased the hours at which the meters must be paid: until 10pm on all days except Sunday. However, this has created a lot of problems for the users of these spaces – the students, staff, and faculty at CMU. We have implemented a survey, which will soon be analysed for trends, in order to understand what is the effect of this policy on the community at CMU. It is possible that there are better, more efficient ways for the parking on Frew and Tech Streets to be handled, either by CMU or by the city of Pittsburgh. For instance, if nobody parks behind on these streets any longer, the city loses revenue instead of gaining revenue as expected.

CREATING VIRTUAL MARKETPLACES FOR THE COMMODITIZATION OF RENTAL SPACES

STUDENTS Jonathan Francis *Electrical & Computer Engineering* | Zhijun Huang *Economics* | Kenneth Wong *Mathematics*

ADVISORS Carol Goldburg *Economics*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 11:30

Our research team has identified specific difficulties and frustrations that prospective renters and property owners have encountered, whilst transacting over residential entities (i.e., houses, lofts, apartments, garages, parking spaces, etc). We have developed mitigation strategies that may be used to overcome those market challenges and issues that are hereafter mentioned, while still assessing how such variables as "distance from campus", "type of housing", "price", "area", etc. affect user tastes and preferences.

ENGINEERING FLEXIBILITY TO IMPROVE THE NORMALIZED CUT IMAGE SEGMENTATION ALGORITHM

STUDENTS Yi Xiang Chong *Mathematics*
ADVISORS Rebecca Nugent *Statistics*
ROOM/TIME Dowd / 4:00

Image segmentation is the process of dividing a digital image into individual segments which share similar visual characteristics. The Normalized Cut (NCut) algorithm is one of the latest and novel graph-based approaches in image segmentation. The NCut algorithm is powerful in that it aims at extracting the global impression of an image, a process which closely resembles how a human would approach image segmentation. However, the algorithm is heavily dependent on a constant 'locality' tuning parameter that is subject to arbitrary assignment prior to running the algorithm. This 'locality' parameter is independent of the image and indirectly specifies the degree of global features one wants to get from the segmentation process. Given this shortcoming, we propose a more flexible approach in computing this 'locality' parameter as a function of the image. In particular, we look at improving the segmentations by introducing multiple 'neighborhood-locality' parameters that are adjusted to specific regions of the image. We do this through a semi-supervised method, where the specific regions are taken from the segmentations of the original NCut algorithm. Through our methodology, we get to incorporate additional local features into the algorithm without sacrificing too much of the global impression extracted by the NCut algorithm. Results show that our methodology correctly segments a sample image which the original NCut algorithm could not.

EXTREMAL COMBINATORICS IN STRONGLY REGULAR GRAPHS

STUDENTS Travis Nell *Mathematics*
ADVISORS John Mackey *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

The asymptotic density of complete four subgraphs and independent sets on four vertices is poorly known. We use identity generation techniques to get a lower bound on this quantity in strongly regular graphs and then do some analysis on the bound in the asymptotic case.

INNOVATION OF OPTOELECTRONICS IN THE US: STATE SPACE MODELS OF INVENTOR MOBILITY

STUDENTS Stephanie Kao *Mathematics*
ADVISORS Rebecca Nugent *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Many leading U.S. firms in optoelectronic technologies have moved manufacturing offshore since the burst of the telecommunications bubble in March 2000. This research uses Markov Chain models to understand the impact that offshoring has on the trajectories of innovation for individual inventors. Patents granted by the United States Patent and Trade Office often give an adequate measure for the level of innovative activity. Working with patent data for 110 inventors at 28 firms, we build a probability distribution for the states of these inventors, and run simulations using these probabilities as rules.

INTERNET PIRACY AT CMU: STUDENT BEHAVIOR & OPINIONS

STUDENTS James Bogie *Statistics* | Benjamin Gorman *Economics* | Chelsea Grindle *Mathematics* |
Jongwoo Lee *Statistics* | George Nardi *Philosophy* | George Volichenko *Statistics*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Throughout the latter half of 2011 and the early months of 2012, internet piracy and copyright enforcement have been at the forefront of legislative debates, media coverage, and corporate public statements. The harsh reaction from the internet community (online institutions such as Google, Wikipedia; frequent users of social media such as Facebook, Twitter) in response to the proposed SOPA and PIPA bills suggest that there are divergent, strongly held convictions amongst the population on how to deal with copyright enforcement in the information age. We are surveying Carnegie Mellon undergraduates to see how often they engage in internet piracy and what opinions they hold on related copyright enforcement legislation. Our data-collection tool is an anonymous, self-administered online survey sent to a random sample of undergraduate students. The survey contains questions regarding the types of piracy students engage in, their views on the ethics and legality of piracy, and what steps students take to find media entertainment online. Our survey results will hopefully be indicative of the views of high-performing university students nationwide, offering insight into how the most computer-literate segment of the population approaches pirated media. The conclusions we reach will be of interest to politicians shaping copyright enforcement legislation, media companies hoping to tweak their monetization strategies, and citizens wondering how others may judge what is largely a private behavior.

SCOUTING ANDROID APPLICATION

STUDENTS Yaoran Chen *Mathematics* | Alexander Lockwood *Computer Science*
ADVISORS Ananda Gunawardena *Computer Science*
ROOM/TIME Peter / 12-2:30

We developed an Android application for the Girls of Steel robotics team, an all-girl robotics team made up of high school students in the Pittsburgh area. The application provides an easy means of gathering and visualizing information during robotics competitions, a crucial method commonly used in robotics competitions called "scouting".

THE SPREADING OF A DROPLET ON AN OSCILLATING THIN LIQUID FILM

STUDENTS Elias Fatsi *Mathematics*
ADVISORS Ellen Peterson *Mathematics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

My project last summer intentioned to expand an existing mathematical model which tracks the spreading of droplets on thin liquid films.

Due to errors in numerics or mathematics, the existing model was not conserving mass. I conducted analysis of the model to narrow down the search for the skewing factor. My work went toward the progress of a multi-disciplinary research group investigating Surfactant Replacement Therapy as a possible treatment for Cystic Fibrosis.

PHYSICS

BIPEDAL WHEELED PLATFORM FOR HYBRID LOCOMOTION

STUDENTS Neil Abcouwer *Electrical & Computer Engineering* | Job Bedford *Undecided* | Cory Chang *Computer Science* | Chad Cole *Electrical & Computer Engineering* | Jitu Das *Computer Science* | Siddharth Dedhia *Electrical & Computer Engineering* | Priyanka Deo *Computer Science* | Connor Dixon *Mechanical Engineering* | Alexander Franchuk *Electrical & Computer Engineering* | Zachary Greenberg *Mathematics* | David Mehrle *Physics* | Corey Sobel *Computer Science* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*

ADVISORS Chris Atkeson *Robotics Institute* | Elliot Rosen *Electrical & Computer Engineering*

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

Most robots are designed to specialize in one task, but at the cost of versatility. In mobile robotics, maneuvering diverse terrain is often difficult for robots with only one form of motion. For example, urban search and rescue robots designed for flat surfaces will fail on rubble, and robots designed for rubble will move slowly on flat surfaces. Our team proposes to solve this problem by creating a robot that can change its method of motion depending on the type of terrain it encounters. We will build a robot that combines wheeled and bipedal motion, allowing it to handle multiple types of terrain. The robot will be able to adapt its motion to the current terrain. Wheels provide benefits such as fast, power-efficient movement on flat terrain, whereas bipedal locomotion allows a robot to handle complicated environments like stairs or rocky terrain. This "hybrid locomotion" has enormous potential to benefit the field of robotics since a successful hybrid gets both the benefits of speed and maneuverability.

CHARACTERIZATION OF FAP-FLUOROGEN COMPLEXES FOR SOFI

STUDENTS Lauren Beck *Physics*

ADVISORS Marcel Bruchez *Chemistry*

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

The objective of this research is to characterize the usefulness of fluorogen activating proteins-fluorogen complexes for super-resolution optical fluctuation imaging (SOFI). SOFI is a relatively new fluorescence microscopy imaging method that overcomes the diffraction limit and quickly produces background-free images by analyzing temporal fluorescence fluctuation. At equilibrium the binding and dissociation of the fluorogen from the FAP potentially represents an ideal fluorescent labeling approach for this method. FAP-fluorogen complexes under different labeling conditions designed to achieve various levels of fractional and dynamic labeling will be used to acquire multiple data sets for SOFI. This will involve culturing yeast cells with FAPs on the cell surface, preparing specimens for microscopy, and generating fluorescent microscopy data sets from these experimental conditions.

COMPUTER BASED ANALYSIS OF LOW-ANGLE X-RAY SCATTERING DATA FOR STRUCTURE FACTOR VISUALIZATION

STUDENTS Jonathan Michel *Physics*

ADVISORS Stephanie Tristram-Nagle *Physics*

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

I have been working in the Nagle/Tristram-Nagle lab to improve the modeling of the mosaic spread, an angular distribution in the orientations of lipid bilayers in a stack of 2000 bilayers. I helped to obtained low angle x-ray scattering (LAXS) data on many samples consisting of a stack of lipid bilayers at the Cornell High Energy Synchrotron Source (CHESS) in November, 2011. These LAXS data provide both structural and material properties about the membranes. The mosaic spread is an important parameter in fitting the data to liquid crystal theory. My contribution is to improve the correction added to account for the mosaic spread, by modifying the existing C++ data fitting program (NFIT). I am developing a new model for the mosaic spread to be used as a fitting parameter in the NFIT data analysis program.

DARK MATTER HALOS: LUMINOSITY FUNCTION AT THE REIONIZATION EPOCH

STUDENTS Yelena Goryunova *Physics*
ADVISORS Hy Trac *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

Our group uses N-body simulations to model dark matter halos during the epoch of reionization. Their luminosity function describes how these dark matter halos are populated with matter. Typically, the Schechter Luminosity function is used to describe the distribution of luminosities through these halos. Our group investigates the dependence of the luminosity function on matter accretion rate instead of matter, as the units are thus more naturally matched. Via the abundance matching technique, we obtain a luminosity function of mass accretion rate.

DENSITY MEASUREMENTS OF THE LUNG LIPID DPPC VS. TEMPERATURE

STUDENTS Kelsey Hallinen *Physics*
ADVISORS John Nagle *Physics* | Stephanie Tristram-Nagle *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:45

My project involved measuring the density of the main lipid in the human lung, DPPC (dipalmitoylphosphatidylcholine), using two methods: densimetry and neutral flotation. DPPC undergoes the main phase transition (41.4 oC) near body temperature (37 oC) and one theory states that a gel-fluid phase change occurs each time that we breathe. DPPC has been widely studied, since it is so important in lung function, and determining the density change as a function of repeated scans would lead to more understanding in how pulmonary surfactant works. I primarily used the Anton-Paar densimeter to measure the DPPC density in the fluid (high temperature) and gel (low temperature) phases with a precision of 10-6 g/ml. The differential densimeter scans the temperature from 10 oC to 50 oC and then back to 10 oC in 0.5 oC steps. During repeated temperature scans, I observed an increase in DPPC density at the same temperature, similar to previously published results by Tiddy et al. However, upon remixing the lipid samples, the density returned to its initial value. This result was confirmed qualitatively by another density measurement, neutral flotation, using D2O/H2O mixtures. To account for the observed increase in density with scan repetition, we think that when DPPC undergoes a phase transition, the gross morphology of the multilamellar vesicles in our experiment changes, since this change in density is reversed by mixing the sample.

DESIGN OF A LEAD ACID BATTERY CHARGE ESTIMATION AND MONITORING SYSTEM

STUDENTS Peter McHale *Physics* | Christopher Palmer *Electrical & Computer Engineering* | Esha Uboweja *Computer Science* | Robert Wedler *Electrical & Computer Engineering*
ADVISORS Susan Finger *Civil and Environmental Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

State of charge information from lead acid batteries is important in any system which relies on batteries as a primary power source. It is difficult to predict the current capacity of a lead acid battery because capacity changes due to wear over time and is also a function of ambient temperate. A computer data model has the ability to improve estimation of the capacity of a set of batteries by recording previous battery history and predicting how the maximum capacity has changed over time.

DETERMINING THE GAUSSIAN MODULUS OF BIOLOGICAL LIPID MEMBRANES

STUDENTS Jason Rocks *Physics*
ADVISORS Markus Deserno *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

In order to accomplish many of their biological functions within cells, lipid membranes frequently undergo fission and fusion processes.

The involved deformations of the membranes are energetically costly and depend strongly on a membrane's stiffness which is characterized by two quantities, the bending and Gaussian moduli. While the bending modulus can be easily determined in multiple ways, very little is known about the Gaussian modulus, even though its contribution to fission and fusion energetics is equally important. The Deserno group has recently developed a novel and accurate method to extract Gaussian moduli from computer simulated membranes. The method has been successfully tested for simple coarse-grained models consisting of a single type of lipid. My project has focused on extending this method to take into account the extra complications introduced by the presence of multiple lipid types within a membrane. My final goal is to develop a method which can extract information about the Gaussian modulus from biologically realistic membranes, allowing for further insight into the reasons for specific cell membrane compositions.

ENERGETIC BARRIERS TO MAGNETIC SWITCHING IN COMPACTED NANOPARTICLES

STUDENTS Alexander Edelman *Physics*
ADVISORS Sara Majetich *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:00

Ordered arrays of magnetic nanoparticles have tremendous promise as materials for bit patterned data storage media, where each bit is written to a single nanostructure with a well-defined size rather than a region of a bulk magnetic solid, thus enabling much higher information densities than today's hard drives. In order to efficiently write data to such nanoparticle arrays, it is important to understand the energy barriers and characteristic time scales involved in switching the nanoparticle magnetization state. We report the results of experiments with compacted magnetic nanoparticles arranged in toroidal geometries. Oscillating magnetic fields were induced in these toroids over a many-decade frequency range, and the magnetic response measured. From these measurements we have obtained the complex magnetic permeability of the nanoparticles, which is determined by the distribution of energetic barriers to switching. Our results are discussed in terms of various microscopic

models that could account for the observed behavior.

EXPLORING THE USE OF CUDA GPU FOR HIGH PERFORMANCE 3-D FFT APPLICATIONS

STUDENTS James Komianos *Physics*

ADVISORS Rupert Croft *Physics* | Dr. Robert Gomez & Dr. Yang Wang, *Pittsburgh Supercomputer Center*

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

The use of GPU (Graphics Processing Units) as accelerators in high performance computing has been increasingly explored by scientific communities in the past decade. Optimized for performing simple graphical operations and offering high memory bandwidth and floating-point performance, GPU can significantly increase performance in scientific computing. But, many problems arise when trying to mix GPU's with CPU for high performance computing, as GPU is much less general purpose than CPU. Luckily, NVIDIA CUDA (ComputeUnified Device Architecture), a new GPU architecture and programming language based in C, allows for a broader scope of applications in using GPU for scientific computing. The main goal of this project is to find ways to use CUDA GPU in Fast Fourier Transformation applications, making them faster and more efficient. FFT's are used in a wide range of physics applications, including astrophysics and materials science simulations. I will use Lincoln, a GPU cluster located at the National Center for Supercomputing Applications for testing of this project.

PONDER

STUDENTS Joel Lu *Physics*

ADVISORS David Andersen *Computer Science* | Ariel Procaccia *Computer Science*

ROOM/TIME Peter / 3-5

A social collage board that helps people find what is important. I believe a problem lies in a lack of focus towards developing ideas instead of just thinking them. In response, this system builds the identity of an idea and not of an individual by employing voting mechanics like the Copeland method to get more honest feedback. The sy stem is still in beta test and its influence is not measured. I hope it will be a start towards aggregating thoughts for better ideas faster. www.ponderthings.com/about

RECONSTRUCTING THE LYMAN-ALPHA FOREST

STUDENTS Joseph Vukovich *Physics*

ADVISORS Rupert Croft *Physics*

ROOM/TIME Pake / 4:20

Quasars emit electromagnetic radiation and cause hydrogen to absorb certain frequencies of radiation. Thus, by looking at quasar spectra, and looking for where these absorptions occur, we can infer the location of intergalactic hydrogen (also known as the Lyman-alpha forest) on the line from us to the quasar. With enough quasar data it is possible to interpolate to fill in the regions between the quasar lines-of-sight. Interpolation is used to reconstruct a simulation of the Lyman-alpha forest from a subset of that data to assess the quality of the interpolation algorithm.

SELF-DISPERSING FLUIDS FOR PULMONARY DRUG DELIVERY

STUDENTS Dara Krute *Physics*
ADVISORS Stephen Garoff *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

About 35 million Americans suffer from obstructive lung diseases. The aerodynamic mechanism used in inhaled aerosol antibiotics can cause very non-uniform deposition over the lung surface in the presence of obstructions to consistent air flow, leading to reduced medication efficacy, drug resistance and suppression, rather than elimination, of bacterial infection. Previous murine studies show that adding surfactants to aerosol antibiotics leads to more persistent peripheral delivery, higher drug plasma concentrations, and increased survival rates for the animals. Perflubron is the preferred delivery vehicle for aerosolized lung medications due to its extremely low surface tension (17 dynes/cm); biological and chemical inertness; and high fluidity, compressibility, gas solubility, and density. In previous studies, we found that high surface tension at the perflubron-mucin interface prevented self-dispersal of a pipetted-drop of perflubron solution without surfactant over a Petri dish containing 5% porcine gastric mucus in H_2O. Perflubron is hydrophobic, lipophobic, and non-ionic. We therefore expected to find perflubron to be insoluble with hydrophilic, lipophilic, and/or ionic molecules. Instead, upon thorough search of the literature, we found support for perflubron's miscibility with ten different chemical surfactant types that were hydrophilic, lipophilic, and/or ionic. Our preliminary results so far support this miscibility.

THE ORDERING OF MAGNETITE NANOPARTICLES IN SUPER-LATTICES FORMED VIA SELF-ASSEMBLY.

STUDENTS Amrit Narasimhan *Physics*
ADVISORS Sara Majetich *Physics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The Colvin synthesis process for magnetite (Fe_3O_4) nanoparticles produces monodisperse particles with magnetic moments. These particles can be easily arranged in vast ordered monolayers via self-assembly. These monolayers have uses in patterning substrates used for data storage applications. However, some nanoparticles have been shown to form large and complex super-lattices. We will explore the possibility of using self-assembly to create nanoparticle crystals using particles synthesized in the Colvin process. The efficacy of a few different methods and conditions to create nanoparticle crystals will be evaluated. Images and analysis of the size and shape of these crystals, as well as their regularity, will be presented. Structures of these crystals may be discussed.

THE TECHNICALITIES OF MARIMBA MALLETS

STUDENTS Nanfei Yan *Physics*
ADVISORS Paul Evans *Music*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

The modern marimba belongs to the mallet percussion family. Five octaves of wooden bars are arranged as keys imitating that of a piano, with large tubular resonators below the bars to amplify sound. It is typically played using mallets composed of a wrapped core attached to the end of a long shaft, similar to that of a xylophone mallet. The sound produced from the contact of the mallet to the bar depends on three components:

wrap, core, and shaft. There is an assortment of mallets available on the market nowadays, but very little public information is accessible regarding the science and technique behind the deceptively simple task of wrapping yarn around a core. This study looks into how using different materials and techniques on the wrap, core, and shaft, affect the overall sound produced by the mallet, and attempts to gather information in a format that will allow other musicians to make their own mallets.

USING WIDE ANGLE X-RAY SCATTERING TO PROBE IN-PLANE ORDER OF HIV MEMBRANE MIMICS

STUDENTS Zachary Benamram *Physics* | Alexander Boscia *Physics*
ADVISO Stephanie Tristram-Nagle *Physics*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

It is controversial whether the so-called Cytoplasmic Terminal Tail (CTT) of the transmembrane gp41 fusion protein of HIV is actually in the cytoplasm of the HIV virion or on the exterior. We took five variants of the CTT peptide LLP-2 and four different HIV and cell membrane mimics to the Cornell High Energy Synchrotron Source (CHESS). We participated in the X-ray data collection for four days at CHESS. By focusing on wide angle X-ray scattering data (WAXS), we are able to tell if the peptides change the in-plane order of the membrane. The order is increased by membrane components, such as cholesterol, and sometimes peptides. The order is expressed as S-xray, which tells us how rigid the lipid chains are in a bilayer. We analyzed the diffuse WAXS data using a theory developed in the Nagle/Tristram-Nagle Lab. The theory yields Sxray, which parallels another order parameter, Snmr. We used MATLAB to obtain Sxray with one or two order parameter fits and correlated these with possible misorientation of the sample by measuring the mosaic spread. We also attempted to automate this procedure by writing a MATLAB program.

VISION-BASED OBJECT FOLLOWING WITH AN AUTONOMOUS QUADROTOR

STUDENTS Julian Binder *Undecided* | Christian Burchhardt *Electrical & Computer Engineering* | James Church *Chemical Engineering* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Graham Harvey *Electrical & Computer Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Peter McHale *Physics* | Nicolas Mellis *Electrical & Computer Engineering* | Doci Mou *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Matthew Sebek *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Thomas Wucherpfennig *Mechanical Engineering* | Alexander Zirbel *Computer Science*
ADVISORS Sanjiv Singh *Robotics Institute*
ROOM/TIME Class of '87 / 3:40

Robots are becoming a common sight in every aspect of modern life. In aerial robotics, helicopters and other flying platforms are perfect for surveillance in harsh environments where ground-based navigation is extremely difficult or impossible - such as in dangerous military zones or disaster-stricken regions. Aerial robots are also useful for supporting ground vehicles: they can use their increased visual range to scout ahead, extend the range of communication with outside entities, or provide supplies and tactical assistance in emergency situations. However, the challenge of visually tracking and keeping up with an object on the ground is difficult enough that current implementations usually involve a human controller for the vehicle. This symposium presents our efforts to make the tracking of a grounded object both autonomous and robust, so that the robot can provide support for a ground vehicle without human assistance.

UNDECIDED

I-CONSERVE

STUDENTS Jia Chin *Social & Decision Sciences* | Won Seong Kim *Undecided* | Shivam Naik *Undecided* |
Henry Neale *Undecided*
ADVISORS Jeria Quesenberry *Information Systems*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Due to the rising prospect of improving sustainability through the use of information systems, we have decided to focus our collective efforts on improving the sustainability of Carnegie Mellon's campus. Universities are generally among the largest and most influential organizations in their communities and thus, the creation of a more sustainable university would be particularly impactful to both students and surrounding locals. In addition, it has been shown that humans typically take around six weeks to build and adopt new habits. Our ultimate goal is to turn Carnegie Mellon University – one of the world's premier institutions of higher learning – into a place where life-long sustainable habits are built.

In our project, we discuss two solutions that will improve Carnegie Mellon's sustainability through the use of information systems; the first of these involves the implementation of more efficient lighting systems, while the other involves improving the monitoring and management of the university's energy consumption. Since the project mainly concerns university campuses, our target audience includes students, faculty members, administration, other university staff, as well as private corporations that will be considered as our potential partners. We provide case studies to substantiate our theories. For the lighting system solution, we propose the installation of motion-sensor controlled lighting in order to more efficiently reduce electricity usage. The case studies relevant to this solution include a motion-sensor lighting project done by the University of Colorado-Boulder's Environmental Studies Program, as well as UC San Diego's 2011 lighting retrofit project, which utilized occupancy sensors. For the energy monitoring system, we propose that the current system be improved upon so that the real-time impact of energy consumption can be displayed in more intuitive and meaningful ways. Furthermore, we hope to encourage the practice of sustainable actions and lifestyles among the student body by initiating a campus-wide energy saving competition between residence buildings. For this solution, we looked at Harvey-Mudd College's implementation of a real-time metering system and a similar competition.

In conclusion, the two solutions will be most effective if promoted together. Because the two are similar in implementation, doing so would be cost-friendly as well as time-efficient. The projects will not only enhance CMU's sustainability and save money—as shown in case studies—but also create friendly relationships with large corporations, provide exceptional experiences to members of our community and ultimately, improve CMU's reputation.

SCHOOL OF COMPUTER SCIENCE

COMPUTER SCIENCE

A FIREFOX XPCOM MODULE FOR THE ICLICKER CLASSROOM RESPONSE SYSTEM

STUDENTS Andrew Drake *Computer Science* | Margaret Richards *Self-defined*
ADVISORS Mark Stehlik *Computer Science*
ROOM/TIME Peter / 12-2:30

The iClicker classroom response system facilitates student interaction in large lecture settings, the taking of attendance, and real-time evaluation of student understanding. Our project provides a web application programming interface to iClicker data collection enabling instant online publication, user interface flexibility, and more efficient course management. Using the Firefox web browser with its Cross-Platform Component Object Model (XPCOM) we bring these features to a plugin available for all major platforms. This tool provides a starting point for direct integration with the Blackboard course management system.

A OPTIMIZATION FOR PROPERTY DIRECTED REACHABILITY

STUDENTS Michael Wang *Computer Science*
ADVISORS Edmund Clarke *Computer Science*
ROOM/TIME Peter / 3-5

We describe our attempt to optimize Property Directed Reachability, a model checking algorithm, to run faster.

A POLITICAL SURVEY OF THE CMU COMMUNITY

STUDENTS Dev Doshi *Computer Science* | Emily Gehrels *Science and Humanities Scholars* | William Weiner *Social & Decision Sciences* | Crystal Wray *Economics* | Pavan Yalamanchili *Biological Sciences*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

We are seeking a measurement of each respondent's stance on social, political, economic, and election issues. We will obtain demographic information (age, gender, student/faculty/staff, major/department, QPA) and see if there is a relationship between the demographic information and stance. That is, can we predict a person's political leaning or election behavior given their demographic information? Also, we want to ask how representative of the US population the CMU community is.

A TYPE THEORY FOR LINKING

STUDENTS Michael Arntzenius *Computer Science*
ADVISORS Karl Crary *Computer Science*
ROOM/TIME Wright / 12:00

The processes of linking and loading, while fundamental to the way code is actually executed on modern computers, have hitherto evaded type-theoretic explanation. This prevents us from producing a typesafe linker and loader, which would satisfactorily close the gap between high-level type safe programming languages and low-level typed assembly languages and proof-carrying code. We develop such a type theory, by way of defining the syntax and semantics of a lambda-calculus with explicit support tfor libraries. As a proof of

concept, we implement a compiler from this calculus to a simple abstract machine language and associated object-file format, and an interpreter for this machine.

APPLICATIONS OF SPECTRAL ALGORITHMS

STUDENTS Hui Han Chin *Computer Science*
ADVISORS Gary Miller *Computer Science*
ROOM/TIME Wright / 12:20

The goal of this thesis is to show that various graph algorithms can be redefine as spectral graph optimization problems. The key advantage of the unified spectral approach is that the different sub-algorithms can share one common data structure, the underlying graph, and greatly benefit from the speed of a fast linear system solver. We would demonstrate the spectral framework on classical image processing tasks such as denoising and segmentation. Also we would reinterpret and implement in code, standard image processing algorithms such as Total Variational Minimization and Non-local Means into the spectral framework.

AUTOMATED MOTION CAPTURE FOR HUMAN-ROBOT INTERACTION

STUDENTS Christian Burchhardt *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*
ADVISORS Siddhartha Srinivasa *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

One of the major obstacles preventing robots from working in human environments is the difficulty of communicating with and understanding people. To communicate effectively and efficiently with humans, a computer needs to have the ability to understand body language; however, most robot sensors are not designed to view and process visual data describing human position and gestures. This symposium presents our work toward building a physical workspace with mounted cameras facing a static scene from all angles, allowing a computer to collect and analyze data about human action within the workspace. Secondly, we present our analysis of the camera output to provide a single source of information regarding the position, gestures, and expressions of any human in the workspace.

AUTOMATED WAREHOUSE STORAGE AND RETRIEVAL SYSTEM USING A LOW COST ROBOT COLONY

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Jonathan Goldman *Computer Science* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*
ADVISORS George Kantor *Robotics Institute*
ROOM/TIME Dowd / 1:40

As robotic capabilities improve and costs decrease, the use of robots in commercial applications is greatly increasing. One emerging application of robotics is warehouse distribution: robots can autonomously store and retrieve physical inventory. The warehouse system can be made safer and more efficient by eliminating human operators. The Colony Scout research team aims to advance the state of the art in this area using distributed

robotics: a swarm of robots will divide warehouse tasks among itself and cooperate to move inventory in the least amount of time practical. We intend to overcome the swarm robotics challenges presented by this task, namely navigating the warehouse, responding to a series of tasks, and cooperating efficiently to complete all assigned work.

AUTOMATIC HEAP EXPLOIT GENERATION

STUDENTS Brent Lim Tze Hao *Computer Science*
ADVISORS David Brumley *Electrical & Computer Engineering*
ROOM/TIME Wright / 12:40

The automatic exploit generation (AEG) challenge is, given a program, automatically find vulnerabilities and generate exploits for them. Avgerinos et al showed that, given the source code of the program, AEG was possible for certain stack smashing and format string exploits. In Automatic Heap Exploit Generation (AHEG), we do away with the need for source code and we extend AEG to automatically find heap bugs and generate heap exploits on applications running on Windows XP SP3. Our contribu- tions are: 1) we show how techniques developed by Avgerinos et al generalize to binary-only analysis, 2) we propose memory tagging, a technique used to infer the class of data, as opposed to the type of data, base on semantic analysis of the program, 3) we introduce "2-steps exploits", which extends Avgerino's approach to exploit generation to heap exploits 4) we build an end-to-end system that takes executables on Windows XP SP3 and automatically generates crashing inputs against them.

BIPEDAL WHEELED PLATFORM FOR HYBRID LOCOMOTION

STUDENTS Neil Abcouwer *Electrical & Computer Engineering* | Job Bedford *Undecided* | Cory Chang *Computer Science* | Chad Cole *Electrical & Computer Engineering* | Jitu Das *Computer Science* | Siddharth Dedhia *Electrical & Computer Engineering* | Priyanka Deo *Computer Science* | Connor Dixon *Mechanical Engineering* | Alexander Franchuk *Electrical & Computer Engineering* | Zachary Greenberg *Mathematics* | David Mehrle *Physics* | Corey Sobel *Computer Science* | Vikram Sunder *Computer Science* | Peter Wei *Electrical & Computer Engineering*
ADVISORS Chris Atkeson *Robotics Institute* | Elliot Rosen *Electrical & Computer Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Most robots are designed to specialize in one task, but at the cost of versatility. In mobile robotics, maneuvering diverse terrain is often difficult for robots with only one form of motion. For example, urban search and rescue robots designed for flat surfaces will fail on rubble, and robots designed for rubble will move slowly on flat surfaces. Our team proposes to solve this problem by creating a robot that can change its method of motion depending on the type of terrain it encounters. We will build a robot that combines wheeled and bipedal motion, allowing it to handle multiple types of terrain. The robot will be able to adapt its motion to the current terrain. Wheels provide benefits such as fast, power-efficient movement on flat terrain, whereas bipedal locomotion allows a robot to handle complicated environments like stairs or rocky terrain. This "hybrid locomotion" has enormous potential to benefit the field of robotics since a successful hybrid gets both the benefits of speed and maneuverability.

BOTH WORK AND PLAY MAKE JOHNNY GOOD AT FRACTIONS: MOTIVATING LEARNING ON A FRACTION COMPARISON TASK WITH GAME INTERLUDES: PRESENTATION

STUDENTS Luke Davis *Psychology* | Christopher Reid *Social & Decision Sciences* | Yueran Yuan *Computer Science*
ADVISORS Albert Corbett *Human Computer Interaction Inst.*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

We investigate the effect of one of the motivational tools we implemented in an original educational game that helps students practice fractional reasoning. We present the results of an experiment looking at the effect of game interludes between fraction practice blocks on students' motivation and subsequent learning on fraction comparison tasks. We vary the relationship between the fraction task and the game task. In one condition, students' performance on the fraction task influences their performance on the game task. In a second condition, the students' performance on the fraction task has no impact on the game task. Motivation, game performance, and transfer to a standard fraction task are compared across conditions.

COLONY SCOUT: A LOW-COST, VERSATILE PLATFORM FOR AUTONOMOUS SYSTEMS IN COLLABORATIVE ROBOTICS

STUDENTS Julian Binder *Undecided* | James Carroll *Computer Science* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Lalitha Ganesan *Electrical & Computer Engineering* | Yuyang Guo *Undecided* | John Howland *Mechanical Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Timothy Koh *Mechanical Engineering* | Alexander Lam *Computer Science* | Abraham Levkoy *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Benjamin Wasserman *Electrical & Computer Engineering* | Leon Zhang *Electrical & Computer Engineering* | Alexander Zirbel *Computer Science*
ADVISORS George Kantor *Robotics Institute*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Cooperative robotics is the concept that a group of robots working as a team can solve problems faster and more efficiently than a single robot. In the past, the Colony Project has explored numerous applications of group robotics, from mapping to formation control to cooperative manipulation. As is the case with a group whose stated goal is to be low-cost, past projects have always been hindered by imprecise sensors, faulty hardware components, and limited mobility. We propose to design and develop a new generation of Colony robots, the Colony Scout, to overcome these obstacles and increase performance, consistency, and robustness. Scout will dramatically improve upon the current generation of robots, Colony 3.0, with an innovative design that includes a more powerful drive system, more capable processing, and more reliable sensors. The main innovations of the Colony Scout will be capability to handle rough terrain and the ability to add new components (for example, a forklift) on an enhancement bay at the back of the robot. With more reliable and capable hardware, the Colony Project hopes to embark on more ambitious projects than in the past and to contribute in a more significant way to swarm robotics research.

COLORMYGRAPH: STUDENT PROOF ANALYSIS AND VERIFICATION

STUDENTS Adam Blank *Computer Science*
ADVISORS Klaus Sutner *Computer Science* | Luis A Von Ahn *Computer Science*
ROOM/TIME Wright / 1:00

College-level Mathematics and Theoretical Computer Science is almost universally based in proof. We prove our theorems true, our code correct, our invariants constant. Traditionally, students struggle a lot with learning the art and science of writing proofs. Often, it presents such a barrier that they give up on understanding what to do.

My senior thesis focuses on the development, implementation, and testing of a new type of assignment which we call a "Verification Assignment" in which students review and comment on each others' proofs via an online system. Our hope is that these assignments simultaneously help students gain a better understanding of the underlying concepts as well as decrease the time spent on grading.

CROWDSOURCING AND ROBOTICS: THE APPLICATIONS TO A ROBOT TOUR GUIDE

STUDENTS Marlena Abraham *Computer Science*
ADVISORS Thomas Kollar *Computer Science* | Manuela Veloso *Computer Science*
ROOM/TIME Peter / 12-2:30

An important aspect in designing a tour is not only to give a brief and accurate overview of each location but also being able to anticipate related questions from the audience. Giving the audience this option of interaction adds a depth and variety to the tour that is crucial when the main goal of the tour is to give the audience the ability to pursue information that is relavant to them.
The first step in approaching this problem was to apply simple person to person crowd sourcing by asking questions like "If you came across a robot in the hallway, what would you ask it?" and "If you were a perspective student and were given a tour by a robot, what questions would you ask?" to various students around campus.

The resulting questions from applying this sampling approach were varied but generally fell into one of several broad categories, such as general information that might be found by using a simple internet search, information more specific to a building, location, or person that might not exist on a public database, unspecific questions such as "What is that?" that are dependent on gesture, and random questions that are posed often in jest are some of the broader categories. In designing a system for answering questions posed during a specific tour, it is important to be able to anticipate and respond to each type of question.

The focus in approaching this problem was to begin with the last mentioned category of questions: a grab-bag of questions that can be expected given that being able to ask a robot a question is a novelty. These questions, such as "Are you happy?", "What's your favorite superhero?", and "Mac or PC?" are so varied and often opinion specific that they usually cannot be searched for by using the internet or some other preexisting database.

The next step in this process if refining a way to implement the chosen method of solving this problem: employing crowd sourcing techniques. The general format of the approach is that first a question is posed and using preexisting voice recognition software it is stored as a string. The string is searched for in a database of existing question and answer sets and if it exists, an appropriate answer is chosen and returned. Otherwise, the question is added to a list of questions to be posed to human counterparts. After one or more appropriate answers are refined from the crowd, the answer or answers are saved with the corresponding question in the

database.

Some problems with this approach include similarly worded questions, the current limitations of voice recognition software, and gleaning appropriate answers to the questions posed to the people who answer the questions. The next steps are to refine a database to store the questions and answers and to determine a way to combat the submission of incorrect or nonsense answers.

DESIGN OF A LEAD ACID BATTERY CHARGE ESTIMATION AND MONITORING SYSTEM

STUDENTS Peter McHale *Physics* | Christopher Palmer *Electrical & Computer Engineering* | Esha Uboweja *Computer Science* | Robert Wedler *Electrical & Computer Engineering*
ADVISORS Susan Finger *Civil and Environmental Engineering*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

State of charge information from lead acid batteries is important in any system which relies on batteries as a primary power source. It is difficult to predict the current capacity of a lead acid battery because capacity changes due to wear over time and is also a function of ambient temperate. A computer data model has the ability to improve estimation of the capacity of a set of batteries by recording previous battery history and predicting how the maximum capacity has changed over time.

DEVELOPMENT OF GPU-BLAST 2.0

STUDENTS Alexander Kaufmann *Computer Science*
ADVISORS Nikolaos Sahinidis *Chemical Engineering*
ROOM/TIME Peter / 12-2:30

The BLASTN algorithm as developed by NCBI is widely used as a tool to obtain partial and exact nucleotide sequence matching against large databases of DNA information. Due to the scope of the problem, specifically the length of nucleotide sequences and the size of many databases, this algorithm is very time intensive. GPU-BLAST 2.0 ports the industry standard NCBI algorithm to a graphical processing unit using CUDA in order to take advantage of the per database sequence parallelism. By working from the existing code base, GPU-BLAST 2.0 should maintain consistency of output while increasing performance with respect to time.

EFFORTLESS EMBEDDED ENGINEERING

STUDENTS Nathaniel Barshay *Computer Science* | Tomer Borenstein *Electrical & Computer Engineering* | Brandon Kase *Computer Science* | Dylan Koenig *Electrical & Computer Engineering* | Evan Shapiro *Computer Science* | Nisha Singh *Psychology* | Leonard Sokol *Information Systems*
ADVISORS David Kosbie *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:30

The availability of tools for the software programmer has made it easy for amateurs to build world changing companies in a day. Until now, this productivity has remained trapped inside the computer. We are providing an easy interface between hardware and software, so the next generation of innovators will be be free to hack the physical world.

EVALUATING BUCKET-WHEEL EFFECTIVENESS UNDER MICROGRAVITY

STUDENTS Hahna Alexander *Mechanical Engineering* | Kayla Aloyo *Mechanical Engineering* | Tiffany Bassey *Undecided* | Andrew Sheng *Computer Science*

ADVISORS Krzysztof Skonieczny *Robotics Institute*

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

The excavation of regolith (Lunar soil) is essential to the construction of future off-planet outposts and harvesting of fuel deposits, both of which are vital for prolonged human presence on the moon. The bucket wheel excavator is a machine used for surface mining and digging. The mechanism consists of a large wheel with a continuous pattern of "buckets" used to scoop material as the wheel turns. This method of excavation is useful due to the low resistance forces and lightweight operation. The proposed bucket wheel excavator will be mounted centrally on a Lunar Rover, and runs transverse to the direction of forward rover motion. This setup enables the collection of regolith, which is essential to the success of the excavating concept. The behavior of the bucket wheel mechanism is unknown in low gravity environments. Fundamentally, it is questionable if regolith will even be able to fall out of a bucket on the lunar surface. Bucket functionality must be evaluated in microgravity before bucket wheel implementation is feasible. A microgravity experiment will examine the behavior of the bucket wheel in lunar gravity by testing the amount of regolith gathered after specified rotations of an individual bucket. Buckets will be optimized for ideal aspect ratio, overall size, and shape. Additionally, Lunar soil simulant with similar properties will be used to mimic Lunar regolith. Testing bucket excavator functionality in microgravity is critical to the success of future lunar excavator concepts. The goal of this research is to evaluate bucket wheel effectiveness in a Lunar gravity environment. The team will evaluate if selected design parameters uphold terrestrial bucket wheel theory, thus enabling the implementation of bucket wheel excavators on future Lunar rover missions.

FACE RECOGNITION ON THE ROMIBO ROBOT PLATFORM

STUDENTS Laxman Dhulipala *Computer Science*

ADVISORS Mark Stehlik *Computer Science*

ROOM/TIME Peter / 12-2:30

With advanced open source libraries, the once specialized task of face detection has become possible on devices as minuscule as a smartphone. A challenging task when creating a Robot for use in Autism therapy is knowing when a child is actively engaging the robot in play, and responding appropriately. We aim to solve this problem by first building a computer based system to analyze video and coordinate motions in the robot. Once this preliminary work is finished, attempts to perform all actions autonomously by means of an onboard smartphone will be started.

FEATURE DETECTION ON FPGA

STUDENTS Wennie Tabib *Computer Science*

ADVISORS William Whittaker *Robotics Institute*

ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:45

Fast, accurate, autonomous robot navigation is essential for planetary robots when communication with Earth is delayed, limited or nonexistent. Feature detection is the crux of robot autonomy. It calculates feature descriptors which are the basis of visual odometry and obstacle avoidance. The first step in calculating a

motion estimate using visual odometry is to detect features in a pair of stereo camera images mounted on a vehicle. Without feature detection, the robot cannot determine where it is and how to get to its destination. Feature detection is understood, but requires fast computation, which is not available on planetary rovers. The feature slows rover progress. Consequently, the feature is turned off, risk is accepted, and exploration progress is possible. For example, the Mars Exploration Rover was entrapped and lost when feature detection was turned off.

The need is for fast, spaceworthy feature detection. This means near-real-time speed, low power consumption, and radiation tolerance. This research accomplishes this vision by developing a feature detection algorithm to be synthesized on FPGA.

FORMULA SAE CAR PROJECTS FOR SPRING 2012

STUDENTS Pronoy Biswas *Electrical & Computer Engineering* | Adam Brecher *Mechanical Engineering* | Anne Dirkes *Mechanical Engineering* | Uriel Eisen *Design* | Margaret Hall *Materials Science Engineering* | Eva Humphrey *Mechanical Engineering* | Brian Langone *Mechanical Engineering* | Derek Miller *Electrical & Computer Engineering* | Jack Moldave *Mechanical Engineering* | Michael Ornstein *Mechanical Engineering* | Mark Sun *Mechanical Engineering* | Gabrielle Williams *Design* | Tom Zhang *Computer Science*

ADVISORS Reinhard Schumacher *Physics* | Satbir Singh *Mechanical Engineering*

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

Formula SAE creates a high performance race car from the ground up every year. We compete against hundreds of other universities around in engineering design, cost analysis, business potential, and vehicle performance. This year is focused on the development of new manufacture techniques for the car's carbon fiber body, implementation of new mass optimization strategies, and instrumentation of vehicle loads and dynamics for future development.

GRAPHICAL NUMERICAL INFERENCE A.K.A. BRAIN SURGERY FOR EXCEL

STUDENTS Jerene Yang *Computer Science*

ADVISORS Manuel Blum *Computer Science*

ROOM/TIME Wright / 1:20

Excel's drag and auto-fill feature works for most simple numerical cases like addition. However, it fails when someone gives it a checkerboard pattern with 1s and 0s and tries to extend the pattern. Excel is unable to expand this obvious pattern because its entire inference is based on a static snapshot of the final data. Graphical Numerical Inference Program (GNIP), on the other hand, takes a dynamic approach by monitoring how the sequence is being filled. It will then try to figure out how the user is filling up the entries. After that, it picks up where the user has left off and fills in the rest of the entries.

HOW DOES DEPTH PERCEPTION FACILITATE VIRTUAL MANIPULATION WITH STEREOSCOPIC DISPLAY?

STUDENTS Huiyang Xing *Computer Science*

ADVISORS Nancy Pollard *Robotics Institute*

ROOM/TIME Peter / 3-5

In this research, I would like to test whether and how stereoscopic rendering improves people's performance on virtual manipulation tasks.

Much research has been done on related topics. Many studies suggest that using stereoscopic rendering helps construct a better sense of depth in the scene. In this project I will set up two tests to examine the effectiveness of head mounted stereoscopic rendering for the purpose of virtual manipulation. The first (baseline) test will focus on depth perception alone and the second test will focus on integrating virtual manipulation with depth perception.

This research is expected to examine the subject's ability to manipulate in virtual environments with and without stereoscopic rendering.

From an analysis of the observations, we can conclude whether stereoscopic rendering really helps virtual manipulation.

IDENTIFYING CONFUSABLE CONTEXTS IN SECOND LANGUAGE PRONUNCIATION TRAINING

STUDENTS Elizabeth Davis *Computer Science*
ADVISORS Maxine Eskenazi *Language Technologies Inst.*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 7 / 10:00

The purpose of this project is to create a web interface for a tool that aids in English pronunciation tutoring as part of the REAding Practice (REAP) language learning project. Pronunciation is a crucial part of language understanding, as mixing up a single phoneme (sound) in certain contexts can mean the difference between speaking with an accent and being misunderstood. Thus we developed a real time, web-based tool that can be used for developing a curriculum for a novel pronunciation tutor that aims to correct these confusions. It first takes in a piece of English text and decomposes the words into their individual phonemes using natural language processing (NLP) tools. Then it iteratively replaces a single phoneme in each word with another phoneme. If the new set of phonemes can be mapped back to a valid word and tagged with the same part of speech, then the program tags it as confusable and saves the new word. After the entire text has been analyzed, it returns the original text with confusable words highlighted and provides a word bank with the generated confusing word variations. The interface allows the words in the word bank to be substituted in the original text so that the user can see just how confusing a misspoken phrase could actually be.

IDENTIFYING DEATH-RELATED POSTS IN BREAST CANCER FORUMS

STUDENTS Margaret Schervish *Computer Science*
ADVISORS Carolyn Rose *Language Technologies Inst.*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

Recently, work has been done to predict milestones in a breast cancer patient's medical history based on the frequency of their posts to an online forum and the distribution of topics in these posts. However, little work has been done on identifying text that relates to the topic of death. The goals of this project are to build a model to identify whether or not a post relates to death and to use that information to gain more insight into how patients relate to the topic of death at different points during their diagnosis.

IDENTIFYING MALICIOUS APPS IN THE ANDROID APP STORE

STUDENTS Anuraag Jain *Computer Science*
ADVISORS Christos Faloutsos *Computer Science*
ROOM/TIME Peter / 12-2:30

The app market is a growing space that is capable of generating millions of dollars in revenue. The lack of strict regulations on the android app market allows developers to create false reviews and malicious applications fairly easily.The project aims at using a dataset created by crawling the android app market and individual reviews on each application to then create statistical plots and use graph techniques to identify potential outliers and malicious application developers.

IMPLEMENTING CODESEARCH WITH PRE-PROCESSING AND SUFFIX ARRAYS

STUDENTS Andrey Tydnyuk *Computer Science*
ADVISORS David Andersen *Computer Science*
ROOM/TIME Peter / 3-5

Searching through code for specific expressions and words is different from searching through English text. Code is a lot more structured and there are a lot of lines that appear multiple times in a single file such as "i++" and "}". This project is an implementation of code search using a pre-processor to shrink the text size and suffix arrays for the indexing and lookup. This results in a reduced index size and faster lookup time.

IMPROVING LUNAR TERRAIN DATA

STUDENTS Jason Koenig *Computer Science* | Andrew Sheng *Computer Science*
ADVISORS William Whittaker *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 12-2:30

Accurate, high resolution models of the surface elevation and appearance of the moon, Mars, and asteroids are useful for a variety of scientific and technical objectives, but directly measured elevation data is low resolution. Using techniques from computer vision such as shape from shading and Markov random fields, elevations can be estimated from existing imagery. These techniques have be applied to small patches of the moon and other bodies, but new techniques are required to generate data for the entire moon. This research will develop a system capable of processing and storing the very large quantity of data required for a generating a global, high resolution model of the lunar surface. Due to the large amount of data involved, significant hard drive space is required, on the order of a dozen terabytes.

JOULE - A JIT FOR LUA

STUDENTS Alex Crichton *Computer Science* | Robert McElrath *Computer Science*
ADVISORS Andre Platzer *Computer Science*
ROOM/TIME Peter / 12-2:30

Lua is an embeddable scripting language widely used in the gaming industry for applications like modeling AI, enhancing interactivity, configuration, and run-of-the-mill scripting. Lua is already one of the fastest interpreted languages, but the language is highly dynamic, and could benefit greatly from just-in-time (JIT) compilation and optimizations. Using an LLVM backend, we have created Joule, a JIT for Lua, as both a learning experience and

to see the degree of performance improvements attainable over interpreted code. Our JIT uses many of the optimizations provided by LLVM, as well as other Lua-specific optimizations to increase performance. Several optimizations have not yet been implemented, though Joule already outperforms the standard Lua interpreter in many tests, often by a wide margin.

LUX: FASHIONABLE TECHNOLOGY

STUDENTS John William Brieger *Computer Science* | Alanna Fusaro *Design*
ADVISORS Mark Stehlik *Computer Science*
ROOM/TIME Connan / 3-5

We think about what we want to wear, but not necessarily how we want to wear it. Through the use of accelerometers, cameras, and other sensors, LUX forces wearers to examine their own motions in the context of their clothing. By displaying real-time feedback in the form of light visualizations, clothing in LUX broadcasts the motions and emotions of the wearer to a larger audience. By playing with the sensitivity and programming of each garment, wearers can be nudged into performing certain actions more or less frequently. LUX seeks to examine the relationship we have with our clothing and our own bodies through wearable electronics, providing insight into our daily routines and habits.

MEMORY ALLOCATOR FOR ANDROID OS

STUDENTS Tae Hyun Ahn *Computer Science*
ADVISORS James Morris *Computer Science*
ROOM/TIME Peter / 12-2:30

This approach/application will try to tackle the problem with the native web browser in Android.
    The problem is that the native browser stalls and freezes occasionally in the OS. No one has been able to find the reason/solution for the problem and this approach will try to solve that problem.

MODE CHECKING FOR LAZY FUNCTIONAL LOGIC PROGRAMMING

STUDENTS Matthew Mirman *Computer Science*
ADVISORS Frank Pfenning *Computer Science*
ROOM/TIME Wright / 1:40

Functional logical programming is a paradigm that introduces predicate satisfaction as a first class construct into the functional setting.
    Given the difficulty of reasoning about the time complexity of logical code, lazy evaluation is desirable.

In consolidating logical and functional semantics, a complete logical query primitive is necessary. In the non strict and breadth first evaluation strategy, it is possible to return unground logical variables. Such results are meaningless in the context of determinism. Given the semantics for a practical lazy functional logical language, we attempt to supply a flexible type and mode system in order to ensure progress.

MODULAR UNITY RPG

STUDENTS Henry Zwally *Computer Science*
ADVISORS Jonathan Aldrich *Computer Science*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

The goal of this project is to design and develop a 3d first person RPG following my original vision for the game. To do this, I am leading a team of 13 people consisting of artists, modelers, programers, designers and writers. More than just creating the game, a major focus of this project is to produce the game using professional practices. This includes developing the game in a very extensible way, with a focus on modularity and good design so that future team members who work on the project (who are likely to not be the same people who are working on it now) are able to easily pick up from where others left off with the only additional support being my guidance. Furthermore, the graphics are supposed to be very high quality, and the game is supposed to have an engaging and well developed story (since this is only level 1, you will only see the start of the story, but the overarching story is being created so that it can follow in subsequent levels to be made in later semesters). Also, one of the main focuses of the project is on professional level development, meaning that in the process of developing the game, I wanted to employ professional practices.

MULTIPLAYER MATHEMATICAL GAMES ON FINITE GRAPHS

STUDENTS Jai Woo Lee *Computer Science*
ADVISORS Alan Frieze *Mathematics*
ROOM/TIME Peter / 12-2:30

Mathematical games are multi-player games whose strategies can be studied by theoretical ideas in combinatorial game. This observation considers a number of mathematical strategies over different types of rules, the number of piles, chips on each pile, and various arrangement of piles. The main goal of this independent study is to optimize the final value and get the winning position of each game using dynamic programming on finite graph, the main method for solving each NP-hard game. In the future, these ideas can be used to develop further theoretical game strategies in combinatorial game theory.

PARSING BULLETIN BOARDS

STUDENTS Ryan Cahoon *Computer Science*
ADVISORS Manuela Veloso *Computer Science*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

The bulletin boards scattered around the Carnegie Mellon University campus are a common method of publicly announcing information, but this information is only available for a short period of time and may not reach the entire campus community. I will present a system that will allow a robotic agent to autonomously capture and catalog the posters displayed around CMU to allow for the creation of a centralized archive of these displays.

PHASE TRANSITIONS IN THE RANDOM BIT VECTOR FORMULA DECISION PROBLEM

STUDENTS John Davis *Computer Science*
ADVISORS David Brumley *Electrical & Computer Engineering*
ROOM/TIME Peter / 12-2:30

Phase transitions from polynomial to exponential time are well-studied for SAT solvers, typically occurring at a density of ~4.3 clauses per variable. However, it is not known if SMT solvers (a related class of solvers for the decision of constrained bitvector formulae) are subject to a similar phase transition threshold, or if phase transitions occur in them at all. We investigate the runtime of one such solver, STP, in the hopes of observing such a transition.

PRINCIPLES OF SOFTWARE SYSTEMS CONSTRUCTION SUPPLEMENT

STUDENTS John Phelan *Computer Science*
ADVISORS William Scherlis *Computer Science*
ROOM/TIME Peter / 3-5

Building novel content and content types for 15214

PROBABLISTIC ELEMENTARY CELLULAR AUTOMATA

STUDENTS Samir Jindel *Computer Science*
ADVISORS Klaus Sutner *Computer Science*
ROOM/TIME Peter / 12-2:30

We study the behavior of a class of discrete dynamical systems (elementar cellular automata) under the introduction of probablistic update rules.

PROPERTIES OF THE TRANSDUCTION SEMI-GROUP GENERATED BY A CERTAIN 3-STATE MEALY AUTOMATON.

STUDENTS Joseph Appel *Computer Science*
ADVISORS Klaus Sutner *Computer Science*
ROOM/TIME Peter / 12-2:30

Investigation of various questions concerning a specific semi-group. Problems include: Identifying a function for the Knuth Normal Form of a transduction.
    Proving that the orbit relation automaton is finite without using analysis techniques. Quickly finding the automata for arbitrary transductions.

REDIFINING FAIR: THE ROAD TO EQUITABLE DIVISION

STUDENTS Max Tucker *Computer Science*
ADVISORS Ariel Procaccia *Computer Science*
ROOM/TIME Peter / 3-5

The swiss poet Johann Lavater once suugested that to truly know a man's character, one should attempt to divide an inheritance with him. The task of dividing some common set of goods amongst a group of individuals

with different opinions about the value of the goods is known as cake-cutting, and it is one of the more interesting fair division problems.

How can we obtain a fair division when we cannot agree on the value of the goods? the answer to this question depends on subtle variations of what we consider to be fair and how we deal with envy. This expo is intended to introduce the listener to the field, explaining the core concepts of cake-cutting while delving into some of the specific hurdles it entails for establishing upper and lower bounds on the solution runtime.

SCOUTING ANDROID APPLICATION

STUDENTS Yaoran Chen *Mathematics* | Alexander Lockwood *Computer Science*
ADVISORS Ananda Gunawardena *Computer Science*
ROOM/TIME Peter / 12-2:30

We developed an Android application for the Girls of Steel robotics team, an all-girl robotics team made up of high school students in the Pittsburgh area. The application provides an easy means of gathering and visualizing information during robotics competitions, a crucial method commonly used in robotics competitions called "scouting".

SIMPLE ALGORITHMS FOR BIVARIATE POLYNOMIAL INTEGRATION

STUDENTS Dennis Meng *Computer Science*
ADVISORS Manuel Blum *Computer Science*
ROOM/TIME Peter / 3-5

The motivation behind this was wanting to have a program that could "guess" a pattern. The user would input part of a pattern, and it would be up to the computer to continue on the pattern as far as it could. My colleagues are working on programs to continue complex patterns in one dimension and simple patterns in two dimensions. What I hope to do is to find something that is a combination of the two; interpolating polynomials in two variables (and perhaps move on to recurrences in the future).

The subject of bivariate polynomial integration is one that has been studied for much of the last 100 years. I will compare and contrast two relatively easy approaches, one involving univariate polynomial interpolation and one involving Gaussian elimånation. The hope is to make a thorough analysis of these two algorithms in an effort to provide ideas as to what the best would have to do in order to be successful.

SPATIAL AND ANALYTICAL STUDY OF STUDENT HOUSING AT CARNEGIE MELLON UNIVERSITY

STUDENTS Shannon Lauricella *Science and Humanities Scholars* | Samuel Lavery *BHA* | Ariel Liu *Computer Science* | Terra Mack *Psychology* | Alejandra Munoz Munoz *Architecture*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Carnegie Mellon is an urban university with many students living off-campus. Finding housing off-campus is generally left up to individual students, who take into account many variables when choosing a house or apartment. We are interested in investigating the possibility of a correlation between where students choose to live and what they choose to study. Our research presentation seeks to answer questions about the dynamics of student housing at CMU. Is there a correlation between address and major? Do students in certain majors cluster together? Which off-campus neighborhoods are most popular with undergraduate students versus

graduate students? Our poster provides visual evidence for the statistical correlations found pertaining to these questions.

TEMPORAL ANALYSIS OF INFORMATION CASCADES ON TWITTER

STUDENTS Maryam Aly *Computer Science* | Brendan Meeder *Computer Science*
ADVISORS Luis A Von Ahn *Computer Science*
ROOM/TIME Wright / 2:00

There has been much work in the area of information propagation. However, most of this work has been node-centric or edge-centric. My thesis is taking a more global approach, looking at properties of the entire graph over time. Specifically, I am analyzing how the closeness centrality changes over time.

TRANSIENT ANALYSIS OF QUEUEING SYSTEMS

STUDENTS Adrian Trejo *Computer Science*
ADVISORS Mor Harchol-Balter *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:00

The body of work concerning queueing systems deals primarily with steady state analysis, i.e., of systems that have reached equilibrium. However, this is unrealistic for most applications since systems typically don't reach the steady state.

Transient analysis asks what is the state of a system at time t given that we start at t=0 with certain initial conditions.

We begin by surveying the known results for transient analysis. We find that these are extremely complex, involving many summations, and are typically only numerically tractable. We then present a new simple technique for transient analysis of a single-server system with an infinite queue based on combinatorial methods. Finally, we propose several open problems in the field of transient analysis.

TRANSPARENT SYSTEM CALL BASED PERFORMANCE DEBUGGING FOR CLOUD COMPUTING

STUDENTS Nikhil Khadke *Computer Science*
ADVISORS Priya Narasimhan *Electrical & Computer Engineering*
ROOM/TIME Wright / 3:00

Problem Diagnosis and debugging in concurrent environments such as the cloud and popular distributed systems frameworks has been a traditionally hard problem. We explore an evaluation of a novel way of debugging distributed systems frameworks by using system calls. We focus on Google's MapReduce framework, which enables distributed, data-intensive, parallel applications by decomposing a massive job into smaller (Map and Reduce) tasks and a massive data-set into smaller partitions, such that each task processes a different partition in parallel. Performance problems in such systems can be hard to diagnose and to localize to a specific node or a set of nodes. Additionally, most debugging systems often rely on forms of instrumentation and signatures that sometimes cannot truthfully represent the state of the system (logs or application traces for example). We focus on evaluating the performance of the debugging these frameworks using the lowest level of abstraction – system calls. By focusing on a small set of system calls, we try to extrapolate meaningful information on the control flow and state of the framework, providing accurate and meaningful automated debugging.

TVERBERG'S THEOREM AND RELATED PROBLEMS

STUDENTS Margaret Meyerhofer *Computer Science*
ADVISORS Gary Miller *Computer Science*
ROOM/TIME Peter / 3-5

Given n points, a point p has Tverberg depth r if the n points can be partitioned into r sets such that each set contains p in its convex hull. It was proven by Tverberg that each set of n points in d dimensions has depth has a point of depth at least n/(d+1), known as a Tverberg point. I have investigated several problems related to Tverberg points, including the computational complexity of finding a Tverberg point given a set of n points. I also studied a conjecture of Gil Kalai's stating that the sum over depths r from 1 to n of the number of Tverberg points of depth r is always nonnegative. This conjecture, if true, would imply Tverberg's theorem as well as providing additional information about the structure of such points.

USARSIM AT CMU-QATAR

STUDENTS Sidra Alam *Computer Science* | Hanan Alshikhabobakr *Computer Science*
ADVISORS Brett Browning *Computer Science* | Mary Bernardine Dias *Robotics Institute* | Balajee Kannan *Robotics Institute*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Multi-robot research can be very challenging due to the difficulty of operating several complex vehicles simultaneously. Simulation can be a powerful tool to speed up software development if the simulator is sufficiently accurate. The project builds from an existing robot simulation tool – the Urban Search And Rescue Simulator (USARSim). The focus of the research was to customize and enhance the USARSIM multi-robot environment to enable high confidence of capturing the complexities of real robot execution, specifically for the robots in the Qri8 robotics lab at Carnegie Mellon University in Qatar. In terms of an application domain, our focus was on disaster response scenarios. This project involves developing an environment scenario for a multi-robot research field, namely, disaster response. The primary task for the robots in this scenario is exploration. For the simulation testing, we created maps for the disaster response scenario and physical configuration models for the robots are added. We used a generic robot control software called Player to control the robots in the simulator. To validate the experiment, we ran a test with real robots and an identical simulation test and compared the executed behaviors.

VISION-BASED OBJECT FOLLOWING WITH AN AUTONOMOUS QUADROTOR

STUDENTS Julian Binder *Undecided* | Christian Burchhardt *Electrical & Computer Engineering* | James Church *Chemical Engineering* | Jeffrey Cooper *Computer Science* | Priyanka Deo *Computer Science* | Graham Harvey *Electrical & Computer Engineering* | Daniel Jacobs *Electrical & Computer Engineering* | Peter McHale *Physics* | Nicolas Mellis *Electrical & Computer Engineering* | Doci Mou *Electrical & Computer Engineering* | Thomas Mullins *Electrical & Computer Engineering* | Matthew Sebek *Electrical & Computer Engineering* | George Stanley *Electrical & Computer Engineering* | Thomas Wucherpfennig *Mechanical Engineering* | Alexander Zirbel *Computer Science*
ADVISORS Sanjiv Singh *Robotics Institute*
ROOM/TIME Class of '87 / 3:40

Robots are becoming a common sight in every aspect of modern life. In aerial robotics, helicopters and other flying platforms are perfect for surveillance in harsh environments where ground-based navigation is extremely difficult or impossible - such as in dangerous military zones or disaster-stricken regions. Aerial robots are also useful for supporting ground vehicles: they can use their increased visual range to scout ahead, extend

the range of communication with outside entities, or provide supplies and tactical assistance in emergency situations. However, the challenge of visually tracking and keeping up with an object on the ground is difficult enough that current implementations usually involve a human controller for the vehicle. This symposium presents our efforts to make the tracking of a grounded object both autonomous and robust, so that the robot can provide support for a ground vehicle without human assistance.

W-AUTOMATA

STUDENTS Adrian Trejo *Computer Science*
ADVISORS Klaus Sutner *Computer Science*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 11:15

w-automata recognize the w-regular languages, however, they're also useful in specifying behavior of systems that are not expected to terminate, e.g., operating systems.

We're building the automata-theoretic support structure to perform model checking for first-order logic formulas on one-way infinite cellular automata.

We provide a software suite, written in C++, that operates on w-automata and includes an implementation of Safra's Determinization Algorithm.

WORD PROBLEM SOLVING USING SEQUENCE INFERENCE

STUDENTS Aaron Snook *Computer Science*
ADVISORS Manuel Blum *Computer Science*
ROOM/TIME Wright / 3:20

Currently, word problems can be understood by humans but cannot be easily understood by computers. This project proposes using sequence inference as a bridge to this problem. Instead of attempting Natural Language Processing, which is difficult, a human observes a parameter in the problem, and records the answers to the question for small values of the parameter. This is often easy for the human to do but nonetheless provides an effective description of the problem to the computer. The computer extrapolates the sequence given to provide insights about the problem, which it reports back to the human, allowing the computer to participate in informal problem-solving with a human.

HUMAN COMPUTER INTERACTION INSTITUTE

EXPLORING IDENTITY OF SELF USING PHOTOGRAPHY, AS IT IS AFFECTED BY PERCEPTION AND AGNOSIA

STUDENTS Shruti Kataria *Human Computer Interaction Inst.*
ADVISORS Patricia Maurides *Art*
ROOM/TIME Pake / 12:00

To create a series of images reflecting on the changes that have occurred in my self-defined and perceived identity, as I moved to another country, and became a part of culture and community that was different from the one I grew up in. This project will explore an agnosia caused by a drastic change in lifestyle that occurred, and removed elements of identity that I was familiar with before the change and have disregarded since.

PROJECT NUDGE

STUDENTS Shih-Chieh Chu *Design* | Michelle Reinhold *Design* | Phornpavee Saiyavath *Design* | Stephanie Yim *Human Computer Interaction Inst.*
ADVISORS Karim Kassam *Social & Decision Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

Nudge is the action of giving someone a gentle reminder or encouragement. Project Nudge is an attempt to bring about more awareness regarding issues around us by subconsciously promoting positive behavior through fun and play. As Carnegie Mellon students, we are often so immersed in our lives that we become un-aware of how our behavior directly impacts our personal well being, the community, and the environment. One such issue that we identified on campus is the lack of recycling. People have the notion of recycling but are not motivated to persistently recycle because of its inconvenience. With a nudge, we intend to promote better recycling habits by building an interactive recycling receptacle that when used, delivers fun audio messages submitted by members of the campus community. These audio messages will turn a mundane task like recy-cling into an engaging and meaningful experience for members of the campus community. Using SURG, we will build a working prototype of the receptacle and a web interface for message submissions. With a little nudge, we can make a change for the better.

UNDERSTANDING AND SUPPORTING THE ROLE OF DISTINCT CAREGIVERS OF CHILDREN WITH SPECIAL NEEDS, BEHAVIOR PROBLEMS AND/OR PLACED ON THE AUTISM SPECTRUM, ENROLLED IN AN ALTERNATIVE SCHOOL PLACEMENT.

STUDENTS Shruti Kataria *Human Computer Interaction Inst.*
ADVISORS Anind Dey *Human Computer Interaction Inst.*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:30

This project aims to help in the understanding of the flow of information and levels of communication of caregivers associated with a classroom for 4-8 year old children with special needs, behavior problems and/or placed on the autism spectrum, enrolled in an Alternative School Placement at Programs for Living, Education and Advocacy (PLEA), Pittsburgh. Through a series of in-class observations and interviews with the educators, it seeks to advance insight into the frequency and value of communication between the educators, parents

and other involved caregivers of the children. The information gained will be utilized to inform the development of processes and technology in the future that can assist these caregivers in their ability to provide for the children.

SELF-DEFINED

A FIREFOX XPCOM MODULE FOR THE ICLICKER CLASSROOM RESPONSE SYSTEM

STUDENTS Andrew Drake *Computer Science* | Margaret Richards *Self-defined*
ADVISORS Mark Stehlik *Computer Science*
ROOM/TIME Peter / 12-2:30

The iClicker classroom response system facilitates student interaction in large lecture settings, the taking of attendance, and real-time evaluation of student understanding. Our project provides a web application programming interface to iClicker data collection enabling instant online publication, user interface flexibility, and more efficient course management. Using the Firefox web browser with its Cross-Platform Component Object Model (XPCOM) we bring these features to a plugin available for all major platforms. This tool provides a starting point for direct integration with the Blackboard course management system.

SCIENCE & HUMANITIES SCHOLARS

SCIENCE AND HUMANITIES SCHOLARS

A FLUOROGEN-ACTIVATING PROTEIN BIOSENSOR FOR PROTEIN-PROTEIN AND CELL-CELL INTERACTIONS

STUDENTS Lianne Cohen *Science and Humanities Scholars*
ADVISORS Jonathan Jarvik *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:00

The ability to study interactions between different components in a biological system is essential for research. In order to aid in the imaging and analysis of these types of interactions, we have developed a biosensor that detects protein-protein and cell-cell contacts. This biosensor will help to understand the nature of protein interactions and could be used to screen for molecules that affect the interactions. Current methods for studying protein-protein interactions, like FRET, require specific knowledge of protein structure and have high background levels. Additionally, most cell-cell contact assays are irreversible, preventing dynamic studies.
To avoid these issues our biosensor is based on fluorogen-activating protein (FAP) technology: small organic dyes, which are not fluorescent in solution, become constrained by binding a FAP and emit fluorescent signal. In order to create this biosensor, HeLa cells were virally transduced with two different protein constructs.
The first contains a FAP, scFv1, expressed extracellularly connected through a transmembrane domain to the protein FKBP, in the cytoplasm. The second construct has a single-chain avidin outside of the cell and the protein FRB, inside. FKBP and FRB are proteins that bind together in the presence of rapamycin. A reagent was developed to detect proximity of these two extracellular domains, avidin and scFv1; it consists of a biotin molecule connected via a PEG linker to DIR, a fluorogen dye. Presence of this reagent in low concentrations is not sufficient to obtain signal from the scFv1-FKBP protein alone. However, when avidin binds biotin with a high affinity, the local concentration of DIR increases around the scFv1 expressed on the surface of the cell and the reagent is able to bind, producing a strong fluorescent signal that is also reversible. Furthermore, we will also use these constructs in adjacent cells to analyze cell-cell contacts via time-lapse microscopy.

A POLITICAL SURVEY OF THE CMU COMMUNITY

STUDENTS Dev Doshi *Computer Science* | Emily Gehrels *Science and Humanities Scholars* | William Weiner *Social & Decision Sciences* | Crystal Wray *Economics* | Pavan Yalamanchili *Biological Sciences*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

We are seeking a measurement of each respondent's stance on social, political, economic, and election issues. We will obtain demographic information (age, gender, student/faculty/staff, major/department, QPA) and see if there is a relationship between the demographic information and stance. That is, can we predict a person's political leaning or election behavior given their demographic information? Also, we want to ask how representative of the US population the CMU community is.

ACCENTS AND DUAL LANGUAGE ACQUISITION

STUDENTS Amritha Mallikarjun *Science and Humanities Scholars*
ADVISORS Erik Thiessen *Psychology*
ROOM/TIME Kirr Commons-1st Floor, Window side / 12-2:30

Studies indicate that one mechanism babies use to learn languages at an extremely fast rate is statistical learning (Thiessen & Saffran, 2003). Learning two languages becomes even more complicated, as the children have to first differentiate the two languages and then use statistical learning to discern the words in each language. This study will test one way that babies could use to differentiate two languages spoken to them: different accents. The study will present the infants with two different, statistically incompatible language streams to see if they can learn both of them as individual entities. In the control, the two languages will have the same accent. In the experimental case, one will have a Korean accent and one will have a American accent. The goal is to see if different accents can effectively help babies differentiate and learn two languages at the same time. This will help us understand babies' ability to successfully acquire multiple languages.

AN ANALYSIS OF THE SIR PHILLIP SYDNEY GAME WITH MULTIPLE SIGNALS

STUDENTS Patrick Kane *Science and Humanities Scholars*
ADVISORS Kevin Zollman *Philosophy*
ROOM/TIME Dowd / 1:00

The current understanding of the Sir Phillip Sydney Game holds that there are two possible solutions: one where honest signaling exists utilizing a high cost signal and one where signaling is only partially honest but the cost to signaling is much lower. However, up to this point no attempts have been made to compare these two equilibria, in particular there has been no attempt to determine which one is more likely to evolve. In light of this absence in the research literature I created a new version of the Sir Phillip Sydney Game that allows the comparison of the two equilibria.

ANIMALS AS COMMODITIES: PHOTOGRAPHING THE ANIMAL SHELTER

STUDENTS Jena Tegeler *Science and Humanities Scholars*
ADVISORS Paul Eiss *History*
ROOM/TIME Connan / 3-5

Using two animal shelters in the Pittsburgh area as the site of research, I investigated the relationship between humans and domesticated animals in the urban environment. Combining anthropologic observation with artistic practice, I documented these findings using photography. I explore the idea of the animal shelter as a site in which creature becomes commodity. I portray the animals in the grid-like architecture of the shelter using black and white photographs. I collected and analyzed the language used to describe these animals and the rhetoric used by the shelter with potential animal adopters. By observing the endless cycle of adoption and donation, I trace the dual processes of commodification--that is the way in which the animals become replace-able and acquire exchange value--and singularization, as the animals acquire personal or cultural value. This system is problematic however, as the processes of exchange do not merely involve disposable things, but rather come at price of the exploitation of living animals.

CMU CONNECT

STUDENTS Ryan Billings *Self-defined* | Sean Chin *Information Systems* | Salim Peshawaria *Science and Humanities Scholars* | Jonghyun Thom *Self-defined*
ADVISORS Jeria Quesenberry *Information Systems*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 8 / 10:15

CMU Connect offers a platform for university students to meet in social, professional, or academic settings. By combining video chat and instant messaging technologies, this application aims to provide a new way for Tartans to get to know one another, and stay updated on campus life.

CORTICAL REPRESENTATION OF TEMPERATURE SENSATION IN MOUSE

STUDENTS Hannah Wirtshafter *Science and Humanities Scholars*
ADVISORS Alison Barth *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 10:30

While temperature has been mapped to the insular cortex in primates, the exact cortical representation in rodents has remained elusive. The hope is to develop the thermal response as a tool to manipulate neural circuits so that experience dependent neuronal firing can be examined. This experiment uses c-Fos levels, as determined using immunohistochemistry, as a marker of neuronal activity to locate the cortical representation of temperature sensation. Initial findings have shown increased c-Fos levels in the insular cortex in mice whose paws have been stimulated with cold water or menthol, both of which activate the cold-sensing TrpM8 channels. The mice exhibit increased c-Fos expression in layers 2/3 and 5/6 of the insular cortex, an area that has been previously linked to temperature sensation in other mammals.

DENSITY MEASUREMENTS OF THE LUNG LIPID DPPC VS. TEMPERATURE

STUDENTS Kelsey Hallinen *Science and Humanities Scholars*
ADVISORS John Nagle *Physics* | Stephanie Tristram-Nagle *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 10:45

My project involved measuring the density of the main lipid in the human lung, DPPC (dipalmitoylphosphatidylcholine), using two methods: densimetry and neutral flotation. DPPC undergoes the main phase transition (41.4 oC) near body temperature (37 oC) and one theory states that a gel-fluid phase change occurs each time that we breathe. DPPC has been widely studied, since it is so important in lung function, and determining the density change as a function of repeated scans would lead to more understanding in how pulmonary surfactant works. I primarily used the Anton-Paar densimeter to measure the DPPC density in the fluid (high temperature) and gel (low temperature) phases with a precision of 10-6 g/ml. The differential densimeter scans the temperature from 10 oC to 50 oC and then back to 10 oC in 0.5 oC steps. During repeated temperature scans, I observed an increase in DPPC density at the same temperature, similar to previously published results by Tiddy et al. However, upon remixing the lipid samples, the density returned to its initial value. This result was confirmed qualitatively by another density measurement, neutral flotation, using D2O/H2O mixtures. To account for the observed increase in density with scan repetition, we think that when DPPC undergoes a phase transition, the gross morphology of the multilamellar vesicles in our experiment changes, since this change in density is reversed by mixing the sample.

ENERGETIC BARRIERS TO MAGNETIC SWITCHING IN COMPACTED NANOPARTICLES

STUDENTS Alexander Edelman *Science and Humanities Scholars*
ADVISORS Sara Majetich *Physics*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 6 / 11:00

Ordered arrays of magnetic nanoparticles have tremendous promise as materials for bit patterned data storage media, where each bit is written to a single nanostructure with a well-defined size rather than a region of a bulk magnetic solid, thus enabling much higher information densities than today's hard drives. In order to efficiently write data to such nanoparticle arrays, it is important to understand the energy barriers and characteristic time scales involved in switching the nanoparticle magnetization state. We report the results of experiments with compacted magnetic nanoparticles arranged in toroidal geometries. Oscillating magnetic fields were induced in these toroids over a many-decade frequency range, and the magnetic response measured. From these measurements we have obtained the complex magnetic permeability of the nanoparticles, which is determined by the distribution of energetic barriers to switching. Our results are discussed in terms of various microscopic models that could account for the observed behavior.

IDENTIFICATION OF CIS REGULATORY SEQUENCES OF EFFECTOR GENES IN THE SEA URCHIN SKELETOGENIC GENE REGULATORY NETWORK

STUDENTS Stephanie Guerra *Science and Humanities Scholars*
ADVISORS Charles Ettensohn *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 2 / 10:15

The purpose of this project is to identify and analyze cis regulatory sequences in the sea urchin genome that are responsible for the differential expression of key genes expressed in the primary mesenchyme cells (PMCs). This is important because an outline of connections has been determined in the PMC gene regulatory network (GRN) and this project could assist in further refinement of this network. Many gene interactions have been identified in this GRN, but in most cases it is not known whether these interactions are direct or indirect. One way to identify direct interactions is to dissect the cis-regulatory modules that direct the spatial and temporal expression of a given gene and then identify the proteins that bind to those modules. Since many cis regulatory sequences are upstream of the gene of interest, this will be my starting point of exploration. My project will consist of a general screen in which I will take sequences of DNA that are located from -1 to -2000 relative to the transcriptional start sites of the genes of interest. These sequences will be cloned from sea urchin genomic DNA and then integrated into plasmid vectors upstream of a GFP reporter sequence. These plasmids will then be linearized and injected into fertilized sea urchin embryos. After subsequent development to approximately the mesenchyme blastula stage, the embryos will be examined by fluorescence microscopy to determine if the GFP protein has been expressed. If the embryos show specific GFP protein expression in the PMC population, this indicates that the upstream 2000 base-pair sequence is sufficient to initiate expression of its target gene specifically in the PMCs. This experiment will be performed on 15-20 different genes that are expressed specifically by PMCs, with the hope that positive cis regulatory sequences will be identified. These genes were initially chosen because the mechanism for their direct activation in the PMC GRN is unknown.

LEARNING FROM LA VARA: SHAPING SEPHARDIC IDENTITY IN NEW YORK CITY AFTER THE SECOND DIASPORA

STUDENTS Kristen Minno *Science and Humanities Scholars*
ADVISORS Richard Maddox *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 12-2:30

In New York City, the Sephardic immigrant community had established a strong foothold by the 1930s. However, the children of these immigrants were not learning traditions of their old homelands, or of centuries-old aspects of Sephardic culture. In response to this situation, Albert Levy, editor of the Sephardic newspaper La Vara, recognized that he and his paper could help to build bridges between the first generation immigrants from the Second Diaspora and their American children. Thus, on August 31, 1934, Levy published the first English section page in La Vara, which had previously been printed exclusively in the Ladino language in Hebrew characters. The main goal of this page was to reach out to Sephardic youth who were increasingly primary English speakers. This strategic move to English succeeded in creating an open arena for Sephardic youth to gain access to Jewish, and more importantly Sephardic, issues. These issues led to the ultimate formation of their unique identity, which centered on access to education; the lack of unity among Jews in New York; concerns about anti-Semitism; nationalism; an interest in strong historical ties to other world Jewish communities; cultivating Jewish-American identity; and connections to the Hispanic community in the metropolitan region. This paper will explore the complicated question of the identity of Sephardic American Jews based on the issues raised by La Vara.

MERGER RETROSPECTIVE: EXAMINING KIMBERLY-CLARK AND SCOTT PAPER COMPANY MERGER

STUDENTS Alisa Deychman *Science and Humanities Scholars*
ADVISORS Timothy Derdenger *Economics*
ROOM/TIME Class of '87 / 12:20

This study conducts a post-merger retrospective on the 1995 Kimberly-Clark and Scott Paper merger to examine the impact on store prices and consumer welfare. Kimberly-Clark was a premium brand with strong market power in the United States. Scott Paper had the largest market share of tissues in Europe and was positioned as a value-oriented brand. This merger created the second largest U.S. personal care company product. While many simulations are conducted ex-ante, few analyzes are run ex-post the merger. This study examined data from University of Chicago's Booth School of Business using Dominik's database, which surveyed 140 stores in the Chicago area with 9 years of weekly sales data and over 3,500 products. Regressions conducted showed that despite the strong position of the two companies, there were indeed no anti-trust issues and the market remained competitive.

NEWLY FORMED SOUND-ACTION ASSOCIATIONS ELICIT AUDITORY-MOTOR PRIMING

STUDENTS Nicolas Zuniga-Penaranda *Science and Humanities Scholars*
ADVISORS Laurie Heller *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:15

We aimed to study the priming of manual actions by naturally and artificially associated sounds. Previous studies have reported on related cross-modal priming, such as of manual actions by visual stimuli (Brass et al.

2000) (Masson et al. 2011). Castielle et al. (2010) demonstrated that recorded response sounds could be used to elicit affordances for reach-to-grasp actions. In addition, neuroimaging studies (Aziz-Zadeh, 2004) have shown that listening to sounds of human actions activates motor networks in the brain, and suggest that priming a manual action by playing a corresponding sound (i.e. auditory-motor priming) should be possible.

This poster presents a series of three experiments that explored auditory-motor priming. In these experiments, subjects were first trained to associate a sound A (sounds varied across experiments) to an action with their left hand, and a sound B to a right-hand action. After training, subjects heard the sound A or B as a prime, followed by a directional command. Subjects would respond with the hand corresponding to the direction "left" or "right". Primes and directions varied independently, so movement accuracy and reaction time were measured as congruent, incongruent, or null (no prime) trials. The presence of auditory-motor priming between these primes and actions was predicted to cause facilitation or shorter reaction time in congruent trials, and inhibition or longer RTs in incongruent trials.

Experiment 1 used natural sound-action pairings: scrapes and taps. A priming effect was observed. Experiment 2 determined whether, for priming to occur, the sound-motor association must exist prior to the study or could be learned during the course of the study. This was accomplished by removing the sounds produced by the scrape and tap actions. To test whether it was important that the priming sounds be related to the gestures, Experiment 3 used arbitrary gesture-sound associations by pairing button presses with tones of varying frequencies.

Though experiment 1 showed a priming effect by comparing RTs in congruent vs. incongruent trials, experiment 2 evinced no priming effect. Finally, the successful use of artificial sound-action pairings to create the priming effect in experiment 3 demonstrates that auditory-motor priming can be produced by recently learned sound-action pairings.

PORTRAIT PHOTOGRAPHS AND PHOTOGENICITY

STUDENTS David Zimmerman *Science and Humanities Scholars*
ADVISORS George Loewenstein *Social & Decision Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 10:30

Often during social gatherings that require photographs people will claim, "I am not very photogenic, I shouldn't be in this", and use this standard excuse to avoid being in photographs. This research looks into the personal ratings of how photogenic people consider themselves to be. The specific definition of photogenic used is, the level of attractiveness that a photograph captures. Through this definition we try to tease out the differences between inherent attractiveness, that must be judged in person and what a photograph can convey.

PRIMING OF MANUAL ACTIONS BY THEIR RELATED SOUNDS

STUDENTS Nicolas Zuniga-Penaranda *Science and Humanities Scholars*
ADVISORS Laurie Heller *Psychology*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 4 / 11:00

We aimed to study the priming of manual actions by naturally and artificially associated sounds. Previous studies have reported on related cross-modal priming, such as of manual actions by visual stimuli (Brass et al. 2000) (Masson et al. 2011). Castielle et al. (2010) demonstrated that recorded response sounds could be used to elicit affordances for reach-to-grasp actions. In addition, neuroimaging studies (Aziz-Zadeh, 2004) have shown that listening to sounds of human actions activates motor networks in the brain, and suggest that priming a manual

action by playing a corresponding sound (i.e. auditory-motor priming) should be possible.

This oral presentation discusses a series of three experiments that explored auditory-motor priming. In these experiments, subjects were first trained to associate a sound A (sounds varied across experiments) to an action with their left hand, and a sound B to a right-hand action. After training, subjects heard the sound A or B as a prime, followed by a directional command. Subjects would respond with the hand corresponding to the direction "left" or "right". Primes and directions varied independently, so movement accuracy and reaction time were measured as congruent, incongruent, or null (no prime) trials. The presence of auditory-motor priming between these primes and actions was predicted to cause facilitation or shorter reaction time in congruent trials, and inhibition or longer RTs in incongruent trials.

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RECONSTRUCTING THE LYMAN-ALPHA FOREST

STUDENTS Joseph Vukovich *Science and Humanities Scholars*
ADVISORS Rupert Croft *Physics*
ROOM/TIME Pake / 4:20

Quasars emit electromagnetic radiation and cause hydrogen to absorb certain frequencies of radiation. Thus, by looking at quasar spectra, and looking for where these absorptions occur, we can infer the location of intergalactic hydrogen (also known as the Lyman-alpha forest) on the line from us to the quasar. With enough quasar data it is possible to interpolate to fill in the regions between the quasar lines-of-sight. Interpolation is used to reconstruct a simulation of the Lyman-alpha forest from a subset of that data to assess the quality of the interpolation algorithm.

REDUCING COSTS FOR THE PORT AUTHORITY

STUDENTS Michael Pane *Statistics* | Nicholas Rock *Science and Humanities Scholars* | George Volichenko *Statistics*
ADVISORS William Eddy *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The Pittsburgh Port Authority runs a substantial deficit. In times of such economic hardship, it is absolutely essential for them to find feasible cost reduction solutions. For the last few years the Port Authority has collected various information from each of its buses' trips (e.g. scheduled stops, geographic coordinates, passenger entry and exiting, and et cetera). The accessible data contains all records for April 2009 and October 2010 and includes over 20 million such events. Our ultimate goal is to use this data to find efficient ways to reduce costs with minimal sacrifice.

We first take steps to establish the reliability and the accuracy of the provided data set. Elementary data

exploration and information received from the Port Authority reveals that several aspects of the data are inaccurate, particularly passenger flow and route ID. We devise an algorithm to minimize passenger flow error and another to reclassify trips by the best-fit route ID. After refining the data we focus our data analysis on studying the passenger fluctuation for certain routes at various times of the day and week. Based on these findings we can then determine which routes should be limited, eliminated or turned into "express routes" (much fewer stops). This will ultimately lead to reducing costs for the Port Authority.

RELIGION, DISCRIMINATION AND ASSIMILATION: A COMPARISON OF CONTEMPORARY FRANCE AND UNITED STATES

STUDENTS Huma Ali *Science and Humanities Scholars*
ADVISORS Donna Harsch *History*
ROOM/TIME Hoch Commons-2nd Floor, Rangos side / 3-5

This paper will examine how religion and secularism lead to discrimination and serve as barriers to assimilation in France and the United States. Although these two modern Western nations were founded upon similar ideals, their respective histories have resulted in different frameworks for the separation of church and state. In the French case, the nation's culture of exclusive secularism has posed difficulties for the nation's Muslim subpopulation, as demonstrated by the recent headscarves debate. Meanwhile, the United States' culture of religiosity allows for private matters, such as sexual orientation, to become a public concern, as is the case in the ongoing debate surrounding same-sex marriage. In order for either of these affected groups to become accepted, these nations must reconcile religion's role with respect to the distinction between public and private spheres.

SPATIAL AND ANALYTICAL STUDY OF STUDENT HOUSING AT CARNEGIE MELLON UNIVERSITY

STUDENTS Shannon Lauricella *Science and Humanities Scholars* | Samuel Lavery *BHA* | Ariel Liu *Computer Science* | Terra Mack *Psychology* | Alejandra Munoz Munoz *Architecture*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Kirr Commons-1st Floor, Window side / 3-5

Carnegie Mellon is an urban university with many students living off-campus. Finding housing off-campus is generally left up to individual students, who take into account many variables when choosing a house or apartment. We are interested in investigating the possibility of a correlation between where students choose to live and what they choose to study. Our research presentation seeks to answer questions about the dynamics of student housing at CMU. Is there a correlation between address and major? Do students in certain majors cluster together? Which off-campus neighborhoods are most popular with undergraduate students versus graduate students? Our poster provides visual evidence for the statistical correlations found pertaining to these questions.

THE DETERMINANTS OF SELF-EMPLOYMENT IN MEXICO AND HOUSEHOLD TRANSITIONS BETWEEN 2002 AND 2005

STUDENTS Ya Qi Niu *Science and Humanities Scholars*
ADVISORS Rebecca Lessem *Economics*
ROOM/TIME McKenna / 1:40

The study of self-employment has been an intriguing phenomenon in many developing countries. It is, however, difficult to pinpoint the reason for the presence of self-employment. Some argue that it is a matter of choice, in which people utilize their creativity to realize their business ideas. Others argue that it is a form of involuntary unemployment, because the formal labor market sector failed to supply sufficient jobs to meet the work force's needs. In this paper, I analyzed the case of Mexico using Mexican Family and Life Survey found the following results: Asset level, household size, high school education are significant in explaining a household's decision to be self-employed. The number of members per family that is self-employed depends on the household size, high school education, and the asset group of the household. Lastly, the transitions from self-employment to labor market and vice versa is not homogeneous across asset levels.

UNDERSTANDING CONFORMATIONAL CHANGES IN OPIOID RECEPTORS UPON LIGAND BINDING

STUDENTS Maneesha Sakhuja *Science and Humanities Scholars*
ADVISORS Manojkumar Puthenveedu *Biological Sciences*
ROOM/TIME Hoch Commons-2nd Floor, Window side / 3-5

The mu opioid receptor (MOR) serves as the target for many clinically abused drugs and for endogenous opioid neurotransmitters. However, the physiological effects of MOR activation by these drugs and endogenous opioids, including their addictivity, vary significantly. The molecular basis for these physiological differences is likely explained by the fact that MOR adopts different conformations depending on the ligand (drug) to which it is bound. I am using intramolecular Fluorescence resonance energy transfer (FRET) to identify changes in receptor conformation induced by these different ligands. I have labeled specific residues on the receptor with donor and acceptor fluorophores, in order to look for FRET changes corresponding to the movement of specific domains in MOR. Ligand-dependent FRET changes will be defined at a single molecule level in living cells. This will allow me to determine whether there are consistent conformational changes in MOR stabilized by different drugs. Analyzing these changes will help us understand the molecular basis of why opioid drugs are addictive, and may allow for the development of methods that can change the addictive pathways of these drugs.

VALUE HIERARCHIES AND CAUSE: HOW AN ESTABLISHMENT OF CAUSE VIA NATIONAL VALUES CAN INFLUENCE PUBLIC POLICY

STUDENTS Jessica Sochol *Science and Humanities Scholars*
ADVISORS JamesWynn *English*
ROOM/TIME Dowd / 4:40

On March 11th, 2011, Japan's coast was hit first with an earthquake and then a tsunami. These crippled three nuclear power plants, releasing radioactive substances into the air and raising even more alarm to the already devastated coastline. The first events Japan was relatively prepared for, or as prepared as a country can be for an earthquake of unprecedented magnitude in that area followed almost immediately by a tsunami. However,

when the nuclear reactor complex in the area was also damaged, the country was facing a completely new type of plight to overcome. This paper will analyze how Japanese values allowed an establishment of blame and responsibility for the natural and nuclear disasters, and how this classification has contributed to the responses to and reactions by three different subsets of the Japanese population - the media, the government, and the citizens at large - in terms of their political engagement, community action, and attempts at restoration. Understanding this plight will be crucial to other countries' abilities to overcome their own struggles, understanding the motivations, causes, and national outcomes within their specific context.

VISUALIZATION OF GFP-TAGGED PROTEINS IN NEURONAL-FATED MES

STUDENTS Belle English *Science and Humanities Scholars*
ADVISORS Margaret Fuhrman *Biological Sciences* | Jonathan Jarvik *Biological Sciences*
ROOM/TIME Rangos 1 & 2/Sigma Xi Group 1 / 11:00

The purpose of this project was to use confocal light microscopy to visualize the localization of GFP-tagged target proteins in differentiating mouse embryonic stem (mES) cells. Prior to this project a retroviral vector was used to introduce a GFP tag into the mES genome; and cells were sorted for fluorescence with Fluorescence-activated cell sorting (FACS). The clones used in the current project include GFP-tagged dynein, kinesin, and Basp1. These cells were pressured toward a neuronal cell-fate. The goal was to visualize the localization of these proteins as cells differentiated towards a neuronal cell-fate.

TEPPER SCHOOL OF BUSINESS

BUSINESS ADMINISTRATION

AN ANALYSIS OF THE RISK-RETURN TRADEOFF IN THE MARKET FOR DEFAULTED COMPANIES

STUDENTS Anthony Wang *Business Administration*
ADVISORS Juliusz Radwanski *Economics*
ROOM/TIME Wright / 4:00

Much research has been devoted to anomalously low returns on firms with poor credit quality, classified as distressed. In contrast, this work looks into the same issue in the context of firms already defunct, trading over the counter, and registered on the so-called pink sheets. I try to determine if standard asset pricing theory such as Capital Asset Pricing Model (CAPM), or Fama-French Three-Factor Model are able to explain observed excess returns on defaulted firms by relating their observed returns to aggregate risk factors.

CAMPUS SENTIMENT AND SUGGESTIONS FOR ON-CAMPUS PARKING

STUDENTS Silvia Manolache *Business Administration* | Nicholas Thieme *Statistics* | Shu Wang *Mathematics* | Yijia Zhou *Business Administration*
ADVISORS Brian Junker *Statistics*
ROOM/TIME Wean Commons-1st Floor, Connan side / 12-2:30

The city of Pittsburgh has recently increased the rates at the parking meters on Frew and Tech Streets. They have also increased the hours at which the meters must be paid: until 10pm on all days except Sunday. However, this has created a lot of problems for the users of these spaces – the students, staff, and faculty at CMU. We have implemented a survey, which will soon be analysed for trends, in order to understand what is the effect of this policy on the community at CMU. It is possible that there are better, more efficient ways for the parking on Frew and Tech Streets to be handled, either by CMU or by the city of Pittsburgh. For instance, if nobody parks behind on these streets any longer, the city loses revenue instead of gaining revenue as expected.

SOCIAL ENTREPRENEURSHIP: VEHICLE FOR SUSTAINABLE CHANGE

STUDENTS Amy Kao *Business Administration*
ADVISORS Barbara Carryer *Business Administration*
ROOM/TIME Wean Commons-1st Floor, Connan side / 3-5

Social entrepreneurship is a recent budding phenomenon, an international movement, and now an academic discipline that is gaining momentum in a global economy in which governments are unable to sustain efforts to develop solutions to a burgeoning range of social problems. As the subject spans so much activity today, Part 1 of this paper is structured to address a broad range of questions that may pave the way for future exploration of the topic. The main purpose of this paper is to conduct research on social entrepreneurship and put forth a view that social entrepreneurship is a process that stimulates change in society in a way that is not directly correlated to financial benefits that entrepreneurs seek. A comparative analysis of social entrepreneurship and business entrepreneurship will be conducted. The socially entrepreneurial process and different models of social entrepreneurship will also be discussed.

Interesting to explore throughout my thesis is the idea of whether it is appropriate to implement a profit seeking business model to have a positive social impact on society without simultaneously compromising the

responsibility of generating reasonable return for its owners—which urges the following questions: Can a not-for-profit organization model incorporate aspects of a for-profit business model without drifting away from its mission? How can a non-profit organization model be turned into one that is self-sustaining and profit generating and would those elements alone be enough to constitute social enterprise? These are the questions I will address in Part 2 of my thesis by collecting data and analyzing various case studies of social entrepreneurship models to arrive at conclusions that might help determine which model is the best fit given the Pittsburgh demograhic.

THE EFFECTS OF GENDER INEQUALITY FRAMING ON UNETHICAL BEHAVIOR AMONGST WOMEN

STUDENTS Ariel Solomon *Business Administration*
ADVISORS Nazli Turan *Business Administration*
ROOM/TIME McKenna / 12:40

Men have historically been the more dominant gender in the United States. Though women have surpassed men in obtaining higher education, they still lag behind their counterparts in terms of wages and promotions in the workplace. When women are faced with the possibility of bridging gaps caused by inequality, what would they be willing to do? How will their reactions differ based on the framing of the inequality- as male advantage or female disadvantage? Furthermore, when given the opportunity to help the in-group or harm the out-group, how will their responses differ across conditions? This paper will explore the extent to which women are willing to engage in unethical behaviors in order to level the playing field.

THE PRICING OF RISK MEASURES IN DEBT AND OPTION MARKETS DURING THE FINANCIAL CRISIS AND BEYOND

STUDENTS Alexander Nigra *Business Administration*
ADVISORS Lars-Alexander Kuehn *Business Administration*
ROOM/TIME McKenna / 4:20

Times of financial crises are full of uncertainty for all members of society, particularly investors in the financial markets. When investments are based upon the same underlying companies, investors expect the inherent risk-measures to be aligned across markets. I compared risk measures from option and debt markets for select companies in the Dow 30 for a time period including the recent financial crisis. Surprisingly, these risk measures showed far less correlation than one would expect.

THE SIDEWALK PREACHER

STUDENTS Urna Biswas *Business Administration* | Anh Bui *English* | Stefan Dezil *Drama* | Brian Pettitt-Schieber *BHA*
ADVISORS Randy Kovitz *Drama*
ROOM/TIME Connan / 3-5

An uninspired painter seeks a romance with a street evangelist who struggles with faith.

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?

Alan Levine: *Director, Global Information Security, Privacy, and Compliance*
Lauren McCullough: *Director, Global Human Resources Finance*
Joyce Mitole: *Manager, Global Human Resources Finance*
Mac Pinaroc: *Manager, Global Infrastructure*

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.

Cara Costello: *Language Development Specialist, Intercultural Communications Center*
Sharon Dilworth: *Professor, Creative Writing*
Tim Haggerty: *Director, Humanities Scholars Program*
Yona Harvey: *Director of Creative Writing, English*
Cathy Lewis: *The Sprout Fund*
John Mackey: *Assistant Department Head, Mathematical Sciences*
Joe Mannino: *School of Art*
Marge Myers: *Associate Director, STUDIO for Creative Inquiry*
Terese Tardio: *Associate Teaching Professor, Spanish*
Germaine Williams: *The Pittsburgh Foundation*

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 problems through sound engineering principles and innovative technology applications.

Denise Holiman: *Information Technology Manager, Engineering Systems*
Rosemary Potts: *Finance Manager, Employee Development*
Rodney Wheeler: *Engineering Manager, Navigation and Communication Systems*

CIT HONORS POSTER COMPETITION

All students conducting research through the Carnegie Institute of Technology Honors Program participate in the CIT Poster Competition.

Burcu Akinci: *Civil and Environmental Engineering*
Mario Berges: *Civil and Environmental Engineering*
Majidi Carmel: *Mechanical Engineering*
Kris Dahl: *Material Science and Engineering/BME*
Petro Kondratyuk: *Chemical Engineering*
Michael Lancet: *Electrical and Computer Engineering*
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Newell Washburn: *Biomedical Engineering*
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IBM UNDERGRADUATE "SMARTER PLANET" AWARD

IBM, in association with the CMU ACM Student Chapter, is proud to sponsor the Undergraduate "Smarter Planet" Award. As CMU Students, you have the opportunity to change the way the world works. Worldwide systems and processes enable physical goods to be developed, manufactured, bought and sold; services to be delivered; everything from people and money to oil, water and electrons to move; and billions of people to work, govern themselves, and live. For the first time in history, almost anything can become digitally aware and interconnected. Smart airports, smart banks, smart roadways, smart cities with so much technology available at such a low cost, the list of possibilities is endless. New levels of global integration mean that we are all now connected economically, technically and socially. But being connected is not sufficient. We must also infuse intelligence into our systems and ways of working. The world has become flatter and smaller. Now it must become smarter--a "Smarter Planet." This award is designed to challenge some of the brightest minds on the planet - - CMU Undergraduates - - no matter what their field of study - to collaboratively advance the state of the planet and society through interdisciplinary research.

Pat Barron: *Advisory IT Architect, AIM SW*
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JOHNSON & JOHNSON UNDERGRADUATE RESEARCH AWARD

Johnson & Johnson is proud to support innovative projects in the field of Information Technology, with a focus on Innovation. The Johnson & Johnson I/T Innovation organization is responsible for identifying possibilities to drive the Johnson & Johnson business forward. Three prizes will be awarded.

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. A panel of judges will evaluate each project.

David Creswell: *Assistant Professor, Psychology*
Laurie Heller: *Associate Teaching Faculty, Psychology*
Vicki Helgeson: *Professor, Psychology*
Charles Kemp: *Assistant Professor, Psychology*
David Rakison: *Associate Professor, Psychology*
Eric Thiessen: *Associate Professor, Psychology*

RICHARD SCHOENWALD PHI BETA KAPPA UNDERGRADUATE RESEARCH PRIZE

Open only to members of Phi Beta Kappa, this award is sponsored by CMU's Phi Beta Kappa chapter and named after Dr. Richard Schoenwald, late professor of History. Dr. Schoenwald was a member of Phi Beta Kappa, a proponent of undergraduate involvement in research, and the leader of CMU's first application effort (in the early 1970's) to shelter a Phi Beta Kappa chapter at Carnegie Mellon.

William Alba: *SHS, Director*
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Clark Glymour: *Philosophy, Alumni University Professor of Philosophy*
Antonio-Javier Lopez: *Biological Sciences, Associate Professor*
Ann Marie Mesco: *University Libraries, Digitization Projects Manager*

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.

Marlene Behrmann: *Psychology, Faculty*
Marcel Bergerman: *Robotics, Systems Scientist*
Jill Blankenship: *Biological Sciences, Faculty*
Michael Bockstaller: *MSE, Chemistry, Associate Professor*
Maggie Braun: *Biological Sciences, Assistant Deptartment Head*
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Emily Drill: *Biological Sciences: Special Lecturer*
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Wayne Wu: *Center for the Neural Basis of Cognition, Assistant Professor*
Wenjie Xu: *Biological Sciences, Postdoc Research Associate*

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.

MaryLisabeth Rich: *Executive Director of SRC*
Nisha Shukla: *Systems Scientist, Institute for Complex Engineered Systems, Carnegie Mellon*
Chuanjun T Zhang: *Researcher, Intel Labs*

STATISTICS COMPETITION

Sponsored by the Department of Statistics, the purpose of this competition is to encourage undergraduate projects and research in statistics and its applications, 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 faculty in the Statistics Department.

Chad Schafer: *Statistics, Associate Professor*
Ryan Tibshirani: *Statistics, Assistant Professor*

STUDIO FOR CREATIVE INQUIRY AWARD

This competition will reward an atypical, anti-disciplinary and/or inter-institutional student research project that explores new intersections of art, science, technology and culture.

Golan Levin: *Art, SCS, Director of STUDIO for Creative Inquiry*
Jon Minard: *Research Fellow at STUDIO for Creative Inquiry*
Marge Myers: *Associate Director of STUDIO for Creative Inquiry*
Dan Wilcox: *Art, Masters Student, Research Fellow at STUDIO for Creative Inquiry*
Germaine Williams: *History, Doctoral Student*

TOYOTA IDEAS FOR GOOD SCHOLARS AWARD

All participants in Meeting of the Minds, whose research projects emphasize environmental ("green") themes, broadly defined, with applications designed to improve people's lives are eligible to enter the competition for the Toyota Ideas for Good Scholars Award.

This award was created to encourage learning and investigation in green ideas and technology, emphasizing areas the 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.

Karl Kusturok: *VP Production Engineering, Toyota Motor Engineering & Manufacturing North America, Inc.*
Philip L. Lehman: *Ph.D., SCS'78, '84, Associate Dean for Strategic Initiatives, School of Computer Science*

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. Open to any undergraduate student pursuing a degree in Economics or team of undergraduate students enrolled in an UEP course. Eligible projects include students writing a senior honors thesis in Economics and projects developed in UEP courses (including independent study).

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.

David Dzombak: *Steinbrenner Institute for Environmental Education and Research*
Michael Griffin: *Green Design Institute*
Ryan Sullivan: *Mechanical Engineering*
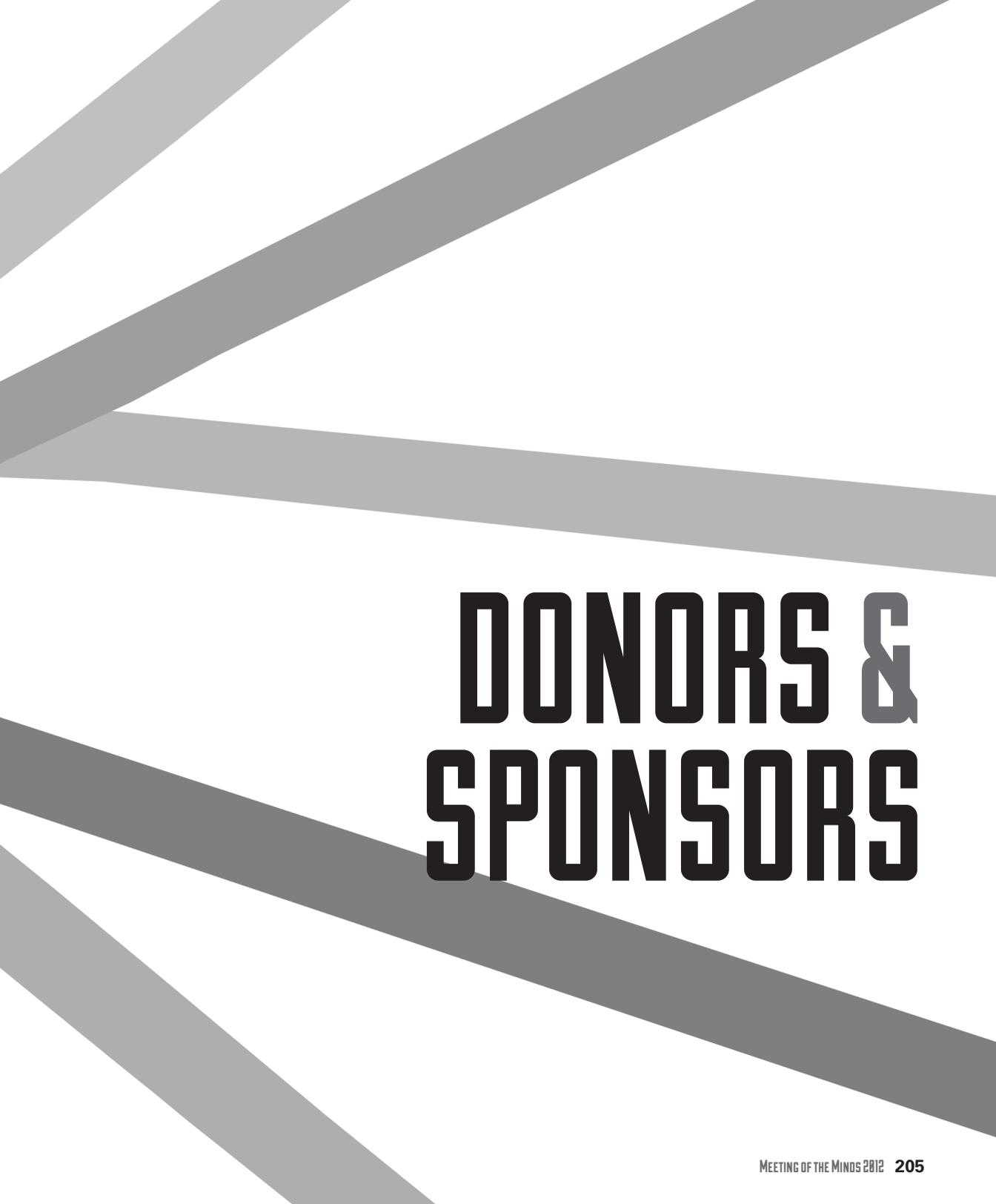
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