MEETING OF THE MINDS

Carnegie Mellon Undergraduate
Research Symposium

Presented by the Undergraduate
Research Office

WELCOME

Welcome to our 16th annual Meeting of the Minds, which showcases the research and creativity of our students and their faculty mentors. If it seems a little overwhelming, the abstracts in this booklet are a good starting point. You can peruse by last names or departments/schools. Or you can simply wander, using this booklet as a guide. The abstracts provide a basic thumbnail sketch of the project. But the opportunity to actually see the posters, hear the oral presentations, engage in an artist's project, or watch a performance will make those abstracts come alive in exciting and unpredictable ways.

Meeting of the Minds belongs to everyone at Carnegie Mellon. Faculty mentors play a critical role in the development of young scholars and artists. Everyone knows someone who is presenting at this event or who has played a role in a research endeavor. That is what makes Meeting of the Minds so unique, because it touches all faculty, staff and students who are associated with our university.

There are two important times 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 two iPads and make announcements for the final rounds of particular competitions.

Just as importantly, at 5:00 pm, our Awards Ceremony begins in McConomy Auditorium. Winners of the eighteen 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, and please enjoy our 16th Annual Meeting of the Minds.

Stephanie Wallach
Assistant Vice Provost for Undergraduate Education
Undergraduate Research Office

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 sumbitted for publication.

CONTENTS

SPECIAL THANKS

WE EXTEND OUR SPECIAL THANKS TO:

/ Apple, Inc. for the two iPads

/ 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 Dan Barnett, Chanda Bates, Amy Burkert, Catherine Copetas, Rachel Douglas, Marcia Gerwig, Anna Houck, Jen Keating-Miller, Kourtney Kissel, Kurt Larsen, Thea Mann, Molly Nix, Neslihan Ozdoganlar, Emily Raffensperger, Jessie Ramey, Roberta Sefcik, Lizzee Solomon, V. Emily Stark, Mark Stehlik, Elisa Tragni Maloney, Jen Weidenhof, Instructional Technology, Catering and Staff, the University Center Staff, Balloons Instead, A.G. Trimble Company, Enhanced Digital Printing, ImagePoint Pittsburgh and all the other wonderful students and staff who make this event work.

PRESENTATIONS

Students who are presenting at the symposium could sign up to do one of four different types of presentations:

Poster Presentation

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 1 and 2. Students participating in the CIT poster competition will be by their posters from 12 noon to 2:30 p.m. in Rangos 3. Students participating in the general poster session will be by their posters from 12 noon until 2:30 p.m. or from 3 p.m. until 5 p.m. in the common areas of the University Center. Please feel free to wander through the poster presentations and ask questions of the students.

Oral Presentation

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

Visual Arts Presentation

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

Performing Arts Presentations

Students will present their work in McConomy Auditorium from 10:30-11:30 a.m. There will be time after their presentations for questions from the audience.

ABSTRACTS

BIOMEDICAL ENGINEERING

CARNEGIE INSTITUTE OF TECHNOLOGY

Accurate EKG lead placement
Wendy Shung / Biomedical Engineering
Advisor(s): Asim Smailagic / Electrical & Computer Engineering
Rangos 3 / 12-2:30

EKG is a transthoracic interpretation of the electrical activity of the heart over time that is used to measure and diagnose abnormal rhythms of the heart. EKG devices are routinely used in hospitals. Leads are placed onto a patient by nurses, who have had training and experience. However, when doctors want to have patients use an EKG at home for an extended amount of time, problems can arise. Specifically, if leads are not placed precisely, it becomes difficult to get accurate and comparable data between tests. Lead placement can be difficult for patients at home for reasons that might include lack of assistance, joint stiffness, reduced dexterity, cognitive issues, reduced visual acuity, or intimidation by technology. The goal of this project is to determine the way EKG leads are misplaced a person's body. 25 participants are used to determine the average misplacement distance error that exists when placing ekg leads on the body according to a diagram. This research will pave the way to create a device that allows easy placement of leads without compromising the accuracy, ease, and convenience compared to having it done in the hospital.

Determination of Neuroanatomical Borders through the Use of Optical Imaging of Intrinsic Signals
Robert Morhard / Biomedical Engineering
Advisor(s): Justin Crowley / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 9 / 11:00

Optical imaging of intrinsic signals is an imaging technique based upon changes in reflectance between active and inactive neuronal populations. This change in reflectance is primarily due to differences in the ratio of oxygenated to deoxygenated hemoglobin. With a spatial resolution of approximately 50 microns, this is a quick and accurate way to determine the correlation between visual cortex activation and presented stimuli. By presenting a sequence of visual stimuli at a known frequency, it is possible to filter out the large amounts of noise associated with this technique and create topographic representations of visual cortex. By analyzing these representations, it is possible to identify the border between V1 and V2. I've developed a robust technique to quickly read in the data, create topographic representations and identify the border. Identifying this border is important for determining whether plasticity changes in visual cortex are global or local.

Exploration and Mapping of Unstructured Environments using an Autonomous Quadrotor

Jeffrey Cooper / Computer Science, Jitu Das / Computer Science, Priyanka Deo / Computer Science, Daniel Jacobs / Electrical & Computer Engineering, Michael Ornstein / Mechanical Engineering, Harrison Rose / Biomedical Engineering, James Wahawisan / Electrical & Computer Engineering, Alexander Zirbel / Computer Science

Advisor(s): Sanjiv Singh / Robotics Institute

Peter / 1:40

Robots are an increasingly common sight in all areas of daily life, and are increasingly useful to humans. As their capabilities expand, they are able to move from strictly controlled environments into an uncharted and potentially dangerous world, where they can accomplish tasks humans would rather avoid. Exploration of hazardous locations like collapsed buildings, mines, and other disaster areas is left largely to humans because few modern robots have the capabilities to reliably replace human explorers. The quadrotor aerial platform provides an attractive solution to this problem: being extremely maneuverable, powerful enough to carry high-performance sensing equipment, and compact enough to fit through small gaps such as a broken window, a quadrotor can gather data about a location before humans or other robots enter it. Once this data is available and the terrain is mapped, robots and humans entering the environment can explore and travel much more efficiently. Applications for this information range from urban navigation to search and rescue maps that can help in quickly developing paths to areas of interest. This research team aims to tackle the problem of exploring and mapping unstructured environments using an autonomous quadrotor.

Reduction of burn progression with topical delivery of (anti-TNF-a)-hyaluronic acid conjugates

Josh Heuslein / Biomedical Engineering

Advisor(s): Newell Washburn / Chemistry

Rangos 1 & 2 / Sigma Xi Group 1 / 11:00

Initial burn-induced injury is followed by a progression of the necrotic zone deeper into the tissue increasing the likelihood of secondary complications, such as impaired healing, systemic immuno-suppression, and hypertrophic scarring. This progression is driven by a microenvironment consisting of elevated levels of pro-inflammatory mediators, predominantly tumor necrosis factor- (TNF-), interleukin-1(IL-1), and interleukin-6 (IL-6). This study explored the hypothesis that a topical application of cytokine-neutralizing antibodies, specifically anti-TNF- and anti-IL-6, conjugated to hyaluronic acid (HA) could be used to alter the local inflammatory response and reduce continued necrosis. Partial-thickness burns were induced on the dorsal of the Sprague-Dawley rats using a custom-built burn instrument with treatments applied every other day. Burn tissues harvested at days 1, 4, and 7 were used to evaluate healing progress. Tissue cytokine concentration analysis demonstrated a reduction in IL-1 levels throughout the experiments in (anti-TNF-)-HA-treated sites, suggesting the (anti-TNF-)-HA conjugate was active in inhibiting expression of downstream mediators, while the other treatments demonstrated no similar effects. A small improvement in total wound closure was also seen by day 7 as well as a reduction in overall inflammation at all time points in additional immunohistochemical staining of macrophages for (anti-TNF-)-HA treated sites compared to other treatment and control sites. Analysis of trichrome-stained tissue sections indicated that while all sites showed signs of granulation tissue, the sites that received (anti-TNF-)-HA

conjugates showed the least necrotic tissue while sites treated with (anti-IL-6)-HA were similar to control-site outcomes. This trichrome observation was verified by the quantified results of vimentin immunostaining, from which it was concluded that HA treatment reduced burn progression by nearly 30% and (anti-TNF-)-HA by over 70%. While the potential for increased risk of infection needs to be understood better, these results suggest that local targeting of TNF- may be an effective strategy for preventing progression of partial-thickness burns.

Tissue Engineering Approach to Breast Reconstruction Surgery
Kathryn Kukla / Biomedical Engineering
Advisor(s):Stephen F. Badylak, DVM, PhD, MD / McGowan Institute for Regenerative Medicine
Rangos 1 & 2/Sigma Xi Group 1 / 11:30

In 2010, there were an estimated 300,000 new cases of breast cancer amongst women in the USA, making it one of the most commonly diagnosed forms of cancer in women. Approximately 50% of these patients will choose to remove a portion or the entire breast through a lumpectomy or a mastectomy respectively, and of these almost 75% will receive reconstructive surgery shortly after the procedure. Reconstructive breast surgery commonly involves the use of a tissue flap from another part of the body or a silicon implant. These procedures result in tissue that approximates the size and shape of the breast prior to the mastectomy. However, complications including scar tissue formation, tissue necrosis at the donor and recipient site, loss of breast sensation, and the risk of infection are common. Regenerative medicine offers an alternative approach that has the potential to alleviate many of these articulated risks. Studies have shown that biological scaffolds composed of extracellular Matrix (ECM) facilitate constructive remodeling in many different tissues in animal models, while additional studies have shown that tissue specific scaffolds promote tissue specific remodeling. These devices are currently used clinically with great success in a variety of applications. The aims of this study were to evaluate the biocompatibility and examine the degradation patterns ECM gels in both their original and genipin cross-linked form. Adipose and urinary bladder matrix (UBM) forms of ECM gels were created using powdered adipose and UBM ECM respectively in a pepsin digest, PBS, and NaOH; a sub group of adipose ECM gels cross-linked were then cross-linked with a 1mM genipin solution. In vitro testing of the devices indicates biocompatibility when seeded with NIH 3T3 fibroblast cells. The devices were also tested in vivo using a bilateral subcutaneous thoracic implant in a rat model. Preliminary histological findings are consistent with the in vitro findings of biocompatibility, and show host cell infiltration of the gel ECM within the early post implantation period. These preliminary findings lead us to believe that further investigation has the potential to develop the technology to provide mastectomy patients with a safe and biocompatible option for reconstructive surgery.

CHEMICAL ENGINEERING

A Feasibility Study of Bio-Gas Digesters and Composting Systems at Carnegie Mellon University

Jule Carr / Civil and Environmental Engineering, Cynthia Clement / Mathematics, Carineh Ghafafian / Materials Science Engineering, Elissa Goldner / Civil and Environmental Engineering, Mahaesh Jayaraman / Chemical Engineering, Lane Kurkjian / Civil and Environmental Engineering, Anna Lenhart / Civil and Environmental Engineering, Kaiyang Liew / Mechanical Engineering, Agnieszka Marszalik / Civil and Environmental Engineering, Tejank Shah / Materials Science Engineering, Lauren Sittler / Chemical Engineering
Advisor(s): Paulina Jaramillo / Engineering and Public Policy
Rangos 1 & 2/Sigma Xi Group 5 / 11:45

Our research examines the feasibility of building and operating a biogas digestion unit for Carnegie Mellon as a way to compost organic waste, offset energy use, and output a nutrient rich byproduct that could be used or sold as fertilizer. We analyze 3 potential alternatives, including a BioTHELYS digester at the Bellfield Boiler plant, a black water unit installed in a new campus building and an in-vessel compost system located in the University Center.

We consider the collection of organic waste, the installation, operation and maintenance of the digester, and the uses for the final products. Our research was conducted based on interviews with Carnegie Mellon faculty and Housing and Dining Services staff, literary sources, and case-studies of other universities where biogas digesters are already in use. The study includes models that can be used to determine if each digestion unit method would be feasible, but also beneficial to our campus by examining the net monetary cost and payoff, the potential energy production, and the nutrient composition of the slurry output.

Adsorption of anionic surfactants in silica nanoparticles grafted with poly(2-(dimethylamino)ethyl methacrylate) brushes

Joyce Xu / Chemical Engineering
Advisor(s): Robert Tilton / Chemical Engineering
Rangos 3 / 12-2:30

The interaction between polymers and surfactants is a phenomenon that has been widely investigated for many decades. The adsorption of the anionic surfactants sodium dodecyl sulfate (SDS) onto silica nanoparticles grafted with poly(2-(dimethylamino)ethyl methacrylate)(PDMAEMA) brushes was studied at various aqueous pH and ionic strength. Three silica nanoparticles with various grafting density of the PDMAEMA polymer brushes were evaluated. The interaction between SDS with the Si-PDMAEMA nanoparticles was examined based on the turbidity, zeta potential and particle sizes formed in the samples.

Advancements to a Novel method of Length-Based DNA Separation, End-Labeled Free Solution Electrophoresis
Heather Dolan / Chemical Engineering
Advisor(s): James Schneider / Chemical Engineering
Rangos 3 / 12-2:30

Length-based DNA separations are critical to biological research fields such as forensic analysis and genetics. Current methods of length-based DNA separation, predominantly capillary gel electrophoresis (CGE), are capable of reading long DNA strands, but can only read up to 600 bases per hour. End-Labeled Free Solution Electrophoresis (ELFSE), a novel method of length-based DNA separation, is orders of magnitude faster than CGE, but has historically been limited in the lengths of DNA it can read. This research makes two significant advances in ELFSE technology. First, a series of micellar end-labels that separate DNA strands within different length ranges with high resolution were developed. A measure of the length of DNA that an end-label can read, (alpha), was computed for each mixed micellar end-label. Prior research groups report alphas no greater than 70 for their end-labels; we have developed mixed micellar end-labels with alphas as high as 1694. Second, optimal experimental conditions were determined for detection of DNA fluoresced with YOYO-1 dye for two modes of sample injection, electrokinetic and hydrodynamic pressure. This was done so that these conditions could ultimately be applied to detection of miRNA using ELFSE. ELFSE will yield shorter run times and higher sensitivity than current miRNA detection methods.

Aerosol delivery of self-dispersing pulmonary drug formulations
Rachel Bradley / Chemical Engineering
Advisor(s): Stephen Garoff / Physics, Todd Przybycien / Biomedical Engineering, Robert Tilton / Chemical Engineering
Rangos 3 / 12-2:30

In cystic fibrosis patients, inhalation of aerosol is the easiest method to deliver drugs. The pulmonary mucus build-up restricts air flow and misdirects drugs away from areas of infection. Researchers have explored using surfactants to enhance post-deposition spreading on airway surfaces. Previous research has provided proof of principles that surfactants do enhance spreading. In this project, we explore how varying total dose and dose rate affect post-deposition spreading. A nebulizer has been built and characterized, and arrival dose rates have been determined in order to enable experiments that measure the extent of spreading for systematically varying dose rates.

Computational Pathology to Discover Common Mechanisms of Premature Aging Diseases
SiWon Choi / Chemical Engineering
Advisor(s): Kris Dahl / Biomedical Engineering
Rangos 3 / 12-2:30

Several premature aging diseases, such as xeroderma pigmentosa(XP), Werner's syndrome(WS), and Hutchinson-Gilford progeria syndrome(HGPS) have different causes but all show a common cellular phenotype of altered nuclear structure. Although the molecular mechanisms of the diseases are known, the downstream effects of the mechanisms are yet to be discovered. In this work, nuclear deformation of these aging diseases is compared at the nucleus and cell level using sophisticated computational image analysis tools, such as feature and geometric space analyses.

This method will determine modes of deformation and correlations between altered structures and localized regions of structural proteins. The goal of the project is to use large sample sizes, automated analysis, and physical intuition to statistically analyze multiple samples to determine similar downstream mechanisms common among the diseases. This will provide insight into different aging diseases and synergize with ongoing research in the area of functional nuclear mechanics.

Cytokine-induced changes in force generation in tendon cells
Sebastien Persaud / Chemical Engineering
Advisor(s): Kris Dahl / Biomedical Engineering
Rangos 3 / 12-2:30

Transforming growth factor- (TGF-) is a soluble protein that acts as a multifunctional regulator in cells, affecting cellular growth, proliferation, differentiation, and force generation. One of the most important roles of TGF- is in inhibiting proliferation, but paradoxically it is found to be upregulated in cancer cells which proliferate uncontrollably. This disconnect is thought to be caused by the cell response to a downstream perturbation in the signaling pathway that ignores the suppressive effects of TGF-. To test this disconnect, we examined the role of TGF- on force generation in rabbit tendon cells. We upregulated TGF- in a rabbit tenocyte model and used traction force microscopy to determine force generation. Preliminary experiments have shown an increase in the traction force of cells transfected with a plasmid containing TGF- when compared to cells transfected with a nonsense gene and untreated cells. This may prove an effective metric to identify potential cancer cells by their mechanical properties.

Delivery of siRNA Using Cationic Nanostructured Star Polymers to Prevent Cell Differentiation to Bone
Chin Shu Watt / Chemical Engineering & Kenneth Yan / Chemical Engineering
Advisor(s): Jeffrey Hollinger / Biological Sciences
Hoch Commons / 2nd Floor, Window side / 3-5

Fibrodysplasia ossificans progressiva (FOP) is a rare genetic disorder characterized by the malformation of the great toes at birth and post-natal extra-skeletal endochondral ossification in soft tissues beginning before the age of ten. It is caused by the over-expression of bone morphogenetic protein (BMP), which activates the transcriptional factors such as Runx2 and Osx that control stem cell differentiation to osteoblasts and the mineralization of osteoblasts to bone. In our research, we tested a potential approach to diminish the extra-skeletal bone growth using post-transcriptional gene silencing. In this method, anti-Runx2 and anti-Osx small interfering ribonucleic acids (siRNA) are delivered in cationic nanostructured star polymers (NSP) to cells to suppress the bone formation. The objective of this study was to target transcriptional factor mRNAs in mouse myoblast C2C12 cells using siRNA delivered by cationic NSP to prevent BMP-induced osteoblast cell differentiation. The results suggest that anti-Runx2 siRNA delivered by cationic NSPs can prevent cell differentiation of the C2C12 cells to osteoblasts in the presence of BMP. However, anti-Osx siRNA delivered by the same polymers was less efficient in preventing cell differentiation and mineralization to bone.

Design and Development of Fuel Cell and Pressure Based Cars

Katia Bazzi / Chemical Engineering, Eric Chu / Chemical Engineering, Jyo Lyn Hor / Chemical Engineering, Travis Horst / Chemical Engineering, Yong Kim / Chemical Engineering, Stacey Lee / Chemical Engineering, Annelie Niebuhr / Chemical Engineering, Kaitlyn Nowak / Chemical Engineering, Alexander Yoshikawa / Chemical Engineering, Amy Yuan / Chemical Engineering, Minghui Zhang / Chemical Engineering, Ziyi Zhu /Chemical Engineering

Advisor(s): James Miller / Chemical Engineering
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

The Chemical Engineering Car Competition is a national, collegiate competition sponsored by the American Institute of Chemical Engineers (AIChE). The competition 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 75 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. Our objective is to develop two unique cars that will compete at a high level at the regional competition next semester. The first car we plan to develop is a hydrogen fuel cell car which uses a manometer-type stopping mechanism. The second car we plan to develop is a pressure based car powered by the catalyzed degradation of hydrogen peroxide.

Determining the effects of PEGylation on therapeutic enzymes
Nikunja Kolluri / Chemical Engineering

Advisor(s): Todd Przybycien / Biomedical Engineering and Robert Tilton / Chemical Engineering
Rangos 1 & 2 / Sigma Xi Group 5 / 10:45

The goal of this project is to determine the effects of modifying therapeutic proteins through the addition of a polyethylene glycol chain, a process called PEGylation. PEGylation is a common modification that has been used to increase in vivo circulation time of therapeutic proteins. Our group has proposed that PEGylation may also improve sustained release of therapeutic proteins from specialized delivery depots by “protecting” the protein as it is released. This work aims to changes in protein secondary and tertiary structure due to PEGylation, which may ultimately indicate changes in protein function. Secondary structure is tested using circular dichroism and tertiary structure is detected using fluorescence spectra. The methods and results from this study can also be extended to understand changes in proteins that have been released from microsphere delivery depots to determine if PEGylation improves sustained drug delivery.

Modeling of Planar Flow Casting Process for Efficiency in Synthesizing Magnetic Ribbon
Samuel Kernion / Materials Science Engineering & Edward Smongeski / Chemical Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

Planar flow casting (PFC) is a single stage process for producing thin metal ribbons. It is desirable to create such ribbons from magnetic materials with high magnetic fluxes for use in high efficiency energy conversion processes. Notable properties of the ribbon that affect its magnetic flux density

include ribbon thickness, solidification rate, and surface roughness. Research has been done into the relation of these variables with the process variables of PFC. This project seeks organize these relations using MATLAB® to create a simple system that can accurately predict the properties of the ribbon based on given input variables. Upon completion of the modeling files, a series of ribbons will be synthesized on a PFC, and their properties will be compared to the output of the MATLAB® files.

Optimal production of biodiesel from the transesterification of algal oil using bioethanol
Kristen Severson / Chemical Engineering
Advisor(s): Ignacio Grossman / Mechanical Engineering and Martin Mariano / Chemical Engineering
Rangos 1 & 2 / Sigma Xi Group 6 / 12:00

This work studies the production of biodiesel from algal oil using ethanol. Four different transesterification technologies are evaluated: alkali, acid and heterogeneous catalysts and non-catalyzed under supercritical conditions. A superstructure is proposed involving the four alternatives. The problem is formulated as an MINLP to select on the best technology using the modeling language GAMS. Each technology is simultaneously optimized and heat integrated to determine the best operating conditions. A detailed economic evaluation is also performed. Finally water consumption is calculated using mathematical programming techniques so as to recycle and reuse the water streams involved in the process. The results show that the most economical process is the alkali catalyzed, which has a production cost of $0.65 per gallon of diesel. This process was found to consume 2.7 MJ of energy and 0.48 gallons of water per gallon of biodiesel produced, both lower than the values reported in the literature that represent the current industry standards.

Optimizing the Flexibility of a Chemical Plant Subject to Random Failures and Planned Maintenances
Richard Pattison / Chemical Engineering
Advisor(s): Ignacio Grossman / Mechanical Engineering
Rangos 3 / 12-2:30

Chemical plants often require maintenance in different process units in order to function optimally throughout their lifetime. Due to certain functionality issues, these units are also subject to random failures that result in downtime of the unit. Both planned maintenances and random failures reduce the plant's ability to provide the necessary amount of product demand. In order to increase the flexibility of the plant, an optimal choice of parallel units and intermediate storage tanks are selected from a superstructure which lists all possible choices. Markov chains are used for modeling the mass balances within the intermediate storage tanks. To model the planned maintenances, two different methods are used. The first method models the planned maintenances as pseudo-random failures. The second method uses a two-step optimization process to optimize the design. First, the optimal planned maintenance schedule and plant design are selected, then the optimal way of running the plant is selected in order to allow the storage tanks to refill themselves between maintenances. It has not yet been determined which method is superior.

Polymer encapsulated nanoscale zero-valent iron for ground water decontamination
Laura McKee / Chemical Engineering
Advisor(s): Robert Tilton / Chemical Engineering
Rangos 3 / 12-2:30

Polymer-encapsulated zero-valent iron nanoparticles have been identified as a viable solution to groundwater contamination. The reaction of zero valent iron nanoparticles can effectively degrade many chlorinated contaminants in groundwater. Additionally, the iron nanoparticles facilitate the release of hydrogen, which is the preferred electron donor of several de-chlorinating bacteria. Sustained release of hydrogen, which is measured using a thermal conductivity cell, encourages the growth of these bacteria. The research question for this project is if I can develop a sustained release microsphere system to deliver hydrogen to the subsurface to sustain de-chlorinating bacteria.

Protein Transport through Nanostructured Block Copolymer Hydrogels
Brandon Chock / Chemical Engineering

Advisor(s): LynnWalker / Chemical Engineering
Kirr Commons / 1st Floor, Window side / 3-5

To properly handle and transport protein-based pharmaceutical drugs remains a real challenge, especially with the need for safe and reliable medicine. Pluronics are a class of PEO-PPO-PEO triblock copolymers which are being investigated as a potential protein storage medium. While it has been demonstrated that block copolymer can template globular proteins in the interstitial spaces of the nanoscale structure, the extent of protein transport through this system has not been studied. Work has been done to better characterize the system by tracking protein diffusion using Fluorescence Recovery after Photobleaching (FRAP). For these experiments, FRAP was used on composite Pluronic-protein systems with varying concentrations of block copolymer, to determine how protein moves through increasingly concentrated Pluronic systems. A fluorescently tagged globular protein, Bovine serum albumin (BSA), is the target of this work. Results from this study show that higher concentrations of block copolymer inhibit protein diffusion, which suggest conceivable applications in preventing aggregation and denaturation of protein-based medicine.

Rheology of Pickering Emulsions and Colloidosome Synthesis
Alexander Yoshikawa / Chemical Engineering

Advisor(s): Robert Tilton / Chemical Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

An emulsion is mixture of two or more immiscible fluids where one of the fluids is evenly dispersed throughout the other. An example of an oil in water emulsion is provided when an oil based salad dressing is initially shaken up. Rheology is the study of the flow of matter. Rheological properties describe how the fluid interacts with itself and can provide vital information regarding the intermolecular interactions and organization of complex fluids. I will be continuing my work with Professor Tilton's research team by measuring various rheological properties of oil in water emulsions that have been stabilized by highly charged polyelectrolyte-grafted silica nanoparticles. In order to create the particles used in this experiment, poly(2-(dimethylamino)ethyl methacrylate) or PDMAEMA polymers were grafted to a Silica core in order to create Si-PDMAEMA particles. PDMAEMA polymers are cationic polymers due to tertiary amine groups and are therefore very sensitive to changes in pH and ionic strength. By creating emulsions with these particles at various temperatures, pH's, ionic strengths, and nanoparticle types and then measuring the relationship between viscosity and shear rate as well as the elastic and viscous moduli, we will continue to discover the rheological effects of changing certain parameters as well as specific details regarding

the packing of the Si-PDMAEMA nanoparticles at the oil/water interface . This information could lead to a greater understanding of complex emulsion systems as well as the development of improved emulsifiers. The development of new thermally responsive emulsifiers such as Si-PDMAEMA particles could lead to the creation of new drug delivery devices, improved fuel mixtures, and improved medical, cosmetic and even machining lubricant products.

Saponin as a Naturally Derived Surfactant
Greta Michalczuk / Chemical Engineering

Advisor(s): Robert Tilton / Chemical Engineering
Rangos 3 / 12-2:30

The purpose of this project was to examine potential natural or otherwise renewable substitutes for the petroleum derived surfactants that are commonly used. Often surfactants are complexed with soluble polymers to control their performance in applications such as solubilization, detergency or wetting processes. The occurrence of complexation can be revealed by the surface tension of the mixture, in which case the apparent critical micelle concentration is decreased. The natural surfactant saponin was mixed with the water soluble, plant-derived polymer carboxymethyl cellulose and the surface tension was measured to determine if complexation occurs. The critical micelle concentration of combinations of the polymer with the saponin was found to be no different from that of the saponin solution alone, suggesting that no complexation occurred. The effects of combining saponin with a traditional, petroleum derived polymer are also examined.

Separation of Chiral Molecules Using Nanoparticles
Nathaniel Ondeck / Chemical Engineering

Advisor(s): Nisha Shukla / Physics
Hoch Commons / 2nd Floor, Rangos side / 3-5

Dr. Shukla's research group is examining a new method for separation of chiral molecules. Finding a better technique for separation of chiral molecules is very important to the pharmaceutical industry, among others. The technique being explored involves creating chiral nanoparticles that will attach to one enantiomer of the chiral molecule, allowing differentiation and separation of the enantiomers. Wet chemical synthesis and the use of pressure cells will be used to synthesize the nanoparticles. The enantiomer separation will take place in solution. This method is a fast and inexpensive alternative to current methods of enantiomer separations. The long-term vision of the proposed work is to lay the foundation for the preparation of highly selective and stable chiral nanoparticles and for a better understanding of how novel synthesis methods for nanoparticles can be used to tailor activity and selectivity.

Shape and Size Controlled Synthesis of Nanoparticulate Catalysts
Abigail Ondeck / Chemical Engineering

Advisor(s): Nisha Shukla / Physics
Kirr Commons / 1st Floor, Window side / 3-5

The main purpose of this research experiment is to determine the exact processes for creating metal nanoparticulate catalysts with certain shapes and sizes. When created and used, they are very

important due to their beneficial effects on preserving the environment. Today, nanoparticles can be synthesized but their use is very limited due to the inability to produce batch processes all with similar shapes and sizes. The long term goal of this research project is to make stable nanoparticles with a procedure that will produce a certain size and shape nanoparticulate catalyst. Another goal is to also gain a deeper understanding of different methods of creating nanoparticulate catalysts with a specific shape and size and their effects and when each method is more appropriate.

Synthesis and Characterization of Biodegradable Polymers
Sharanya Venkat / Chemical Engineering

Advisor(s): Christopher Bettinger / Materials Science Engineering
Kirr Commons / 1st 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. SUPPORTING MATERIALS.

Synthesis of Sub-Nanometer Sized Metallic Nanoparticles
Ryan Kissell / Chemical Engineering

Advisor(s): Nisha Shukla / Physics
Wean Commons / 1st Floor, Connan side / 12-2:30

Controlled chemical synthesis of metallic nanoparticles (NPs) has enabled the synthesis of catalytic materials with highly controlled selectivity, thermal stability and improved contaminant tolerance. As the sizes of such NPs are decreased, they begin to have new, non-metallic properties that provide new opportunities for improvement and control of catalyst function. Control of size and composition in the sub-nanometer range will access a catalyst particle size range that has not yet been fully explored and offers the opportunity to identify undocumented catalyst activities and selectivities and new frontiers in catalytic nanoparticle science.

ZnO Functional Layers for Chemiresistive Sensors
Sojung (Lindsey) Lee / Chemical Engineering

Advisor(s): James Miller / Chemical Engineering
Kirr Commons / 1st Floor, Window side / 3-5

Chemisorption or reaction of target molecules on the surface of a semiconductor (i.e., ZnO) cause a change in the resistance of the semiconductor. This phenomenon can be used to quantify the concentration of a target gas in ambient air. Sensor performance (selectivity and sensitivity) can be controlled through the chemistry and microstructure of the semiconductor layer.

CIVIL AND ENVIRONMENTAL ENGINEERING

A Case Study of Gustav Lindenthal's Smithfield Street Bridge in Pittsburgh
Jessica Guerrero / Civil and Environmental Engineering, Emilia Howard / Civil and Environmental Engineering, Adrian Lopez / Civil and Environmental Engineering, Hermona Tamrat / Civil and Environmental Engineering, Amy Zhang / Civil and Environmental Engineering

Advisor(s): Sarah Christian/ Civil and Environmental Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

Significant historic structures are those that have had a profound impact on their society's culture and history. The Smithfield Steel Bridge is one such structure, deemed a National Historic Civil Engineering Landmark by the American Society of Civil Engineers. An analysis of multiple aspects of the Smithfield Street Bridge was conducted, concentrating on its design, its designer, and its influence on other structural designs. This case study is the first segment of a broader research project into the history of structural engineering and significant structures of Pittsburgh. Along with the structural analysis, a PASCO bridge is included to model the results of the structural analysis on a smaller scale. The case study developed will be integrated in a CEE class at Carnegie Mellon, either the CEE introductory course or a course on historic structures.

A Feasibility Study of Bio-Gas Digesters and Composting Systems at Carnegie Mellon University
Jule Carr / Civil and Environmental Engineering, Cynthia Clement / Mathematics, Carineh Ghafafian /Materials Science Engineering, Elissa Goldner / Civil and Environmental Engineering, Mahaesh Jayaraman / Chemical Engineering, Lane Kurkjian / Civil and Environmental Engineering, Anna Lenhart / Civil and Environmental Engineering, Kaiyang Liew / Mechanical Engineering, Agnieszka Marszalik / Civil and Environmental Engineering, Tejank Shah / Materials Science Engineering, Lauren Sittler / Chemical Engineering

Advisor(s): Paulina Jaramillo / Engineering and Public Policy
Rangos 1 & 2 / Sigma Xi Group 5 / 11:45

Our research examines the feasibility of building and operating a biogas digestion unit for Carnegie Mellon as a way to compost organic waste, offset energy use, and output a nutrient rich byproduct that could be used or sold as fertilizer. We analyze 3 potential alternatives, including a BioTHELYS digester at the Bellfield Boiler plant, a black water unit installed in a new campus building and an in-vessel compost system located in the University Center.

We consider the collection of organic waste, the installation, operation and maintenance of the digester, and the uses for the final products. Our research was conducted based on interviews with Carnegie Mellon faculty and Housing and Dining Services staff, literary sources, and case-studies of other universities where biogas digesters are already in use. The study includes models that can be used to determine if each digestion unit method would be feasible, but also beneficial to our campus by examining the net monetary cost and payoff, the potential energy production, and the nutrient composition of the slurry output.

An Assessment of 33% RPS in California and Projection of its position and CO2 Emissions from the Electricity Sector in 2020

Ya Qi Niu / Economics & Karen Yu / Civil and Environmental Engineering
Advisor(s): Ines Azevedo / Engineering and Public Policy
Wean Commons / 1st Floor, Connan side / 3-5

The CPUC and the California Energy Commission are responsible for implementing the state's Renewables Portfolio Standard Program. They have established a 33% renewable goal to help California meet its climate change targets established in AB 32, which requires that California's statewide GHG emissions to be reduced to the 1990 level by 2020 (a reduction of about 25%). The objective of our research is to determine the feasibility for California to achieve the aims of AB 32. In addition, we aim to extrapolate, given current data of carbon dioxide emissions, the extent of emission reductions in 2020 and to predict if the quota of 33% RPS could be attained from current policies and effort by the Californian legislation.

Analysis of the Thermal Performance of Green Roofs

Dyanna Becker / Civil and Environmental Engineering & Daisy Wang / Civil and Environmental Engineering
Advisor(s): David Dzombak / Civil and Environmental Engineering
Rangos 3 / 12-2:30

Green roofs have been found to reduce heating and cooling loads in buildings. This is due to the insulating quality of the soil and plants, evaporative cooling from the soil, and evapotranspiration from the plans. This project aims to quantify this reduction from the green roofs on Hammerschalg Hall and the Allegheny County Office Building. Our research is one part of a long-term research project and focuses specifically on the insulation that the soil provides.

Effect of Silver Nanoparticles on Bacterial Populations

Karen Yu / Civil and Environmental Engineering
Advisor(s): Greg Lowry / Civil and Environmental Engineering
Rangos 1 & 2 / Sigma Xi Group 5 / 10:15

Engineered silver nanoparticles released into the environment from commercial products will interact with bacterial populations in soil and water. Silver nanoparticles are currently being used in a variety of commercial applications, but little is known about their interactions in the natural environment during their lifecycle. This project examines the effects of the addition of engineered silver nanoparticles on bacterial populations over time within controlled environments, known as mesocosms. The bacteria are those naturally occurring in wetland soil and water, and the project also examines the effects of different environments (e.g., different ratios of soil and water, anaerobic

vs. aerobic, sunlit vs. dark) on the interactions between the silver particles and bacteria. Gum Arabic and PVP coated silver nanoparticles are compared against silver ions and blank samples. Both forms of nanoparticles inhibited bacterial growth, but less than the silver ions did. Bacterial growth was inhibited the most in water environments and the least in terrestrial environments, which could be due to increased transport in water environments. Sunlit environments did not have significantly different populations from dark environments. Changes in population numbers as well as bacterial species will be determined. This project is a part of a larger project at CMU to study the effects of silver nanoparticles on soil, water, and microorganisms in different environments, which in turn supports larger scale mesocosm experiments being conducted by the Center for Environmental Implications of Nanotechnology (CEINT) and housed at Duke University.

Estimating the Ecological Integrity of a Stream from a Water Quality Perspective: Using Dunkard Creek as a Case Study
John Sourbeer / Civil and Environmental Engineering
Advisor(s): Jeanne VanBriesen / Civil and Environmental Engineering
Rangos 3 / 12-2:30

Dunkard Creek located in southwestern Pennsylvania and northern West Virginia experienced a fishkill in September 2009 where many fish and mussel species were destroyed. This fishkill is believed to be the result of highly saline water and a golden algal bloom. Dunkard Creek has a history of experiencing degraded water quality and reduced ecological integrity primarily the result of acid mine drainage (AMD). There are also several natural gas drilling locations and various farming practices within the watershed. The Dunkard Creek Watershed will be used to analyze several different water quality parameters such as pH, dissolved oxygen, and sulfate around the time period of the fishkill. This data may help to better explain why this algal species bloomed and why many native species could not survive.

FENCR Material Coating
Zachary McCabe / Civil and Environmental Engineering & Michael Shedlosky / Civil and Environmental Engineering
Advisor(s): Larry Cartwright / Civil and Environmental Engineering
Rangos 3 / 12-2:30

FENCR is a material coating that improves various material and dynamic characteristics in metals, most notably the longevity and coefficient of friction of the specimen. Through this research, the usability of the material coating in bridge construction, especially in suspension bridges, will be determined. Under the advisement of Professor Cartwright, Professor Garrett and Jim Downie, the owner of FENCR, tests will be performed to compare the corrosion resistance, coefficient of friction and ultimate tensile strength of a uncoated wire rope to that of a FENCR coated wire rope. The results of the research will be presented at the Meeting of the Minds, an undergraduate research symposium.

Infants' Detection of Recurrent Evolutionary Threats
Dasha Adamchik / Biological Sciences & Jennifer Frazier / Civil and Environmental Engineering

Advisor(s): David Rakison / Psychology
Wean Commons / 1st Floor, Connan side / 12-2:30

In a recent study, (Rakison & Derringer, 2008) found evidence that infants possess an evolved spider detection mechanism that may have aided in our early ancestors' ability to learn about and avoid these predators to ensure survival. We are continuing this research to determine if 5-month-old infants have a detection mechanism for rats. We expect to find a detection mechanism for rats because they (along with spiders) are a top phobia among adults, and they have been present throughout the evolution of humans. To determine if infants have such a mechanism, we showed infants a schematic rat, a partially scrambled rat, and a fully scrambled rat. If infants do have a detection mechanism for rats, then they will look longest at the schematic rat than the other two images. This interest in potential threats would allow them to make a connection between that threat and the emotional response of an adult. This connection could potentially lead to the child fearing that threat, and therefore help them to be safe in a future encounter. The findings will aid in the understanding of developmental, cognitive, and evolutionary psychology.

Parametric Study of Soil-Structure Interaction Effects
Peter Trocha / Civil and Environmental Engineering

Advisor(s): Jacobo Bielak / Civil and Environmental Engineering & Ricardo Taborda Rios / Unknown
Rangos 3 / 12-2:30

I performed a parametric study of soil-structure coupling under seismic loading in urban areas. To do this, I conducted computational simulations using the Hercules octree-based finite element seismic simulation software developed by the CMU quake group. From these simulations, I analyzed acceleration, velocity, and displacement data while varying parameters such as structure dimensions, material properties, structure orientation, seismic source function, and source position. A better understanding of soil structure interaction effects may allow for the creation of more robust building codes and the development of new active and passive vibration control techniques.

Parametric Study of Soil-Structure Interaction Effects
Peter Trocha / Civil and Environmental Engineering

Advisor(s): Jacobo Bielak / Civil and Environmental Engineering & Ricardo Taborda Rios / Unknown
Rangos 3 / 12-2:30

I performed a parametric study of soil-structure coupling under seismic loading in urban areas. To do this, I conducted computational simulations using the Hercules octree-based finite element seismic simulation software developed by the CMU quake group. From these simulations, I analyzed acceleration, velocity, and displacement data while varying parameters such as structure dimensions, material properties, structure orientation, seismic source function, and source position. A better understanding of soil structure interaction effects may allow for the creation of more robust building codes and the development of new active and passive vibration control techniques.

Sheared Suspensions near Random Close Packing
Peter Trocha / Civil and Environmental Engineering

Advisor(s): Craig Maloney / Civil and Environmental Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

I performed particle-based computer simulations of dense suspensions in shear flow near the random close packing limit. To characterize the flowing state, I analyzed global quantities such as the shear stress and energy dissipation rate, the statistics of the motion of individual particles, and the spatial structure of the particle rearrangements. Despite their ubiquity in nature, dense suspensions are still poorly understood. A better understanding of the particle-scale mechanisms which govern stress buildup and relaxation at various densities and shearing rates will allow for formulating constitutive laws which may be used by process engineers to model flow at macroscopic length-scales.

Temperature and Stiffness Correction of SAW Devices for Wireless Strain Sensing
Nicola Carey / Civil and Environmental Engineering

Advisor(s):Irving Oppenheim / Civil and Environmental Engineering
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Surface acoustic wave (SAW) devices are solid-state components in which a wave propagates along the surface of a piezoelectric material. Changes in strain or temperature cause shifts in the acoustic wave speed and/or the path length, enabling SAW devices to act as sensors. We present experimental studies on lithium niobate SAW devices acting as passively-powered devices. Sensitivity, reproducibility, and linearity are excellent when measuring strain at constant temperature, but the devices are also sensitive to temperature changes. We show experimental results of strain measurement incorporating temperature compensation.

The Attraction of Forms // an Attraction to Form
Charles Alexander / Civil and Environmental Engineering & Lara Mann / Art

Advisor(s):Patricia Bellan-Gillen / Art
Connan / 3-5

We are Charles Alexander and Lara Mann; a civil engineer and an artist, respectively. We would like to make an installation containing a collection of sculptures made from small spherical magnets and a three-dimensional representation of the patterns created by said magnets. Research will be done to find the best ways of arranging magnets into structural members for vertical, cantilevered, hanging and bridge-like constructions. A two-dimensional and three-dimensional art installation will be made in reaction to the patterns discovered in the research of the magnets.

The Wattcher: A Crowd-Sourcing Application for Energy Management
Timothy Pianka / Civil and Environmental Engineering & Shane Rife / Civil and Environmental Engineering

Advisor(s): Mario Berges / Civil and Environmental Engineering
Wean Commons / 1st Floor, Connan side / 12-2:30

The Wattcher is a web application to promote and aid in a crowd-sourced approach to the energy management of buildings. The objectives of the project were to develop the Wattcher website application through Sensor Andrew using CakePHP and develop a prototype to demonstrate the effectiveness of the application. Sensor Andrew is a large-scale sensing middleware capable of providing uniform access to heterogenous sensing devices. In this particular application we leverage its ability to simplify access to energy sensors already installed in a facility. Commercial and residential buildings account for approximately 73% of all the electricity consumed in the United

States. The energy consumption in residential buildings rose approximately 20% since 1998 and will most likely continue to rise. Computing technology has opened various opportunities available to help individuals and communities reduce their energy consumption through real-time feedback and control. However, the energy management systems of today are highly centralized (i.e., monitoring and control operations are done by a select group of individuals), and typically do not engage the building occupants in meaningful ways. In this project, real-time measurements of electricity use are leveraged in combination with self-reported actions from the users to assess and reward energy-saving behavior. For instance, users are able to report when they turn off projectors that were left on after class, and be rewarded if the Wattcher is able to verify this reported action.

Use of Time and Space Averaging to Model One-Dimensional Strain
Michael Panzitta / Civil and Environmental Engineering
Advisor(s): Kaushik Dayal / Civil and Environmental Engineering
Rangos 3 / 12-2:30

This project analyzes the application of coarse-graining techniques to model the strain of a one-dimensional bar. The bar is modeled as a system of ordinary differential equations which are then coarse-grained using time and space averaging. The results of this coarse-grained model will be compared to the fine-grained model. It is hoped that techniques such as these can be used in engineering modeling.

ELECTRICAL & COMPUTER ENGINEERING

A Calibration Platform for Achieving Sensor Accuracy in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science
Advisor(s): George Kantor / Robotics Institute
Hoch Commons / 2nd Floor, Rangos side / 3-5

The Colony project researches cooperative problem solving using a flexible, low-cost swarm of robots. Currently, the largest hurdle to making new behaviors is the quality of our sensor data. Unreliable sensors hinder development and limit the complexity of possible behaviors. For this research, we built an automatic testing and calibration platform to measure sensor output. We then used this data to adapt existing software to mitigate hardware problems. The new system tested all sensors: the Bearing and Orientation Module, infrared rangefinders, wheel encoders, and line-detection sensors. With the output of each sensor standardized, we gained the accuracy of higher-end sensors without the increased cost.

Accuracy of Pittsburgh Bus Timetables Used by CMU Students
Matthew Belenky / Economics, Timothy Higgins / Economicsm, John Sperger / Social & Decision Sciences, Chao Wang / Electrical & Computer Engineering, Tian Wu / Business Administration
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

Many students and Professors at Carnegie Mellon rely on the public transit system to get to work, however students frequently complain about the PAT bus system. The most common complaints are late buses, inaccurate schedules, and the frustration that occurs after waiting for a bus only to have multiple buses of the same route arrive at the same time1. Waiting wastes time, causes frustration, and in the long run could lead commuters to choose to find a way to travel that doesn't involve public transportation. To aim of this study is to first measure the degree to which these complaints are accurate, and if buses are systematically late develop a model for predicting expected arrival time. This study will be build on a strong general literature base on public transportation and investigate the accuracy of bus time tables for the Forbes and Morewood intersection which is the most commonly used bus stop for commuters at Carnegie Mellon University. Bus departure times will be observed and compared to posted bus schedules. A number of potential factors that influence bus punctuality will also be measured including the weather, the time of day, and the level of light. Using these factors and the information collected on bus arrival times, a model will be created to predict when a bus will arrive given the scheduled arrival time.

Achieving Extreme Processor Performance Using Unconventional Cooling
Joel Feinstein / Electrical & Computer Engineering
Advisor(s): Kenneth Mai / Electrical & Computer Engineering
Rangos 1 & 2 / Sigma Xi Group 6 / 11:00

This project investigates the impact of temperature on commercial microprocessor clock frequency with the goal of helping to understand how low temperature operation could be used in future high-performance integrated circuits. We will use various cooling methods (heatsink/fan, liquid cooling, phase change cooling) to regulate the temperature of a commercial microprocessor and test the maximum stable operating frequency of the part.

An Assessment on Current Methodology for Teaching Japanese
Rentaro Matsukata / Electrical & Computer Engineering
Advisor(s): Thomas Werner / Philosophy
Rangos 1 & 2 / Sigma Xi Group 8 / 10:30

When learned as a second language, native-like Japanese pronunciation is said to be impossible to acquire. The reason lies in the fact that Japanese, in comparison to many other languages, lacks characteristics such as variety in consonants. Consequently, in order to maintain its lexical capacity, the Japanese language has many tonal characteristics. These tonal characteristics are unlike those of Chinese; in fact, they are among the components that make Japanese unique from other modern languages and more difficult to learn. This project is the first step towards creating a Japanese language curriculum to allow the acquisition of natural pronunciation. It will reveal the current state of language teaching methodology and assess its strengths and weaknesses.

Center-out Decoding Using an Emotiv EEG Headset
Andrew Noh / Electrical & Computer Engineering & Amber Xu / Electrical & Computer Engineering
Advisor(s): Tai-Sing Lee / Computer Science
Rangos 1 & 2 / Sigma Xi Group 6 / 11:15

Studies have shown that non-invasive measurement of electroencephalogram (EEG) signals can be used to distinguish movement direction of the hand and thus could be used in a Brain Computer Interface (BCI) system. Typical EEG systems used in research are expensive, high maintenance and unsuitable for general use. The Emotiv EPOC is a consumer targeted EEG recording device that trades data resolution for portability and ease of use. Preliminary off-line classification tasks showed that information is available in the EEG signals for above chance classification of a person's motor intention in controlling their legs and arms. In this study, we examine the effectiveness of an Emotiv headset in more refined directional decoding to determine the potential of using the Emotiv system in BCI applications. EEG data was recorded using the Emotiv headset while participants performed a center-out movement task.

CMUcam4: Open Source Programmable Embedded Color Vision Platform
Kwabena Agyeman / Electrical & Computer Engineering
Advisor(s): Anthony Rowe / Electrical & Computer Engineering
Wean Commons / 1st Floor, Connan side / 12-2:30

The goal of the CMUcam project is to provide simple vision capabilities to small embedded systems in the form of an intelligent sensor. The CMUcam4 extends upon this idea by providing a flexible and easy to use open source development environment that complements a very low cost hardware platform.

Design of a Modular Data Acquisition and Processing System
Rentaro Matsukata / Electrical & Computer Engineering, Christopher Palmer / Electrical & Computer Engineering, Robert Wedler / Electrical & Computer Engineering
Advisor(s): Susan Finger / Civil and Environmental Engineering
Hoch Commons / 2nd Floor, Rangos side / 3-5

The acquisition and processing of data from sensors in many different physical locations is applicable in the design of electromechanical systems. Typical data acquisition systems do not have the ability to measure high precision sensors that are not centrally located. A modular system for acquiring data digitally has the benefit of enhanced precision and an increased number of sensors that can be sampled. For a digital system to be effective the proper schematics, components and design must be researched. Additionally, the proposed researchinvolves the programming of microcontroller and FPGA components. These components used in conjunction with each other will allow the system to concurrently receive and collect data from many sensors. The data from these sensors will then be displayed to the user with and LCD screen and stored for later retrieval using an SD memory card. Once the system has been prototyped and tested, circuit boards will be printed and large scale verification of the system will take place.

Designing a Kicking Behavior for the NAO Robots
Wesley Myers / Electrical & Computer Engineering
Advisor(s): Manuela Veloso / Computer Science
Wright / 12-2:30

The Carnegie Mellon United Robots for Soccer (CMurfs) team's goal is to win the International RoboCup competition in Istanbul, Turkey. We developed new kicks that are both faster, more stable, and accurate. One of the things that is important is being able to walk up to the ball and choose a kick that will get the ball to the desired location without having the robot orbit around the ball. Also, a situation that is often run into is the need to clear the ball when two robots are fighting for the ball. To satisfy these needs, various sidekicks and backwards kicks were developed. The backwards kicks fulfill both needs in that we now have the ability to send the ball backwards. This is completely new for the team. With those kicks, we can send the ball as short as half a meter behind the robot or to as far as two meters. The team already has a sidekick, however the foot reaches out far to achieve a larger area for contact with the ball. This could not be used in a confined scenario. To solve this, a stable sidekick was made to help the robot clear out the ball sideways. To further the aggressive intelligence of the robots, a new behavior was developed to kick the ball. This involves the robot being able to quickly locate and go to the ball with as little wasted motion as possible. Lining up for the kick was also made more efficient so that little time is wasted. The key to success in robot soccer is doing everything as fast as possible. Being able to locate the ball, move to the ball, and kick the ball as fast as possible gives the team a great advantage. As a result, we created a faster, more intelligent robot to play soccer.

Designing an Attacker Behavior for the NAO Robots
Wesley Myers / Electrical & Computer Engineering & Ryan Oksenhorn / Computer Science
Advisor(s): Manuela Veloso / Computer Science
Hoch Commons / 2nd Floor, Window side / 12-2:30

The Carnegie Mellon United Robots for Soccer (CMurfs) team's goal is to win the International RoboCup competition in Istanbul, Turkey. This year's addition of a fourth robot creates new flexibility in game strategy, differentiating attacker and defender roles. This challenge required new behaviors to be implemented. New kicks that are both faster and smarter were developed to account for more robots crowding the field. These include forward kicks in half a second, side kicks optimized for tight conditions, and backward kicks to clear the ball. A smart kicking behavior dynamically chooses which kick to use based on both the ball's current and intended positions. To further the aggressive intelligence of the robots, an efficient algorithm was developed for predicting where the ball would go after a kick. Even when we do not know where the ball is, a new algorithm was developed for finding the ball faster. As a result, we created a faster, more intelligent robot to play soccer.

Elastomer Degradation Modeling
Apoorv Khandelwal / Electrical & Computer Engineering
Advisor(s): Christopher Bettinger / Materials Science Engineering
Peter / 4:20

Abstract: Biodegradable polymers have significant potential in biotechnology and bioengineering. A strong, biodegradable, and biocompatible elastomer could be useful in fields such as tissue engineering, drug delivery, and in vivo sensing. I have modeled a tough biodegradable polymer from biocompatible monomers and tried to replicate the experimental polymer's properties using computer software. Utilizing Monte Carlo methods, I have created virtual models of the elastomer that are consistent with experimental data such as the material's cross-linking density, average molecular weight between crosslinks, and mass. I seek to develop a more realistic, multi-scale model of the material as well as a probabilistic explanation of the material degradation. Thus, I will

obtain significant theoretical information about these materials through 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.

Ergobuddy
Mian Luo / Electrical & Computer Engineering
Advisor(s): Dan Siewiorek / Human Computer Interaction Inst. & Asim Smailagic / Electrical & Computer Engineering
Rangos 3 / 12-2:30

Ergobuddy project builds a tool that supports the training of activity recognition systems by non-technical users. This system allows the user to collect data, add that data to a new or existing database, and retrain the model based on the self-annotated data. The supported devices are Motorola MC9500's and eWatches. The MC9500 collects local data and aggregates all data from supporting sensors and transfers them to the database on the PC. The PC side program supports the training of an activity recognition model based on any subset of database data whereas the mobile device supports various output applications like auditory or visual interventions based on the context of the device.

Error Analysis Supporting Logic in Memory Implementation of Polar Format Algorithm for Synthetic Aperture Radar
Eric Turner / Electrical & Computer Engineering
Advisor(s): Franz Franchetti / Electrical & Computer Engineering
Rangos 3 / 12-2:30

In implementations of Synthetic Aperture Radar, traditionally the most computationally intensive calculation is the Polar Format Algorithm, which interpolates the frequency response of a target into a rectangular sampling pattern. We propose to use novel advances in logic-in-memory to replace traditional interpolation algorithms. While this approach uses less complex interpolation techniques, it has been shown that the resultant error from such an approach is indistinguishable from the error generated by current industry algorithms.

Exploration and Mapping of Unstructured Environments using an Autonomous Quadrotor
Jeffrey Cooper / Computer Science, Jitu Das / Computer Science, Priyanka Deo / Computer Science, Daniel Jacobs / Electrical & Computer Engineering, Michael Ornstein / Mechanical Engineering, Harrison Rose / Biomedical Engineering, James Wahawisan / Electrical & Computer Engineering, Alexander Zirbel / Computer Science

Advisor(s): Sanjiv Singh / Robotics Institute
Peter / 1:40

Robots are an increasingly common sight in all areas of daily life, and are increasingly useful to humans. As their capabilities expand, they are able to move from strictly controlled environments into an uncharted and potentially dangerous world, where they can accomplish tasks humans would rather avoid. Exploration of hazardous locations like collapsed buildings, mines, and other disaster areas is left largely to humans because few modern robots have the capabilities to reliably replace

human explorers. The quadrotor aerial platform provides an attractive solution to this problem: being extremely maneuverable, powerful enough to carry high-performance sensing equipment, and compact enough to fit through small gaps such as a broken window, a quadrotor can gather data about a location before humans or other robots enter it. Once this data is available and the terrain is mapped, robots and humans entering the environment can explore and travel much more efficiently. Applications for this information range from urban navigation to search and rescue maps that can help in quickly developing paths to areas of interest. This research team aims to tackle the problem of exploring and mapping unstructured environments using an autonomous quadrotor.

Graph Morphisms To Support Consistency Checking In Cyber Physical System Architectures
Rajeev Krithivasan / Electrical & Computer Engineering

Advisor(s): Bruce Krogh / Electrical & Computer Engineering
Rangos 3 / 12-2:30

This project aims to develop new tools for defining and analyzing the consistency of heterogeneous models developed in the process of designing and implementing complex cyber-physical systems. The diversity of models, which can range from physical component models, to block diagrams for control system design, to models for analyzing the correctness and performance of embedded software, makes it impossible to capture all of the important features of a cyber-physical system in a single modeling framework. Inconsistencies between these models can lead to design errors, which may have severe consequences in safety critical systems. Recently, a CPS architectural style was developed as a framework for creating and evaluating the relationships among these many modeling formalisms. Each model is considered to be a particular architectural view of the base architecture for a system. Within this framework, graph theoretic constructs are being used to define formal notions of consistency being the architectural views and the base architecture. The algorithm that has been developed analyzes structural consistency between architectures and reveals points of inconsistency to aid in system design. This is done using typed graph structures to represent the base architecture and different views and recognizing graph morphisms between them. This algorithm has been implemented as plug-in in the ACME Studio, an environment for implementing architectural design languages. The results of this research have been evaluated using a case study of the design of the STARMAC quadrotor.

GuitarBot
Philip Bailey / Electrical & Computer Engineering, Gerald Carlson / Mechanical Engineering, Daniel Curhan / Mechanical Engineering

Advisor(s): Roger Dannenberg / Computer Science
Wean Commons-1st Floor, Connan side / 3-5

We have received a SURG grant with which to build two GuitarBot prototypes. GuitarBot is a new project under the RobOrchestra umbrella that consists of multiple individual string modules that interact both with each other and with the rest of the RobOrchestra. There are two versions that we are going to create – a sliding fret version and an articulated arm version – and we will compare the performance of each, and replicate the better version to create the final GuitarBot assembly. There is a complex software aspect to the project as well, where the software will need to distribute the notes that the instrument is given across the various string modules that are connected together.

Lateral Tracking Electrothermal Actuator
Amal El-Ghazaly / Electrical & Computer Engineering

Advisor(s): Jim Bain / Electrical & Computer Engineering
Rangos 1 & 2/Sigma Xi Group 6 / 11:30

With the current areal densities of magnetic media in hard disk drives on the order of Tbit/in^2, disk drive heads need to be able to track at 50 nm. In the past, electrothermal deformation of solid structures has been used in hard disk drives for fly height control only. However, the resulting displacements of such deformations could be adequate to resolve nominal tracking fluctuations. Advantages to using eletrothermal actuation for tracking include its simple design, low cost, and durability. The lateral actuator will build on the design of the fly height control by increasing device stiffness for higher bandwidth. Two-dimensional simulation of the lateral actuator shows significant promise for the device. Experiments on a fabricated test structure are being done to validate the simulation results. Using this experimental and simulation data, a model can be developed to describe the frequency-dependence of the lateral displacement. This will allow for a clear picture of the amount of applied power necessary to produce desired lateral tracking, the range of possible displacements, and the resolution of the lateral actuator.

Low Energy Image Reconstruction with Magic Memory
Zhi Yang Lim / Electrical & Computer Engineering

Advisor(s): Franz Franchetti / Electrical & Computer Engineering
Rangos 1 & 2 / Sigma Xi Group 6 / 11:45

Image reconstruction is normally both a computational and memory heavy process. This project explores the use of magic memory to move logic into memory so as to reduce memory calls while still ensuring no significant drops in image quality. Such a technique can help potentially save energy in computation.

Low-Resolution Face Recognition using Coupled Locality Preserving Mappings
Pooya Khorrami / Electrical & Computer Engineering

Advisor(s): Vijayakumar Bhagavatula / Electrical & Computer Engineering
Rangos 3 / 12-2:30

In recent years, several facial recognition algorithms have been proposed that try to accomplish low-resolution facial recognition without having to enter the super-resolution realm. One such algorithm proposed by Li, Chang, Shan and Chen claims to be faster and more accurate than the S^2 R^2 algorithm developed at Carnegie Mellon.My task was to replicate and verify their findings, while introducing modifications to their approach and how it could lead to possible improvements.

Memory Scheduling for Multi-threaded Applications
Rachael Harding / Electrical & Computer Engineering

Advisor(s): Onur Mutlu / Electrical & Computer Engineering
Hoch Commons / 2nd Floor, Rangos side / 3-5

The thread-level parallelism in multi-threaded applications can easily take advantage of the hardware parallelism present in chip-multiprocessor (CMP) systems. Shared DRAM is one part of the system where multi-threaded applications take advantage of CMP's hardware parallelism.

However, while there are many memory scheduling algorithms that exist for single-threaded applications, there has been minimal investigation into algorithms that suit the needs of multi-threaded applications. We investigate imbalance in multi-threaded applications and propose memory scheduling algorithms based off our findings.

Modeling the Relationship Between the Subcellular Location Patterns of Co-observed Proteins
John Sexton / Electrical & Computer Engineering

Advisor(s): Robert Murphy / Biological Sciences
Rangos 3 / 12-2:30

The classification of a single protein from instances of its subcellular location pattern has been demonstrated previously. In this work, I explore the relationship between the subcellular location patterns of co-observed proteins with the goal of characterizing the joint nature with which the protein subcellular location patterns vary. I first demonstrate the feasibility of building a joint distribution over multiple proteins using a Markov chain Monte Carlo approach with a simplified protein subcellular location pattern model. I then construct a generative model of the vesicle distribution conditioned on the microtubule distribution and assess its performance as compared with alternative models.

Multi-Robot Interaction and Design
Philip Etling / Electrical & Computer Engineering

Advisor(s): Manuela Veloso / Computer Science
Kirr Commons / 1st Floor, Window side / 12-2:30

I worked with Manuela Veloso on her Coral Small Size Robotics team. I worked on designing a new defensive play for the team. I had to do two main things: 1. I had to design an evaluation system which would determine which robots are the biggest threat based on where the ball and the where the closest robot to the ball are located. 2. I had to use this evaluation system to positions two sets of robots. 1. Two are positioned between the closest robots and the biggest threats. 2. Two are used to help defend the goal.

Navigating Carnegie Mellon
Manish Burman / Electrical & Computer Engineering, Brian Devincentis / Mechanical Engineering, Brandon Kase / Electrical & Computer Engineering

Advisor(s): David Kosbie / Computer Science
Wean Commons / 1st Floor, Connan side / 3-5

The Navigating Carnegie Mellon (NCM) project is a set of navigational applications that allow members and guests of the Carnegie Mellon community to find the optimal route between any two locations on campus. Preferences allow users to modify the fastest route to walk more inside or outside and exclude stairs or elevators. Users also have the ability to search for a variety of places on campus including but not limited to room numbers, dining facilities, athletic facilities, faculty offices and restrooms. The calculated route is displayed over an interactive map taking advantage of Google Maps and blueprints. Our Android application provides mobility by giving users the ability to determine their path “on the go” while our web application gives the user the ability to print out the list of directions before hand. The applications are available on the Android Marketplace and on our website, www.ncmproject.org, which also has more information on the project.

Navigating Dynamic Traffic Environments in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Megan Dority / Mechanical Engineering, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Daniel Shope / Mechanical Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science

Advisor(s): George Kantor / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:30

The overarching goal of the Colony Project is to maintain a flexible yet inexpensive group of robots for researching emergent behavior and cooperative problem solving. With this research, the Colony Project emulated vehicular traffic in a city-like environment. The development of intelligent, networked cars is a growing field of interest in mobile robotics research, and we will show how we used our robots to study related algorithms and behaviors. Our goal is to enable the robots to autonomously navigate a dynamic environment and to handle interesting traffic objects and events such as lane changes, intersections, tollbooths, and obstacles in the road. This work is a continuation of previous Colony Project research, and it will serve as a foundation for future endeavors. We also hope to contribute to this rapidly growing area of robotics research.

Parameterizable On-Chip Communication Synthesis for Multi-Core Systems
Archa Jain / Electrical & Computer Engineering, Neereja Sundaresan / Electrical & Computer Engineering

Advisor(s): Diana Marculescu / Electrical & Computer Engineering
Rangos 1 & 2 / Sigma Xi Group 9 / 11:15

As multi-core systems are becoming more prevalent, it is clear that efficient and scalable routing of information between cores is necessary. This project seeks to develop a parameterizable on-chip router design methodology with plug and play functionality. The router implementation relies on an adaptive routing scheme and uses output buffers in four directions which allows for concurrency. The proposed design methodology is scalable, since it enables a systematic approach for large scale on-chip communication design. More precisely, we use Matlab's Simulink environment to create our router as it offers a high level of abstraction which is ideal for investigating various designs. Additionally, Simulink offers interactive simulation and testing capabilities which allows us to test different aspects of the design independently and rigorously, as well as an HDL coder which provides a translated version of our design in Verilog. On-chip network routers, such as the one we are designing, are intrinsically adaptable and scalable in nature, thereby opening a research area of high interest in both industry and academic settings. Our results show that, while there are many design considerations and challenges, the network on a chip communication style has the potential to significantly change the field of multi-core processing.

Power for Lunar Surface Systems
Nicholas Letwin / Electrical & Computer Engineering & Michael Tomovich / Electrical & Computer Engineering

Advisor(s):WilliamWhittaker / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:45

Efficient, reliable power systems are paramount for operations of lunar surface systems. The DC power system in Red Rover, designed at Carnegie Mellon for lunar exploration and winning the Google Lunar Xprize, was designed and built with this principle in mind. The system is required to extract the correct amount of power from the solar panels, charge the rover's batteries without damaging them, and convert that battery power into clean power for the rover's onboard electronics. In order to accomplish this, several different components work together to form a power system capable of making effective use of solar power and properly distributing that power throughout the rover.

Real Time Expression Recognition Using GPUs for Home Automation and Driver Awareness Applications
Si Ying Hu / Electrical & Computer Engineering

Advisor(s): Marios Savvides / Electrical & Computer Engineering
Rangos 3 / 12-2:30

The recognition of facial expressions has significant applications that can enhance the human interaction with different machines. For example, a system that can actively recognize facial expressions for sleepiness can be added as safety feature to cars that can alert drivers who fall asleep under the wheel. The detection of other expressions such as emotions like happiness, anger, or surprise can be a provided as a feedback to smart multimodal user interfaces to allow a much more natural human computer interaction. Creating such systems to work on real time presents a real challenge due to the computational costs. This project will leverage NVIDIA's CUDA programming on graphics cards that brings supercomputing to a personal level. This will handle the tasks of classification and training on Support Vector Machines of 4 basic expressions: happiness, anger, surprise and sleepiness.

RoboBuggy - Fully autonomous robotic buggy
Nathaniel Barshay / Computer Science & Alex Klarfeld / Electrical & Computer Engineering

Advisor(s): Mark Stehlik / Computer Science
Pake / 12:40

Autonomous driving is a problem at the cutting edge of robotics research, with the potential to save countless human lives. Current approaches utilize arrays of advanced sensors, including GPS, laser rangefinding, radar, and inertial navigation, as well as racks of computing power. We intent to build a robot to compete in a soap box derby style race on the streets around carnegie mellon univeristy, utilizing only low budget sensors and an small embedded computer. Our pursuit has clear commerical applications in cutting the cost of autonomous driving or driving assitance.

RobOrchestra Vibraphone Project
Jonathan Boerner / Mechanical Engineering, Andrew Burks / Mechanical Engineering, Katherine Coste / Materials Science Engineering , Jaywoo Kim / Mechanical Engineering, Michael Ornstein / Mechanical Engineering, Nicolas Paris / Electrical & Computer Engineering

Advisor(s): Roger Dannenberg / Computer Science
Kirr Commons / 1st Floor, Window side / 12-2:30

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, the group has been experiencing rapid growth in membership and productivity. Several new instruments have been added in the past two semesters, and numerous demos and gigs have taken place to showcase the research. At a time where the resources of the RobOrchestra group can no longer support the quantity of creative ideas worth trying, a special team of experienced members has designed a robot which is capable of playing the vibraphone. Using lessons learned from the construction of previous robots, including one that plays the xylophone, the group is confident that it can create a vibraphone playing robot that is indistinguishable from a human player in performance capability.

Survey of Carnegie Mellon Faculty Regarding Attendance Policy and Student Performance
Emily Boncek / Science and Humanities Scholars, Christopher Chang / Statistics, Kelly Chang / Electrical & Computer Engineering, Stephanie Sindler / Economics

Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 3-5

We are conducting a survey of members of the Carnegie Mellon faculty community in order to determine if there is a relationship between whether or not a class has mandatory attendance and students' performance in the class. This topic is interesting because there is a large disparity in the way classes are structured across various departments of the university, and thus it is possible for two students of different majors to have entirely opposite classroom experiences. This survey is interested in determining if requiring attendance has an effect on or can improve students' performance in classes. We are distributing a self-administered online survey to Carnegie Mellon faculty who taught undergraduate courses in the Fall 2010 semester. Data collected about each course includes department, class size, attendance policy information, and distribution of final grades. We will compare the distribution of final grades for attendance mandatory versus attendance optional courses to determine the effect of attendance policy on student performance. Although we are still in the data collection process, we expect to find that attendance mandatory courses will have better student performance. While we will definitely be able to make conclusions within academic departments, we also hope to generalize these comparisons within and across colleges.

SWANDRIVE - Smart Wireless Analysis Network for Driver Information and Vehicle Efficiency
Ilya Kelner / Electrical & Computer Engineering & Siddharth Nangia / Electrical & Computer Engineering

Advisor(s): Philip Koopman / Electrical & Computer Engineering
Kirr Commons / 1st Floor, Window side / 3-5

Our project is the creation and testing of a modular distributed wireless sensor network for cars, that is designed to be an enhancement for current automotive networks and capable of future expansion to embrace advances in technology. The goal is to be prepared for integration with any "smart highway" system in the future by simply installing a new modular piece into an existing architecture with minimal effort. Simultaneously, the network will allow for comprehensive analysis of the wealth of information that wired/wireless sensors placed around a vehicle provide, and providing an easy to understand yet powerfully informative "heads up display" that projects critical data and efficiency optimizing tips and strategies directly onto images of the road, in the form of traditional dashboard displays and a "dynamic driving line" with calculated acceleration, coasting, braking, and turning points. The net effect is to increase the efficiency of automobiles beyond the

.

simple miles-per-gallon metric by modifying individual driver behavior to turn their driving habits into more environmentally friendly and efficiency boosting actions, while laying a foundation for a system that could communicate with cars and thus effectively manage and shape traffic patterns to reduce the collective impact on the environment.

Systematic Testing of YFS
Theodore Martin / Electrical & Computer Engineering

Advisor(s): Garth Gibson / Computer Science
Wean Commons / 1st Floor, Connan side / 3-5

A common method for testing concurrent systems is stochastic testing, which repeatedly executes a test hoping that if there is an error, it eventually reveals itself. An alternative to stochastic testing is systematic testing, which executes the test in a special environment that guarantees that every time a test is executed a new behavior of the program is explored. The goal of this project is to apply dBug, an implementation of the systematic testing approach, to YFS, a distributed file system developed as part of the 15-440: Distributed Systems class. Instead of blindly running the tests several times in the hope that one will fail, dBug will guarantee each run to have a different ordering of coordination events. The contribution of using dBug for testing of YFS is two fold. Not only does it remove the uncertainty regarding the correctness of the students implementations by exploring all possible orderings, but it also provides a framework in which unique orderings are specifiable and repeatable, aiding in debugging of concurrent code.

Tap Detection and Localization in Claytronics Blinky Blocks
Eric Cheng / Electrical & Computer Engineering

Advisor(s): Seth Goldstein / Computer Science
Rangos 3 / 12-2:30

There are many challenges to achieving accurate sensing capabilities across distributed systems. This project investigates methods of overcoming some of these challenges on the Claytronics Blinky Blocks platform. Specifically, the ability to accurately detect and localize surface taps on individual modules within the ensemble is addressed.

Utilizing GPUs for benchmarking an autotuning system
Rachita Chandra / Electrical & Computer Engineering

Advisor(s): Franz Franchetti / Electrical & Computer Engineering
Rangos 1 & 2 / Sigma Xi Group 9 / 11:45

The goal of this project is to utilize NVIDIA GPUs (Graphics Processing Unit) and AMD APUs (Accelerated Processing Unit) in order to investigate the efficiency of an autotuning system for a random walk boolean satisfiability solver. The efficiency of the code generated by the autotuning system will be gauged by measuring the generated code on both the APU and GPU. Benchmarking in the research will focus on 2 areas: 1. Comparing GPU performance with APU performance 2. Comparing GPU performance with Intel multi-core processor performance.

Wi-Fi Triangulation Using RSSI
Jesse Salazar / Electrical & Computer Engineering & Rajeev Sharma / Electrical & Computer Engineering
Advisor(s): Ananda Gunawardena / Computer Science
Kirr Commons / 1st Floor, Window side / 3-5

We are proposing the development of a location system using 802.11 Wi-Fi to track the position of an embedded mobile device. The technology uses Received Signal Strength Indication (RSSI) values to find the distance of the device from various access points, each with a pre-determined location. RSSI information is accessible from within nearly any mobile development board with a WiFi interface attached, in this case specifically the Chumby 454 MHz Development Board, and is the only medium through which a two-dimensional coordinate can be produced. Obtaining this coordinate (within a pre-defined space) will require but simple calculations, and can thus be done in a repetitive manner without bulky computing power. Hence, the accuracy of the device position will be directly related to the analysis and application of RSSI information, which is the primary focus of this research.

MATERIALS SCIENCE ENGINEERING

A Feasibility Study of Bio-Gas Digesters and Composting Systems at Carnegie Mellon University
Jule Carr / Civil and Environmental Engineering, Cynthia Clement / Mathematics, Carineh Ghafafian / Materials Science Engineering, Elissa Goldner / Civil and Environmental Engineering, Mahaesh Jayaraman / Chemical Engineering, Lane Kurkjian / Civil and Environmental Engineering, Anna Lenhart / Civil and Environmental Engineering, Kaiyang Liew / Mechanical Engineering, Agnieszka Marszalik /Civil and Environmental Engineering, Tejank Shah / Materials Science Engineering, Lauren Sittler / Chemical Engineering
Advisor(s): Paulina Jaramillo / Engineering and Public Policy
Rangos 1 & 2 / Sigma Xi Group 5 / 11:45

Our research examines the feasibility of building and operating a biogas digestion unit for Carnegie Mellon as a way to compost organic waste, offset energy use, and output a nutrient rich byproduct that could be used or sold as fertilizer. We analyze 3 potential alternatives, including a BioTHELYS digester at the Bellfield Boiler plant, a black water unit installed in a new campus building and an in-vessel compost system located in the University Center. We consider the collection of organic waste, the installation, operation and maintenance of the digester, and the uses for the final products. Our research was conducted based on interviews with Carnegie Mellon faculty and Housing and Dining Services staff, literary sources, and case-studies of other universities where biogas digesters are already in use. The study includes models that can be used to determine if each digestion unit method would be feasible, but also beneficial to our campus by examining the net monetary cost and payoff, the potential energy production, and the nutrient composition of the slurry output.

A Study on Students' Change of Majors, What They Choose and Why.
Oliver Lam / Psychology, Michael Len / Computer Science, Go Okumura / Mechanical Engineering, DunyangWang / Materials Science Engineering, Wentian Zhu / Science and Humanities Scholars
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

Selecting a major is an important decision for an undergraduate. What a student chooses to study often determines their future career by providing them with a knowledge base that will enable them to succeed in that field. At Carnegie Mellon University (CMU), students are allowed to change majors as they wish in accordance to certain influences in their life, including but not limited to perceived academic success, future job prospects, personal interests, and social pressures. This study aims to determine the retention rates of each major at CMU, which majors are most popular to switch to, and the prevailing factors that influence a students decision to change or not to change their major. Our results lend insight to what CMU departments can do to affect the popularity and retention rates of their majors by identifying what influences an undergraduate's decision on changing majors the most.

Analysis of Miscibility of Silicone Dioxide nanoparticles in Poly(Methyl Methacrylate) and Styrene Acrylonitrile
Marco Dyer / Materials Science Engineering
Advisor(s): Satyajeet Ojha / Materials Science Engineering
Rangos 3 / 12-2:30

An analysis of nanoparticle miscibility in a nanoparticle composite is presented. Silicone Dioxide particles are fixed to varying levels of Poly(Methyl Methacrylate) and Styrene Acrylonitrile polymers. Nanoparticles are encapsulated within a Poly(Methyl Methacrylate) matrix. Structural as well as quantitative analysis is performed to interpret the resulting miscibility and interactions in the nanocomposite structures. Nanopoarticle creation utilizes atom transfer radical polymerization. Applications of nanocomposites in thin films and optics are discussed.

Carbon Nanotube Aerogel Based Conducting Polymer Composites
Itai Stein / Materials Science Engineering
Advisor(s): Mohammad Islam / Chemical Engineering
Rangos 1 & 2 / Sigma Xi Group 5 / 12:00

Conducting polymer composites could potentially revolutionize the emerging field of mobile electronics. However, the performance of current conducting polymer composites is limited by their low electrical conductivities and fragility, stemming from the phase segregation of the conducting fillers during the fabrication process. Carbon Nanotube (CNT) Aerogel, a three dimensional porous network of CNT, is a shape and size controllable material, which, when backfilled with a polymer, can yield a highly conductive polymer composite. The purpose of this project is to develop a fabrication process for a conductive polymer composite using CNT Aerogel, through polymer backfilling, while preserving the electrical properties of the underlying CNT network. The polymer selected for this project is Poly Methyl (methacrylate) (PMMA), due to its wide availability, low cost, and the thorough documentation of its properties in literature. The conducting CNT-polymer composite is evaluated by measuring and comparing the electrical conductivity and toughness of composite samples to those of both pristine PMMA and CNT Aerogel. Also, the degree of polymer

penetration into the CNT Aerogel network is examined through imaging using a Scanning Electron Microscope (SEM). Finally, the impact of the project results on the applications of CNT-PMMA composites is explored.

Cellular Response to 1D-2D Topographic Features on Adhesive Substrates
Youngeun Kim / Materials Science Engineering
Advisor(s): Yu-LiWang / Biomedical Engineering
Rangos 1 & 2 / Sigma Xi Group 7 / 10:15

Although cell movements have been studied for decades, many aspects remain unclear. This project specifically addresses the preference of migrating cells on 1D tracks versus 2D areas. I found that there is a strong preference for 2D areas. In addition, I have used pharmacological agents and genetically manipulated cells to determine the involvement of myosin II and focal adhesion kinase in cell's dimensionality preference.

Creating Polymer Grafts to CdSe Quantum Dots for Use in Light-Emitting and Photovoltaic Nanocomposites with Emphasis on Understanding the Polymer-Surface Morphology
Michael Schmitt / Materials Science Engineering
Advisor(s): Robert Davis / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 3-5

The United States currently imports $700 billion in oil, producing 25 billion tons of CO2 in order to help produce 1E17 watt-hours of energy on an annual basis. Only approximately 7% of our energy is derived from renewable sources, while solar generation accounts for a mere 1% of renewable generation. This leaves much room for increased adoption of solar technologies to help offset the major economic and environmental costs of current major energy sources. Additionally, the majority of residential power consumption is for lighting. Traditional incandescent bulbs are <5% efficient while compact fluorescent bulbs are still <20% efficient. Quantum dots (QDs) are as much as 90% efficient. In both cases, for photovoltaics and light emitting devices, QDs offer an alternative basis capable of drastically increased efficiencies over traditional devices. However, the efficiency of QD-based devices to date is very low (<1%). The primary reason for this is due to aggregation of QDs in their composite devices. Polymer grafts are a solution that will prevent QD aggregation and presumably facilitate much higher efficiency devices. A vital aspect of these grafts is understanding their interaction with the QD surface, something that due to recent advances can begin to be simulated computationally.

Effects of Fabrication Conditions on the Structure and Performance of TiO2 based Resistive Switching Data Storage Devices
Juan Infante / Materials Science Engineering
Advisor(s): Paul Salvador / Materials Science Engineering
Wean Commons / 1st Floor, Connan side / 3-5

Resistance switching has now widely been studied for heterostructures in which a functional layer, such as Titanium Dioxide (TiO2), is sandwiched by two electrodes. The potential applications for these electro-resistive devices range from non-volatile data storage to reconfigurable logic to trainable neural networks. The goal of the project is to determine the processing conditions that provide conductive and homogeneous TiO2 thin films that can be fabricated into functional

resistive switching devices. The device's heterostructure will consist of TiO2 as the functional layer and Platinum (Pt) as the bottom and top electrodes. The required voltage to initially condition the device (electroforming) will be related to the TiO2 films processing conditions to determine a reproducible processing method.

Electron Band Edge Location in Semiconductors for use in Renewable Energy Applicable PEC Devices
Eric Pripstein / Materials Science Engineering

Advisor(s): Paul Salvador / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

The splitting of water as a source of hydrogen fuel is an important tool in the field of renewable energy. One way to achieve this goal is through the reduction of 2H+ in water to form H2(g), which requires the donation of an electron to each of the H+ ions. For a solid to donate the electron, it must have an electron at an energy, usually this is the band edge state, higher than that of the accepting state of the H+ in water, so that it will be energetically favorable for an excited electron to transfer to the water. Thus, it's important to know the location of the electron band edge in the donating material. For our proposed water splitting scheme, this material is iron oxide (Fe2O3). The goal of this research is to locate the electron band edge in Fe2O3 and to determine how it changes with varying conditions. This will be done by characterizing the products of different photoelectrochemical (PEC) reactions, in which salts are reduced via an analogous process to that which would occur with water. By using a number of salts with known electron energies for the accepting state and using scanning probe characterization techniques, such as atomic force microscopy (AFM), to determine whether or not the reduction reaction occurs, the location of the electron band edge in Fe2O3 will be identified.

Feasibility Study of Campus-Installed Energy-Harvesting Walkway
Tejank Shah / Materials Science Engineering

Advisor(s): Michael Bockstaller / Materials Science Engineering
Wean Commons / 1st Floor, Connan side / 3-5

By considering the amount of nonrenewable and polluting energies utilized today, it becomes important to realize that a paradigm shift in energy generation technologies is necessary. As part of this shift, Carnegie Mellon students will find new and creative solutions to existing environmental issues. By evaluating the potential of a campus-installed energy-harvesting sidewalk, it may eventually become possible to reduce Carnegie Mellon's carbon footprint on campus. Through literature research, surveying of on-campus sites, and consideration of other designs, the first-phase of this project has been completed.

Investigating Antibody-Magnetic Nanoparticle Complexes for Attachment to Tissue Scaffolds
Marianna Sofman / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering & Katie McNerny / Materials Science Engineering
Rangos 3 / 12-2:30

Magnetic nanoparticles (MNPs) can be functionalized with an antibody, attached to collagenic extracellular matrix (ECM) scaffold implants, and then used to monitor the mechanical behavior of implanted scaffold materials. Furthermore, these MNPs can enhance the signal obtained from

Magnetic Resonance Imaging (MRI) such that scaffold materials can be imaged following implantation. The goals of this research project are to (1) image collagen scaffold materials using Atomic Force Microscopy (AFM), (2) measure the binding affinity of the antibody-labeled MNPs using a functionalize AFM tip, and (3) use an external field to align the particles and subsequently align the collagen fibers to induce strain in the scaffold.

Investigation of Spinodal Decomposition in FeNi Invar Alloys for Magnetic Sensor Applications
Anna Colletti / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Rangos 3 / 12-2:30

Invar alloys are important for a large range of applications because they exhibit a near zero thermal expansion. This is due to their high magnetostriction which causes a decrease in volume when the material transforms from ferromagnetic to paramagnetic which offsets thermal expansion. Invar alloys are most commonly FeNi alloys in the range of 30% to 40% Ni with the most common composition being 36% Ni.1 Despite this, FeNi alloys with compositions of up to 50% Ni have very high magnetostriction and can be used for various applications including magnetic sensors. These alloys exist in the spinodal region of the FeNi phase diagram indicating that spinodal decomposition, or the separation of the FeNi solution into two distinct phases, is occurring. The goal of this research is to investigate the effects of the spinodal decomposition on the material properties such as microstructure, hardness, resistivity and various magnetic properties that could potentially affect application performance.

Magnetic Particle Composites for Flip-Chip Packaging
Matthew Ondeck / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Rangos 3 / 12-2:30

A simple electronic package is composed of a Si chip that is fixed to a substrate; this combination is held together by solder. When an electronic package is constructed the silicon chip along with the substrate and solder are exposed to a temperature of nearly 200°C, which can cause damage to the silicon chip and substrate. FeCo magnetic nanoparticles – solder paste composites are known to heat through power losses generated by the magnetic particles when exposed to a Radio Frequency (RF) magnetic field, causing the solder to reflow. Previous experiments showed that the solder composites reflowed by magnetic heating of the nanoparticles, NOT eddy current heating of the solder. Therefore, the magnetic heating is localized to the solder, and does not induce heating to the same extent in the substrate and chip. However, an electronic substrate is composed of multiple Cu sheets, which generate heat when exposed to an RF magnetic field. With this proof of concept, we attempt to quantify the percentage of magnetic heating of the solder composite versus eddy current heating generated by the Cu sheets within the substrate in an RF magnetic field of an electronic package through experimental methods. Cu sheets of varying dimensions were tested with different heating parameters in an applied RF magnetic field to simulate the eddy current heat generated by a typical substrate. The amount of magnetic heating of the FeCo nanoparticles was also measured with respect to particle diameter to justify the use appropriate particle sizes. With these two values we can simulate the amount of heating that would be occurring in an electronic package under a RF magnetic field.

Modeling of Planar Flow Casting Process for Efficiency in Synthesizing Magnetic Ribbon
Samuel Kernion / Materials Science Engineering & Edward Smongeski / Chemical Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

Planar flow casting (PFC) is a single stage process for producing thin metal ribbons. It is desirable to create such ribbons from magnetic materials with high magnetic fluxes for use in high efficiency energy conversion processes. Notable properties of the ribbon that affect its magnetic flux density include ribbon thickness, solidification rate, and surface roughness. Research has been done into the relation of these variables with the process variables of PFC. This project seeks organize these relations using MATLAB® to create a simple system that can accurately predict the properties of the ribbon based on given input variables. Upon completion of the modeling files, a series of ribbons will be synthesized on a PFC, and their properties will be compared to the output of the MATLAB® files.

Modeling the kinetics of spinodal decomposition in the Fe2TiO4-Fe3O4 pseudo-binary system
Yue Ma / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Rangos 3 / 12-2:30

The Fe2TiO4-Fe3O4 pseudo-binary titanomagnetite system found on Mars is known to decompose into a titanium-rich, nonmagnetic ulvospinel phase and a magnetic magnetite phase through spinodal decomposition. This decomposition can potentially describe the remnant crust magnetic field on Mars and shed light on the geological history of the planet, so it is of interest to understand the details of the process. Using data from magnetic measurements and Mossbauer spectroscopy collected throughout the decomposition process, a model with solutions to the 3-D diffusion equation with periodic boundary conditions will be developed to characterize the kinetics of the spinodal decomposition.

Novel Solder-Magnetic Nanoparticle Composites and Their Reflow Using AC Magnetic Fields
Emily Walker / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Kirr Commons / 1st Floor, Window side / 12-2:30

The electronics industry has recently begun to limit its use of lead-based solders for semiconducting chips 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 is investigating the possibility of combining magnetic nanoparticles with the solder, in order to make a composite solder paste that can be heated to reflow temperatures with an AC magnetic field.

RobOrchestra Vibraphone Project
Jonathan Boerner / Mechanical Engineering, Andrew Burks / Mechanical Engineering, Katherine Coste / Materials Science Engineering, Jaywoo Kim / Mechanical Engineering, Michael Ornstein / Mechanical Engineering, Nicolas Paris / Electrical & Computer Engineering

Advisor(s): Roger Dannenberg / Computer Science
Kirr Commons / 1st Floor, Window side / 12-2:30

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, the group has been experiencing rapid growth in membership and productivity. Several new instruments have been added in the past two semesters, and numerous demos and gigs have taken place to showcase the research. At a time where the resources of the RobOrchestra group can no longer support the quantity of creative ideas worth trying, a special team of experienced members has designed a robot which is capable of playing the vibraphone. Using lessons learned from the construction of previous robots, including one that plays the xylophone, the group is confident that it can create a vibraphone playing robot that is indistinguishable from a human player in performance capability.

Solder Magnetic Nanoparticles and their Reflow
Anya Prasitthipayong / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Kirr Commons / 1st Floor, Window side / 3-5

Due to Pb (lead) toxicity that caused environmental and health concerns, Sn-Pb solders have been replaced with the Pb-free SAC (Sn-Ag-Cu) solders. In order to avoid package warpage during the reflow of solder bumps in the flip-chip packaging, different compositions of FeCo magnetic nanoparticles have been introduced into the SAC solders (e.g. SAC305); Those MNPs generate localized heating during reflow due to the RF heating and eliminate the necessity for putting the entire package in an oven. The interrelationship between mechanical and electrical properties of the solder composites and their microstructures and compositions therefore needs to be studied in order to improve the packaging and optimize the reflow process. In particular, the role of the nanoparticles on refining the eutectic microstructure will be studied.

The characterization of lead free solders and the relation to magnetic nanoparticles used in biomedical applications
Leah Yingling / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Wean Commons / 1st Floor, Connan side / 12-2:30

This project deals with particles on a nanoscale, specifically magnetic properties of electronic packaging. A tool has been developed that uses radio frequency coils to heat specially designed magnetic particles that are mixed with solder pastes. A solder is a metal alloy used to bond metals together. By varying the concentration and composition of these magnetic particles the time it takes to heat them can be controlled, which ultimately helps improve the speed of processing them. Certain analysis techniques and image scanning have been used to determine and compare densities within a material on a nanoscale in the electronic packaging processes.

Torsional Magnetoelastic Deformation of Ferrogels
Anthony Rice / Materials Science Engineering

Advisor(s): Michael McHenry / Materials Science Engineering
Rangos 3 / 12-2:30

Ferrogels are polymer materials with ferromagnetic particles bound throughout the material. By applying magnetic fields, large deformations may be observed. Torsional responses are calculated and the viability of “magnetically winding” polymer chains for strengthening is explored.

Synthesis of cobalt ferrite magnetic nanoparticles for cancer thermotherapy
Kelly Collier Materials / Science Engineering
Advisor(s): Michael McHenry / Materials Science Engineering & Katie McNerny / Materials Science Engineering
Rangos 3 / 12-2:30

Blood vessels are poorly developed in cancerous tissue and have a lower thermal resistance than healthy tissue. Magnetic nanoparticles (MNPs) suspended in fluids are known to dissipate heat when exposed to a non-bioinvasive radio frequency magnetic field, and therefore they are being explored as an alternative cancer treatment that exploits cancer tissue’s sensitivity to heat. Magnetic heating of nanoparticles is quantified by a characteristic specific loss power (SLP), which depends upon the magnetic and physical properties of the MNPs and can be tuned in order to deliver heat to cancerous tissue. A maximum in the SLP occurs for a specific particle size, and the magnitude of this peak is dependent upon nanoparticle monodispersity. By controlling the particle size and size distribution, we will show that heating rates can be optimized in order to deliver smaller volumes of particles while still achieving large heating rates. The experimental SLP of cobalt ferrite MNPs with varying sizes and size distribution will be presented and compared to a model for magnetic heating of particles.

MECHANICAL ENGINEERING

A Calibration Platform for Achieving Sensor Accuracy in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science
Advisor(s): George Kantor / Robotics Institute
Hoch Commons / 2nd Floor, Rangos side / 3-5

The Colony project researches cooperative problem solving using a flexible, low-cost swarm of robots. Currently, the largest hurdle to making new behaviors is the quality of our sensor data. Unreliable sensors hinder development and limit the complexity of possible behaviors. For this research, we built an automatic testing and calibration platform to measure sensor output. We then used this data to adapt existing software to mitigate hardware problems. The new system tested all sensors: the Bearing and Orientation Module, infrared rangefinders, wheel encoders, and line-detection sensors. With the output of each sensor standardized, we gained the accuracy of higher-end sensors without the increased cost.

A Computational Fluid Dynamic Study of the Application of Momentum Kill Procedure to Oil Drilling
Jacob Beatty / Mechanical Engineering
Advisor(s): Cecil Higgs / Mechanical Engineering
Rangos 3 / 12-2:30

Recent events, such as the BP Deepwater Horizon accident, have shown the need for better procedures for stopping the flow of oil during a blowout. The so-called “Top Kill” method, which is known as the momentum kill method in the oil and gas industry, provides a quicker alternative to stop an oil blowout than the traditional relief wells. However, there has been no in-depth computational study of the momentum kill method. The following research uses a commercial computational fluid dynamics (CFD) software to provide the basis for a clearer understanding of the requirements needed for the momentum Kill method to be successful.

A Feasibility Study of Bio-Gas Digesters and Composting Systems at Carnegie Mellon University
Jule Carr / Civil and Environmental Engineering, Cynthia Clement / Mathematics, Carineh Ghafafian / Materials Science Engineering, Elissa Goldner / Civil and Environmental Engineering, Mahaesh Jayaraman / Chemical Engineering, Lane Kurkjian / Civil and Environmental Engineering, Anna Lenhart / Civil and Environmental Engineering, Kaiyang Liew / Mechanical Engineering, Agnieszka Marszalik /Civil and Environmental Engineering, Tejank Shah / Materials Science Engineering, Lauren Sittler / Chemical Engineering

Advisor(s): Paulina Jaramillo / Engineering and Public Policy
Rangos 1 & 2 / Sigma Xi Group 5 / 11:45

Our research examines the feasibility of building and operating a biogas digestion unit for Carnegie Mellon as a way to compost organic waste, offset energy use, and output a nutrient rich byproduct that could be used or sold as fertilizer. We analyze 3 potential alternatives, including a BioTHELYS digester at the Bellfield Boiler plant, a black water unit installed in a new campus building and an in-vessel compost system located in the University Center. We consider the collection of organic waste, the installation, operation and maintenance of the digester, and the uses for the final products. Our research was conducted based on interviews with Carnegie Mellon faculty and Housing and Dining Services staff, literary sources, and case-studies of other universities where biogas digesters are already in use. The study includes models that can be used to determine if each digestion unit method would be feasible, but also beneficial to our campus by examining the net monetary cost and payoff, the potential energy production, and the nutrient composition of the slurry output.

A Study on Students' Change of Majors, What They Choose and Why.
Oliver Lam / Psychology, Michael Len / Computer Science, Go Okumura / Mechanical Engineering, DunyangWang / Materials Science Engineering, Wentian Zhu / Science and Humanities Scholars
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

Selecting a major is an important decision for an undergraduate. What a student chooses to study often determines their future career by providing them with a knowledge base that will enable them to succeed in that field. At Carnegie Mellon University (CMU), students are allowed to change majors as they wish in accordance to certain influences in their life, including but not limited to perceived academic success, future job prospects, personal interests, and social pressures. This study aims to determine the retention rates of each major at CMU, which majors are most popular to switch to, and the prevailing factors that influence a students decision to change or not to change their major. Our results lend insight to what CMU departments can do to affect the popularity and retention rates of their majors by identifying what influences an undergraduate's decision on changing majors the most.

An Investigation of the Wear Mechanisms Leading to Self-Replenishing Transfer Films
Patrick Dougherty / Mechanical Engineering
Advisor(s): Cecil Higgs / Mechanical Engineering
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Since the late 1980's, interest has risen in solid powder lubrication due to its proven ability to provide low friction and wear in interfaces unsuitable for traditional oils. This may be in the form of augmenting oil performance as an additive, or in the form of thin, solid transfer films since it was found that sliding materials sometimes inherently generate a film that can protect the contact interface during relative motion. In particular, in situ self- replenishing solid lubrication has shown the ability to maintain lubricious conditions through the continual deposition of thin powder transfer films to "dry" surface asperities from a sacrificial compact. An emerging class of self-lubricating compacts is being developed by compacting lamellar powder particles into different homogeneous and heterogeneous solid lubricant structures or "pellets." An in situ self-replenishing solid lubricant system may be created by placing these pellets into tribosystems in such a way that their transferred film is continuously applied to dry asperities in load-bearing interfaces. Therefore, special emphasis must be given to understanding the method of transfer film deposition and depletion, if the lubrication process is to be predicted, controlled, and optimized. The purpose of this investigation is to examine the wear mechanisms which govern transfer film deposition and depletion in an in situ self-replenishing system, such that a more accurate modeling approach may be undertaken in the future. Surface analysis of contact interfaces was performed using an optical interferometer, while friction and wear relationships were gleaned from experiments on a pellet-on-disk with slider pad tribometer. Through an analysis of numerous qualitative and quantitative parameters that describe surface topography, it was found that abrasive wear is the predominant wear mechanism governing the transfer film process. Consequently, an alternate wear description of the in situ self-replenishing transfer film lubrication process is proposed.

Chemotactic Separation of Human Epithelial and Fibroblast Cells Using a Microfluidic Channel
Robert Piston / Mechanical Engineering

Advisor(s): Yong Tae Kim / Mechanical Engineering & Philip LeDuc / Mechanical Engineering
Rangos 3 / 12-2:30

Cell sorting or separation is used in the diagnosis of health disorders, especially cancers, and both research and clinical practice. Human fibroblast chemotaxic separation from epithelial cells has been investigated in a novel microfluidic platform. We observed the migration of fibroblasts in response to a chemoattractant, interleukin-4 using time-lapse microscopy. This approach demonstrated the ability to separate fibroblasts from a combination of epithelial and fibroblast cells by attracting fibroblasts away by their own movements. Human cell lines of WI-38 fibroblasts and A549 epithelial cells were cultured in T25 flasks using standard cell cultivation protocols and transferred to microfluidic devices for the chemotactic experiment. Our microfluidic device was designed and developed to create uniform chemical gradients of interleukin-4 for chemotaxis of fibroblasts. This technology will be useful in areas including cancer chemotherapy to purify human cancerous tissue explants containing epithelial tumor cells ("target cells") that is covered by a number of unnecessary fibroblasts ("buffer cells").

Exploration and Mapping of Unstructured Environments using an Autonomous Quadrotor

Jeffrey Cooper / Computer Science, Jitu Das / Computer Science, Priyanka Deo / Computer Science, Daniel Jacobs / Electrical & Computer Engineering, Michael Ornstein / Mechanical Engineering, Harrison Rose / Biomedical Engineering, James Wahawisan / Electrical & Computer Engineering, Alexander Zirbel / Computer Science

Advisor(s): Sanjiv Singh / Robotics Institute
Peter / 1:40

Robots are an increasingly common sight in all areas of daily life, and are increasingly useful to humans. As their capabilities expand, they are able to move from strictly controlled environments into an uncharted and potentially dangerous world, where they can accomplish tasks humans would rather avoid. Exploration of hazardous locations like collapsed buildings, mines, and other disaster areas is left largely to humans because few modern robots have the capabilities to reliably replace human explorers. The quadrotor aerial platform provides an attractive solution to this problem: being extremely maneuverable, powerful enough to carry high-performance sensing equipment, and compact enough to fit through small gaps such as a broken window, a quadrotor can gather data about a location before humans or other robots enter it. Once this data is available and the terrain is mapped, robots and humans entering the environment can explore and travel much more efficiently. Applications for this information range from urban navigation to search and rescue maps that can help in quickly developing paths to areas of interest. This research team aims to tackle the problem of exploring and mapping unstructured environments using an autonomous quadrotor.

Fire Identification and Localization for Autonomous Firefighting Robotics
Philip Brown / Mechanical Engineering, Dev Doshi / Computer Science, Christopher Tomaszewski / Mechanical Engineering
Advisor(s): Illah Nourbakhsh / Robotics Institute
Kirr Commons / 1st Floor, Window side / 3-5

This two-stage project evaluates the viability of a household robotic firefighting platform. The first stage entails the development of a fire identification system which employs thermal and optical sensors to pinpoint the base of a fire. The future second stage will integrate the fire identification system with an autonomous, mobile extinguishing platform as part of a home firefighting solution.

GuitarBot
Philip Bailey / Electrical & Computer Engineering, Gerald Carlson / Mechanical Engineering, Daniel Curhan / Mechanical Engineering
Advisor(s): Roger Dannenberg / Computer Science
Wean Commons-1st Floor, Connan side / 3-5

We have received a SURG grant with which to build two GuitarBot prototypes. GuitarBot is a new project under the RobOrchestra umbrella that consists of multiple individual string modules that interact both with each other and with the rest of the RobOrchestra. There are two versions that we are going to create – a sliding fret version and an articulated arm version – and we will compare the performance of each, and replicate the better version to create the final GuitarBot assembly. There is a complex software aspect to the project as well, where the software will need to distribute the notes that the instrument is given across the various string modules that are connected together.

In-Situ Through Plane Measurements to Determine the Effects of Nafion Loading in the Cathode Catalyst Layer of a PEMFC
John Boyle / Mechanical Engineering
Advisor(s): Shawn Litster / Mechanical Engineering
Rangos 3 / 12-2:30

A proton exchange membrane fuel cell (PEMFC) is a promising energy conversion device that gives off no carbon emissions. These fuel cells operate with hydrogen as its fuel and oxygen as its oxidant. Many new developments need to be made before PEMFCs are ready for mass production to power vehicles and portable devices. The cathode catalyst layer plays an important role in maximizing the performance and reducing the cost of a PEMFC. The catalyst layer is a porous network of ion and electron conducting materials, voids, and platinum catalyst particles. The balance of the ion, electron, and oxygen transport pathways through the catalyst layer is crucial in fabricating the most effective electrode. Specifically, an increase in Nafion loading in the catalyst layer increases proton conductivity but hinders oxygen transport. This research study finds the optimum amount of Nafion in the catalyst layer by collecting in-situ, through plane measurements of a catalyst layer using a micro-structured electrode scaffold (MES). The MES consists of a stack of five sensing layers separated by insulating layers that is constructed around a column of catalyst layer. The Nafion sensing layers contact the catalyst layer at five discrete points to allow for through plane ionic potential distribution measurements through the thickness of the catalyst layer, giving insight into the ion transport properties of the porous electrode. The thickness of the MES and the aspect ratio of the column of catalyst layer are such that charge and mass transport are one-dimensional. The loading of Nafion in the catalyst layer was parametrically varied through a range centered around an optimal loading determined by previous studies of fuel cell performance. The results of this research will elucidate the balance between proton conductivity and oxygen transport and determine an optimal amount of Nafion in the catalyst layer.

Jack Plate and Trim Switch Implementation for Thrust Optimization
Jonathan Boerner / Mechanical Engineering, Ibuki Kamei / Mechanical Engineering, Paul Kimball Jr. / Mechanical Engineering
Advisor(s): Susan Finger / Civil and Environmental Engineering
Hoch Commons / 2nd Floor, Window side / 3-5

The inclusion of a jack plate and trim switch on a powerboat will greatly alter the boat's maneuverability and acceleration. For a boat at a given speed, drag forces will effect the optimal application of the thrust provided by the motors, which will maximize the rate at which the boat can accelerate. Due to such differences, a moveable jack plate (which controls thrust elevation) in combination with an adjustable trim switch (which controls the thrust angle) can be used to alter the thrust of the motors. Through the observation of real-time data during lake-trials of a powerboat outfitted with such mechanisms, analysis can be performed to determine the optimal settings for both the jack plate and the trim level at any given velocity of the boat, such that it accelerates as quickly as possible.

Measuring Fractional Coverage of a Powder Lubricant Transfer Film in a Sliding Contact
David Stonestrom / Mechanical Engineering
Advisor(s): Cecil Higgs / Mechanical Engineering
Rangos 3 / 12-2:30

We present the results of a study intended to measure the fractional coverage of powder lubricant in a sliding contact. The experimental setup is a pin on disc tribometer where a pellet of compacted molybdenum disulfide powder is worn against the disc to provide a lubricating transfer film for the slider pin. The measuring device is a camera aimed at an exposed section of the disc between the slider and the pellet. Comparisons are made between the measurements of fractional coverage and theoretical fractional coverage based models.

Modular Modeling Frameworks: Opportunities and Limitations of Causal and Acausal Approaches
John Langford / Mechanical Engineering
Advisor(s): Bruce Krogh / Electrical & Computer Engineering
Rangos 3 / 12-2:30

This project investigates the role of causal and acausal modeling approaches to modular component-connector modeling. Causal modeling is examined using Simulink, while acausal modeling is examined using MapleSim. Causal modeling is a component-base framework where links connected to each component act as either inputs or outputs. The value of the output connector for a component is affected only by the inputs to the component and its internal dynamics. Acausal modeling is a component-based framework in which each component represents a physical component in the overall system. As a result, the values associated with links do not correspond to component inputs and outputs, but rather the value associated with a connector can depend on the entire interconnected ensemble of components. This project examines how causal and acausal modeling can be used to understand a system and how to interpret the role of subsystems, model hierarchy, and the use process for the control engineer. It also compares these modeling frameworks and identifies which tasks in an overall model-based development process are best addressed using each framework.

Navigating Carnegie Mellon
Manish Burman / Electrical & Computer Engineering, Brian Devincentis / Mechanical Engineering, Brandon Kase / Electrical & Computer Engineering

Advisor(s): David Kosbie / Computer Science
Wean Commons / 1st Floor, Connan side / 3-5

The Navigating Carnegie Mellon (NCM) project is a set of navigational applications that allow members and guests of the Carnegie Mellon community to find the optimal route between any two locations on campus. Preferences allow users to modify the fastest route to walk more inside or outside and exclude stairs or elevators. Users also have the ability to search for a variety of places on campus including but not limited to room numbers, dining facilities, athletic facilities, faculty offices and restrooms. The calculated route is displayed over an interactive map taking advantage of Google Maps and blueprints. Our Android application provides mobility by giving users the ability to determine their path “on the go” while our web application gives the user the ability to print out the list of directions before hand. The applications are available on the Android Marketplace and on our website, www.ncmproject.org, which also has more information on the project.

Navigating Dynamic Traffic Environments in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Megan Dority / Mechanical Engineering, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Daniel Shope / Mechanical Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science

Advisor(s): George Kantor / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:30

The overarching goal of the Colony Project is to maintain a flexible yet inexpensive group of robots for researching emergent behavior and cooperative problem solving. With this research, the Colony Project emulated vehicular traffic in a city-like environment. The development of intelligent, networked cars is a growing field of interest in mobile robotics research, and we will show how we used our robots to study related algorithms and behaviors. Our goal is to enable the robots to autonomously navigate a dynamic environment and to handle interesting traffic objects and events such as lane changes, intersections, tollbooths, and obstacles in the road. This work is a continuation of previous Colony Project research, and it will serve as a foundation for future endeavors. We also hope to contribute to this rapidly growing area of robotics research.

Novel cardiovascular flow regimes in patient-specific anatomies
Ming-Yang Hung / Mechanical Engineering
Advisor(s): Kerem Pekkan / Biomedical Engineering
Rangos 1 & 2 / Sigma Xi Group 9 / 10:45

Cardiovascular fluid dynamics of patient-specific anatomies have been studied extensively both through computational and experimental tools. In this paper, using standard and time-resolved particle image velocimetry a survey of complex internal flow regimes and fluid structures are presented. While the major focus is on the characterization of anatomical and surgical venous flow components, experiments involving arterial patient-specific anatomies such as the abdominal aneursyms (with and without thrombus) are also presented. Experimental methodology incorporates transparent rapid-prototype replicas of several anatomical models with multiple inlet/outlet vessels and two/three-component particle image velocimetry. Refractive index matched blood analogue solution with fluorescent particles is used as a working fluid in steady flow loops. In addition to the basic hemodynamic understanding provided, experimental results can be utilized as challenging test case templates for ongoing efforts in cardiovascular computational fluid dynamics solver development, particularly for test cases that require unsteady characteristic boundary conditions.

Numerical Modeling of the Soft Elastohydrodynamic Tribosystems
Sean Lubner / Mechanical Engineering
Advisor(s): Cecil Higgs / Mechanical Engineering
Rangos 3 / 12-2:30

A first principles approach is used to numerically model the interaction of soft, sliding surfaces in the presence of fluid by building on a pre-existing particle-augmented mixed lubrication (PAML) model for chemical mechanical polishing (CMP). The model is constructed based exclusively on the physics of fluid mechanics, particle dynamics and contact mechanics, without the use of empirical fitting. Modeling reveals the formation of areas of sub-ambient fluid pressure between a deformable pad sliding over a wafer with a thin fluid medium separation.

Numerical Simulation of Unsteady Separation Over a Pitching Airfoil
Edward Burns / Mechanical Engineering
Advisor(s): Donghyun You / Mechanical Engineering
Rangos 3 / 12-2:30

The purpose of the research is to understand the flow physics associated with a pitching motion of a typical rotor-blade of helicopters and wind turbines at a low Reynolds number condition. The computational simulation was conducted on a computational model consisting of an airfoil, technically known as Sikorsky SSCA09. The computational mesh for this model was developed using a structured, curvilinear grid topology. The computational simulations were carried out using high-fidelity computational fluid dynamics simulation programs available at the Computational Flow Physics and Engineering Lab at CMU. The computed flow field information was systematically analyzed to gain deeper understanding of the fluid dynamics phenomena observed on typical helicopter rotors or wind turbine blades.

Optimizing the Design of Carbon Nanotubes Aerogels for Thermal Transport Applications
Gabriella Coloyan / Mechanical Engineering
Advisor(s): Alan McGaughey / Mechanical Engineering
Rangos 1 & 2 / Sigma Xi Group 7 / 10:45

low-density aerogel, whose thermal properties are currently unknown. The structure of the aerogel is complex, with a wide range of CNT lengths, separations, and orientations. The Large-scale Atomic/ Molecular Massively Parallel Simulator (LAMMPS) has been used to study the thermal properties of the CNTs in an aerogel, so that guidelines can be developed to help in materials design. Simulations were performed on single nanotubes of varying length at different temperatures, and on two-tube junction systems with varying lengths, orientations, and temperature. The thermal conductivity of asingle tube and the thermal conductance of a two-tube junction increase with increasing tube length. The junction spacing that maximizes thermal conductance is 2.7 Å. For a single tube, thermal conductivity decreases with increasing temperature, while for a two-tube system, the junction thermal conductivity is temperature independent. The thermal conductance of the junctions decreases as the angle between the two tubes increased.

RobOrchestra Vibraphone Project
Jonathan Boerner / Mechanical Engineering, Andrew Burks / Mechanical Engineering, Katherine Coste / Materials Science Engineering, Jaywoo Kim / Mechanical Engineering, Michael Ornstein / Mechanical Engineering, Nicolas Paris / Electrical & Computer Engineering
Advisor(s): Roger Dannenberg / Computer Science
Kirr Commons / 1st Floor, Window side / 12-2:30

The RobOrchestra project is dedicated to the creation of music using technology coupled with art. Now in its fifth year, the group has been experiencing rapid growth in membership and productivity. Several new instruments have been added in the past two semesters, and numerous demos and gigs have taken place to showcase the research. At a time where the resources of the RobOrchestra group can no longer support the quantity of creative ideas worth trying, a special team of experienced members has designed a robot which is capable of playing the vibraphone. Using lessons learned from the construction of previous robots, including one that plays the xylophone, the group is confident that it can create a vibraphone playing robot that is indistinguishable from a human player in performance capability.

Single Particle Coefficient of Restitution Studies: Experiments and Modeling
Richard Musgrave / Mechanical Engineering

Advisor(s): Cecil Higgs / Mechanical Engineering
Hoch Commons / 2nd Floor, Window side / 3-5

Particle based modeling approaches, such as the discrete element method (DEM) approach, require the definition of accurate contact (collision) models. Two essential parameters within these models are the collision time (duration of impact) and the coefficient of restitution (e), which defines the ratio of post-collision to pre-collision relative velocity during the collision of two materials. In this study, of various steel-material combinations, e is predicted through both physical experiments and explicit finite element modeling (FEM) of a falling sphere colliding with a stationary plate, and examined against a theoretical formulation of e. Experiments are performed on various sphere materials including steel, brass, chrome steel, tungsten carbide, aluminum, polybutadiene, and nitinol 60. Experimental results for metals colliding with steel match what is predicted by theory, as they show a decreasing trend in e with increasing impact velocities. Additional experimental results for polybutadiene rubber show no velocity dependence, remaining constant across the impact velocities examined; this matches with theory. Modeling results, obtained via the explicit finite element method (FEM) approach, are compared against experimental results for verification. Current explicit FEM results show very good quantitative agreement with experimental results for various materials (brass, steel, tungsten carbide, and chrome steel) impacting steel, but do not display the proper decreasing trend in e for increasing impact velocity, over the range of impact velocities examined (~2 m/s - 3.2 m/s). However, for simulations at impact velocities above this range, a decrease in is witnessed. Other explicit FEM work has focused on parametric studies of Elastic Modulus, Yield Strength and Poisson's Ratio, to determine their individual effects on the co-efficient of restitution. In addition to e, the collision time between surfaces is also important because it determines the period of time over which contacting bodies can apply forces on one another. This is particularly relevant in tribological models where a moving boundary is supported by flowing particles. As such, this study also performs preliminary experiments to determine the collision times between various sphere-plate combinations. Current and future work focuses on refining the explicit FEM model to correctly display the qualitative trend of decreasing e with increased impact velocity for the current range of experimental impact velocities, performing experiments on a wider range of impact velocities, performing additional parametric simulation studies to more clearly define an empirical function for e, and the modeling of a granular shear cell.

The Design, Modeling, and Analysis of a Chaotic Microfluidic Heat Exchange Chip
David Chang / Mechanical Engineering

Advisor(s): Nadine Aubry / Mechanical Engineering
Hoch Commons / 2nd Floor, Window side / 3-5

Small size and extremely efficient heat exchangers are in high demand for industrial application. For example, in electronics overheating is a major issue, having small and efficient methods of cooling can allow technology to become more powerful as well as more mobile. These technologies can also be applied in the medical, biological, and chemical fields. For instance, blood analysis chips require fast and accurate measurements. Microfluidic chips can provide the ability to be both of these things. The experimentation will be conducted mostly through the use of a powerful tool called computational fluid dynamics (CFD) which is a numerical approach to solving fluid flow problems. This allows for a much more accurate and highly detailed look at the heat transfer and flow characteristics in the micro heat exchanger. With the use of chaos theory, an efficient heat exchange chip as well as efficient mixing chips can be created.

The Detection of Multiple Ions in a Single Drop of Sample
Andrew Kojzar / Mechanical Engineering

Advisor(s): Shelley Anna / Mechanical Engineering & Stephen Garoff / Physics
Rangos 3 / 12-2:30

The detection of ions in water, blood, and other samples is often needed to determine other factors about the sample. In some applications only a single drop of sample may be available. We discuss a device that can make multiple, parallel tests on a single drop of a sample. Using a thin, flat slot geometry to control fluid flow, portions of the single drop of sample are directed to ion detection strips, used to determine the presences of iron, copper, sulfate, and chloride ions in a sample. The floe was successfully directed to the strips without backflow that would cause contamination of the individual tests. Computer analysis of the color change in the detection strips was used to quantify color in the strips and determine the presence and concentration of ions. It was found that variances in computer detected color changes are sufficient for determining the existence of an ion based on the color change of the detection strips, even when restricting the volume of the sample and maximizing the number of tests conducted in parallel.

Towards a Bioadhesive Controlled-Release Microchip Drug Delivery System
Douglas Bernstein / Mechanical Engineering & Julia Lekht / Biological Sciences

Advisor(s): Lee Weiss / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:00

Orally administered drug treatments for many diseases, such as Parkinson's Disease, are inadequate due in part to the inability to achieve desired release profiles for the medication as a result of patient non-compliance and shortcomings of current drug-delivery technologies. In order to address these issues we have taken the first steps towards the development of a novel bioadhesive drug-delivery microchip that when ingested will be capable of providing prescribed release patterns of medication over a period of approximately one week. A microchip was designed based on biodegradable polymers that act as the active release component of the microchip and tomato lectin protein that acts as a bioadhesive agent to attach the chip to the intestinal wall. A scaled-up version of the chip was prototyped and tested to investigate the ability of various polymer blends to achieve desired release profiles in liquid media. In addition, the synthesis, attachment, and properties of the tomato lectin were investigated to quantify its viability as a bioadhesive agent. This initial research has provided the basis for a new drug-delivery technology that may overcome the current inability to achieve highly controlled release of medication.

UNDECIDED

A Calibration Platform for Achieving Sensor Accuracy in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science
Advisor(s): George Kantor / Robotics Institute
Hoch Commons / 2nd Floor, Rangos side / 3-5

The Colony project researches cooperative problem solving using a flexible, low-cost swarm of robots. Currently, the largest hurdle to making new behaviors is the quality of our sensor data. Unreliable sensors hinder development and limit the complexity of possible behaviors. For this research, we built an automatic testing and calibration platform to measure sensor output. We then used this data to adapt existing software to mitigate hardware problems. The new system tested all sensors: the Bearing and Orientation Module, infrared rangefinders, wheel encoders, and line-detection sensors. With the output of each sensor standardized, we gained the accuracy of higher-end sensors without the increased cost.

Navigating Dynamic Traffic Environments in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Megan Dority / Mechanical Engineering, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Daniel Shope / Mechanical Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science

Advisor(s): George Kantor / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:30

The overarching goal of the Colony Project is to maintain a flexible yet inexpensive group of robots for researching emergent behavior and cooperative problem solving. With this research, the Colony Project emulated vehicular traffic in a city-like environment. The development of intelligent, networked cars is a growing field of interest in mobile robotics research, and we will show how we used our robots to study related algorithms and behaviors. Our goal is to enable the robots to autonomously navigate a dynamic environment and to handle interesting traffic objects and events such as lane changes, intersections, tollbooths, and obstacles in the road. This work is a continuation of

previous Colony Project research, and it will serve as a foundation for future endeavors. We also hope to contribute to this rapidly growing area of robotics research.

ARCHITECTURE
COLLEGE OF FINE ARTS

Architectural Canvas: Prescribing Flexibility
Lowell Day / Architecture, Douglas Farrell / Architecture, Benjamin Lehrer / Architecture
Advisor(s): Dale Clifford / Architecture
Hoch Commons / 2nd Floor, Rangos side / 3-5

An investigation of the interface between art and architecture.

Buildings in Limbo - Informal Cities of the Future
Bizhou Wang / Architecture
Advisor(s): Art Lubetz / Architecture
Connan / 3-5

Favelas in Brazil, johpadpatti in India, gecekonduler in Turkey, barrios in Venezuela, slums in Kenya. Whatever you call it, these are inescapable urban conditions of the future. These informal cities found throughout third world and developing countries are plagued with harsh realities they are also the only – self-built, self-designed, self-motived – architecture in the world. These are the seminal conditions of our cities, present & future, and yet they present baffling conditions to architects, urban planners, and politicians alike. They rely on the pragmatism of its citizens and are an elusive empirical exercise in architecture of survival. These informal structures exist with an uncomfortable relationship to governments that despises them, and yet with the rapidly growth of 'megacities' around the world, they often house the majority of a city's invisible population. I find extraordinary beauty and lessons to be learned from informal architecture. It is not about fancy design, but about a basic human struggle to survival. These ephemeral cities are here to stay, and as part of the research for my architectural thesis, I traveled to Asia's largest slum in Mumbai, India and documented one such condition, presented alongside my own vision for informal cities of the future.

---

conSTRICT
Tobie Chan-Kalin / Architecture & Ibrahim Garcia-Bengochea
Advisor(s): Christine Mondor / Architecture
Rangos 1 & 2 / Sigma Xi Group 8 / 11:00 & Connan / 12-2:30

In most cultures, clothing is an important part of society, whether it is about covering, revealing, or perhaps emphasizing the body. Whether or not a person is interested in fashion, they likely wear clothing, and in doing so present to the world not their real bodily self, but the skin of outer clothing with which they cover themselves. We believe that clothing is an interstitial step between the body and architecture; therefor architecture has come to be another layer of skin that entire civilizations and the everyday modern person have adopted. Our designs are based upon the constrictions clothing can pose onto body, inspired by cultural, psychological and physical binds. In order to

create this line, we plan to expand upon our current knowledge of sewing design and architectural modeling by pushing the limits of how one directly interacts with the fabric on their body, easily transforming into how our architecture elements interact with the body.

EDitIBLE
Alise Kuwahara / Architecture & Kaitlin Miciunas / Architecture
Advisor(s): Pablo Garcia / Architecture
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

We propose to create an experiential, socially driven event by means of gathering for the act of deconstruction rather than view of an installed object. Over the course of this singular event, spatial definition and perception is rewritten as the installation is deconstructed by the guests themselves, using what may be the most temporary of objects as building components: food.

Vernacular and Contemporary Sustainable Building Practices in the Middle East
Adam Himes / Architecture & Alexandra Legrady / Architecture
Advisor(s): Rami el Samahy / Architecture
Hoch Commons / 2nd Floor, Window side / 12-2:30

Through the study of building performance of vernacular architecture across the Middle East we have gained an understanding of sustainable practices and how it has applied to contemporary design. Our research includes specific localized traditions as well as regional Islamic architectural practices. We have specifically studied building features such as passive solar design, natural ventilation, courtyards, water elements, light modulation and shading, and material properties. This has largely been conducted through first hand experiences recorded through photography, sketches, and technical quantifications. The research is compiled and presented in a book format.

ART

Aberration
Zachary Wallnau / Art
Advisor(s): Patricia Bellan-Gillen / Art & Mark Perrott / Art
Connan / 12-2:30

A series of portraits produced with the aid of a distorting mirror. Explores the mixing of painterly style and the range of caricature which painters create naturally with the straightforward document of the photograph.

Area
Elizabeth Solomon / Art
Advisor(s): Ayanah Moor / Art
Connan / 3-5

This installation aims to create a sensory, immersive space for the viewer, challenging the notion of the “white cube gallery.” It consists of two central components: the penetrator and the void.

Somewhere between these two voices is a questioning of normative gender roles and sexual dynamics. The Area encourages the viewer to explore the instinctual, morbid voyeurism that we unnaturally suppress in our digital age.

Best In Show
Stephanie Ross / Art
Advisor(s): Patricia Bellan-Gillen / Art
Connan / 12-2:30

"Best in Show" is an artistic investigation of a subject I am highly interested in; pedigree dog breeding. Dog shows are broadcast nationally and there is a high demand for purebreds. What is often left out of the equation, and what I wish to focus on, is the genetic disorders and diseases which result in human desire for perfection. I plan to express this by creating a series of works highlighting these diseases. They will be larger than life images of a set of popular pedigree dogs and. Information on each disease will also be posted, and the ultimate goal is to have the exhibit stand at the Ellis Gallery. What is significant about these works is that it reaches much farther from the personal. The people I have met who have had dogs die as a result of genetic failings were unaware that these problems even had the chance of occurring. As a social and informational piece it will expose these genetic failings and the methods by which breeders cover them up to sell dogs. As a prospective pet owner and dog lover, exposing these truths is a duty to myself and anyone else who has owned a dog.

Existing Undefined
Carter Warren / Art
Advisor(s): Clayton Merrell / Art
Connan / 12-2:30

Our world is more often segregated into many divisions based on how we may look rather than how we act. My aspiration for this project is to create a work that exposes these practices of judging people based on their self-expression. Via the taboo process of tattooing, I will create a work upon raw uncut leather cowhide using the daisy and the skull. These two images have laced themselves eternally with the culture of tattooing because of their complex hidden meanings and delicately sturdy aesthetics dealing with gender relations. Seeing tattoos placed upon walls will make people look at them as the beautiful art forms that they are rather than frightening markings on gang members. This large work will help others question what is 'male', what is 'female' and what is 'beauty'.

Photography and the American Family
Michael Royce / Art
Advisor(s): Patricia Bellan-Gillen / Art
Connan / 3-5

The current political climate in this country poses a radical intolerance towards anything but the conventional, nuclear family. I propose to produce a small body of large format color photographs that blur the boundary of documentary and staged photography. The photographs will chart the changing makeup of the American family in a detritus strewn suburban landscape and attempt to carve out new and imaginative ways in which to conceive of the familial unit.

Second Harvest (previously PUSH)
Elizabeth Rudnick / Art
Advisor(s): Patricia Bellan-Gillen / Art
Connan / 3-5

Second Harvest explores the paradoxical role of progress and devastation played by synthesized chemicals in man's struggle against both his external environment and his internal physiology. The work is a culmination of research into the socio-political, chemical, and biological history of American agriculture, citing GMO crops as the contemporary counter-example for DDT of a post-natural material with the capacity for extreme devastation. By combining sculptural, painting, and printmaking techniques, the work explores themes of consumption, addiction, domesticity, obesity and government agency. It aims to subvert the perceived distinction between nature and technology, and in doing so, call into question current standards of operation.

---

the Attraction of Forms//an Attraction to Form
Charles Alexander / Civil and Environmental Engineering & Lara Mann / Art
Advisor(s): Patricia Bellan-Gillen / Art
Connan / 3-5

We are Charles Alexander and Lara Mann; a civil engineer and an artist, respectively. We would like to make an installation containing a collection of sculptures made from small spherical magnets and a three-dimensional representation of the patterns created by said magnets. Research will be done to find the best ways of arranging magnets into structural members for vertical, cantilevered, hanging and bridge-like constructions. A two-dimensional and three-dimensional art installation will be made in reaction to the patterns discovered in the research of the magnets.

Travels in Istanbul and Reactions to Domes
Sibel Ergener / Art
Advisor(s): Lowry Burgess / Art
Connan / 3-5

I plan to present the research and works I created based off of my travel to Istanbul, Turkey, to research the domed buildings and culture of the city. My half-Turkish, half-Western heritage is a driving force in my artwork leading me to appreciate and utilize an overlapping cultural history. My study and production of artwork directly in Istanbul and Turkey was a necessary resource in developing my theories and practice as an artist. Resulting in a research paper and installation with paintings, I critiqued and synthesized the roles of the West versus the Middle East. With a focus on the current political climate, my work centralizes on the history of the multicultural symbol of the dome. The experience offers greater perspective and cultural understanding to my research and my artworks. The quality and vivacity of my study in Istanbul allows me to take what I learned and push it to an extraordinary level to create an important impact for the audience.

Zombie College Musical
Stefan Dezil / Drama, Spencer Diaz / Art, David Grabowski / Music, James Krahe / Art, Yulin Kuang / English, Lachlan McKinney / Drama, Alexander Rothera / Art & Benjamin Welmond / Art

Advisor(s): Kristina Straub / Art
McConomy Auditorium / 11:00

The objective of this project is to create a five-episode musical webseries on a low budget, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of students at Carnegie Mellon University. By using an online platform, we hope to fully take advantage of this decade's democratization of storytelling and gain national exposure for our work.

DESIGN

Increasing the Visual Presence of Bike Commuters At Night
Ethan Frier / Design & Jonathan Ota / Design
Advisor(s): Stephen Stadelmeier / Design
Kirr Commons / 1st Floor, Window side / 12-2:30

Bicycle 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.

Leave Only Footprints
Anna Grace Meyer / Design
Advisor(s): Bruce Hanington / Design
Connan / 3-5

"Take only pictures, leave only footprints" -Unknown
When we think of the marks left by humans on the earth, only negative images come to mind. I'm posing this question: Can our "traces" or footprints help to better the earth? "Leave Only Footprints" will be a design project exploring the spread of ideas through physical traces left by humans. This investigation will aid in developing a series of physical artifacts, beginning with shoe soles, which spread the idea of nature conservation..

Leave Only Footprints
Rachel Inman / Design
Advisor(s): Dylan Vitone / Design
Connan / 3-5

Every environment we inhabit shapes the way we move through and in a space, what activities we choose to pursue, and even our emotional state. In the context of a city or town, public spaces are prime opportunities to enhance and inform the movement, recreation and well-being of residents. As an Industrial Design student, I have grown to understand the primary role products and spaces can have in negatively or positively affecting peoples' lives. I am interested in exploring how the design, layout, and resources of a public space can improve or diminish people's perception and

use of that space and the larger neighborhood it exists in. I have used the city of Pittsburgh as a laboratory for this exploration. Through photographic documentation, information mapping, and interviewing, I have investigated how the public spaces of five Pittsburgh neighborhoods are currently being used, how these spaces affect inhabitants, and what design changes would improve the use of these spaces. My ultimate goal is to share my findings with Pittsburgh residents, city leaders and the Carnegie Mellon community in the hope that we can all become advocates for thoughtful design of public spaces in our city and thus, advocates for a better quality of life.

SmartBag
Christopher Ioffreda / Design
Advisor(s): Mark Baskinger / Design
Kirr Commons / 1st Floor, Window side / 12-2:30

SmartBag is a research project that explores the integration of embedded electronics into wearable products: specifically bags. Carry bags are part of our lives; they help us to be organized, they reflect our sense of fashion, and they even affect our health. Created using a comprehensive iterative design process, SmartBag improves the way users interact with bags by taking full advantage of embedded electronics. The design process used includes ethnographic research (how people use their bags), form taxonomies and user interactions, and the prototyping of new concepts. The final carry bag is innovative and fully functional. The bag uses visual communication and organizational systems, movement and interaction, and materials and structure to dictate how we use it. Everything from the aesthetics, to function, to ability to adapt, to connection with other items, to the health effects of the bag all come into play.

Virtual Possessions Project
Alena Tesone / Design
Advisor(s): William Odom / Human Computer Interaction Inst.
Hoch Commons / 2nd Floor, Window side / 3-5

Recently, people have begun to accumulate virtual possessions. . These virtual possessions include personal information inventories, commercial and personal media, digital photos and videos of family and friends, e-books, emails, wealth, and bank records. While much research has been done on how people construct attachments with and perceive value in the material possessions, almost nothing is known about how people relate to their virtual things. My research project investigates how teens and tweens construct value for their virtual things. In addition, it investigates how making these possessions more present in their lives through different displays changes teens and tweens perception of value for these virtual things.

DRAMA

Jean Cocteau's Orpheus (play)
Sophia Schrank / Drama
Advisor(s): Jed Harris / Drama
McConomy Auditorium / 10:30

Members from our company will be discussing our process building a company and fully producing a play from the ground up.

Project Paperless
David Beller / Drama & Brooke Marrero / Drama
Advisor(s): Tina Shackleford / Drama
Pake / 4:20

Recently, a goal for many businesses and organizations has been to move traditionally paper-based operations toward paperless ones. This is motivated by the desire to preserve resources, to reduce waste, and to increase efficiency by eliminating less necessary materials. It is a general practice in theatrical Stage Management to go through a large amount of paper, whether to print multiple scripts, run sheets, or any number of lists, not to mentions reprinting any updates. This paperwork is often collected in a large binder, when in reality it could all be stored electronically. By launching "Project Paperless," the goal is to ascertain whether a Stage Management team could accomplish all of the required tasks, from the pre-production process to the end of the show, without using any paper at all, severely reducing the paper usage on any given production. Brooke Marrero and David Beller plan on pioneering this process with their own personal computers and the help of several other technological devices on their Spring Semester shows of A Number, and Still Life with Iris.

Zombie College Musical
Stefan Dezil / Drama, Spencer Diaz / Art, David Grabowski / Music, James Krahe / Art, Yulin Kuang / English, Lachlan McKinney / Drama, Alexander Rothera / Art & Benjamin Welmond / Art
Advisor(s): Kristina Straub / Art
McConomy Auditorium / 11:00

The objective of this project is to create a five-episode musical webseries on a low budget, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of students at Carnegie Mellon University. By using an online platform, we hope to fully take advantage of this decade's democratization of storytelling and gain national exposure for our work.

MUSIC

Music Generation Application
James Locus / Music
Advisor(s): Roger Dannenberg / Computer Science
Wright / 3-5

The purpose of the project was to create an application capable of generating commercially appealing music through algorithmic processes. The project progresses in two phases, 1) the creation of the generation algorithm and 2) adapting it to run on a desired platform. This presentation explores the first phase of the work in depth.

Zombie College Musical
Stefan Dezil / Drama, Spencer Diaz / Art, David Grabowski / Music, James Krahe / Art, Yulin Kuang / English, Lachlan McKinney / Drama, Alexander Rothera / Art & Benjamin Welmond / Art
Advisor(s): Kristina Straub / Art
McConomy Auditorium / 11:00

The objective of this project is to create a five-episode musical webseries on a low budget, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of students at Carnegie Mellon University. By using an online platform, we hope to fully take advantage of this decade's democratization of storytelling and gain national exposure for our work.

BCSA
CROSS-COLLEGE

Animation and Rig Control
Laura Paoletti / BCSA
Advisor(s): Wanda Dann / Computer Science
Wright / 12-2:30

An implementation of consistent rigging across the two-legged skeletons as well as four-legged skeletons (animals, birds, and other Alice 3 gallery packages). The 3D models produced provide an increased level of quality in the customized gallery, complementary to the SIMS2 characters in Alice 3. Students learn to program in Alice by creating animations and using the characters to tell film-like stories and playing interactive video-style games. I helped develop consistent rigging across the two-legged skeletons as well as four-legged skeletons (animals, birds, and other Alice 3 gallery packages).

Heart-Heart
Robyn Gray / BCSA
Advisor(s): M. Stephanie Murray / BHA
Connan / 12-2:30

This animation is a short focusing on the beginning and end of a relationship between the two main characters. Their relationship is illustrated (literally) through the actions of their hearts rather than their own actions or words. The animation is an experiment in mixing digital and traditional media to create a unique aesthetic.

The Yarners: Waking Ugly
Laura Paoletti / BCSA
Advisor(s): Edward Canaan / Art
Connan / 12-2:30

"The Yarners: Waking Ugly" is a super-hero-fairytale is set in the 1950's, a time when gender roles were strictly enforced. A decade after the war, a 60 year old woman with the ability to work power tools, as well has having the experience of knitting countless numbers of socks for the troops overseas, takes up her knitting needles and welding torch once again when her home town is in danger of an alien invasion. The prick of a spinning wheel, instead of sending her into an endless sleep, forced to rely on a man for her rescue, gives her super human strength. By taking the traditional domestic craft of knitting, and turning it into a weapon similar to the Zai, the character will use her skills that are perceived as womanly alongside those that will turn her into a hero. The main character isn't a damsel in distress. She isn't even a damsel, but a woman with the strength

and single-minded need for adventure and purpose in life usually only reserved for the male lead of stories. She is the hero, the active participant. She is not the moral support, not a piece of eye candy whose strength and power are merely afterthoughts. She does not stand on the sidelines or offer a parting kiss and wish of good luck. She fights. Ultimately I want to combine my computer skills with a traditional narrative and the art style of the 1950's to challenge people's conceptions of gender norms and how they are represented in movies.

BHA

44 Sunsets
Meaghan Callen / BHA
Advisor(s): Jon Rubin / Art
Connan / 12-2:30

The 44 Sunsets project is a series of sunsets recorded at various locations throughout Pittsburgh, then played back on television screens in the storefronts, windows, and lobbies of each location during the month of February, 2011. Winter can be pretty tough in Pittsburgh. Between the weather and the shortened days, we can go for weeks without seeing the sun, let alone watching it set. Sometimes it seems the sun doesn't really set during the winter so much as it does disappear. In The Little Prince by Antoine de Saint-Exupery, the title character lives on an asteroid planet that is so small that he is able to watch the sun set forty-four times in the course of a day. He need only scoot his lawn chair forward a few feet after each sunset to have the right perspective to catch another one. In the book, the Little Prince remarks on how wonderful it is to watch the sunset when "one is so terribly sad". The sunset reminds us of our sense of scale: how very small we are in the scope of things. While, like in The Little Prince, this can inspire a sense of melancholy, it can also inspire an intuitive connection to humanity. There is a distortion of time that occurs when daylight is infrequent and the sun takes an extended leave. Days blur into each other with little environmental demarcation. 44 Sunsets is a city-wide video installation of sunsets to be presented in the winter of 2010-2011. Physically, the locations and displays may range from a large window projection in a vacant storefront, to a TV sandwiched in someone's apartment window, to a security monitor at a small grocery store. The video is recorded at each location during the fall and summer months, when the sunset is clearly visible. The looping of the videos creates the narrative of a sun that is constantly setting, drawing attention to the distortion of time inherent to the winter season. The gesture of watching a sunset is simple, and usually only one or two people share the experience. By creating a network of installations that are publicly visible and accessible anytime, watching the sunset is transformed from a solitary, private moment into an unexpected, shared experience. In addition to the opportunity to escape for a moment into thoughts of warmer times, the network of locations reminds us that no matter where we go, we are all watching the same sun set.

All Bets Were Off: Changes in Scientific Causation and Tort Law through the Lens of Agent Orange from 1984 to 2005
Kendra Albert / BHA

Advisor(s): Richard Scheines / Philosophy
Hoch Commons / 2nd Floor, Window side / 3-5

Agent Orange, a herbicide that contains a toxic chemical called dioxin, was used extensively during the Vietnam War. In the late 1970s, veterans file suit against the chemical manufacturers who supplied Agent Orange to the US Military. The initial Agent Orange legal case, 'Agent Orange' Product Liability Litigation', filed in 1979 and settled in 1984, resulted in what was at the time the largest toxic tort settlement ever reached. In 2004, VAVAO vs. Dow Chemical, Monsanto et al. brought up many of the same issues, but with a different group of plaintiffs: a consortium of Vietnamese citizens representing all citizens of Vietnam. These two cases, isolated by twenty years but with many of the same key questions and presided over by the same judge, allow for a comparison of tort theory, how scientific proof of causation is treated in our legal system, and the strategies and attitudes of plaintiffs and defendants alike.

Always Here
Meaghan Callen / BHA

Advisor(s): Jon Rubin / Art
Connan / 12-2:30

"Always Here" consists of a simple message temporarily installed and photographed at various locations throughout Pittsburgh and its environs. The message glowing in neon, SOMEONE IS ALWAYS HERE, talks about both presence and absence. Depending on context, the message can be literal or metaphorical. When placed outside a hospital or a police station, it reminds us of places that we rely on to always find someone to help. Outside a nursing home or a 24-hour convenience store, it reminds us of spaces that are always occupied, where someone is always waiting. But when placed at the edge of a wood or on the shore of Lake Erie, it becomes a more enigmatic statement, contradicting the absence of "someone" and suggesting presence beyond the physical world.

Building Isolation: Barriers to a Sustainable Built Environment
Anthony Catania / BHA

Advisor(s): M. Stephanie Murray / BHA
Class of '87 / 3:40

My presentation will argue that there has been a critical loss of knowledge and distortion of perspective in the design of the built environment in America during the twentieth century. As such, it has created human living arrangements that are both unfulfilling and unsustainable. The composition will examine the characteristics of this crisis and its implications on society as a whole, and in doing so, identify a common theme of isolation (social, intellectual, and historical) that has hindered comprehensive strategies for sustainability and better design practices. By losing sight of the big picture, an unsustainable built environment emerged after World War II, and the same mentality plagues many of today's efforts to implement sustainable practices. Instead, I will look to an alternative theory for thinking about sustainability and future growth—one that's premise is continuity and coherence, not isolation and rejection. Such a strategy shall be sufficiently grounded in historical context, create fulfilling environments in which to dwell, and allow for the sustainability of a healthy civilization and planet.

Classic Film, Modern Design: Re-Branding for a 21st-Century Audience
Stephanie Huang / BHA
Advisor(s): M. Stephanie Murray / BHA
Connan / 12-2:30

The AUDREY HEPBURN Film Festival project is a branding system for an imagined Audrey Hepburn film festival set in New York City. The goal is to modernize the appeal of the classic films of Audrey Hepburn for a contemporary audience by refreshing the image of Audrey Hepburn herself, as well as implement a scheduled itinerary of events and gatherings that reference pop culture and the films themselves. Project will feature the program's festival identity, program booklet, and promotional posters, as well as a series of contextual renderings of the AUDREY campaign applied in a cityscape.

"Eurhythmic" therapy: "Let the music move you" is not just a cheesy line from romance movies
Sarah Murcek / BHA
Advisor(s): Annabelle Joseph / Music & M. Stephanie Murray / BHA
Class of '87 / 3:20

"Eurhythmic" therapy is my terminology for a proposed style of music therapy that incorporates concepts from Dalcroze eurhythmics and positive psychology into the practice of music therapy. This thesis addresses the significance of physical movement in a therapeutic context, which generally is not emphasized in music therapies. I discuss the benefits of a therapy that strives for flow experience (Csikszentmihalyi, 1990), or optimal experience in the patients and how approaches from eurhythmics (musical movement) can lead to this experience. Rather than designing a specific program for the practice of "Eurhythmic" therapy, my work seeks to make a theoretical case for the importance of incorporating these elements.

Government Funding for the Vidusl Arts: Toward the Pluralism from the 1970s
Heejin Park / BHA
Advisor(s): M. Stephanie Murray / BHA
Class of '87 / 4:00

I firmly believe that the arts in the United States as they are in other nations need to receive some form of government funding both on the national, regional, and local level. The arts cannot survive especially in the current economic climate without a base subsidy. I will demonstrate how and why federal and local funding can benefit creativity when funding has been made available across disciplines and medium.

Iccha: Multimedia Strategies for Promoting English-Language Acquisition among Bhutanese Refugees
Melissa Acosta / BHA
Advisor(s): M. Stephanie Murray / BHA & John Zimmerman / Human Computer Interaction Inst.
Connan / 12-2:30

How can we help refugees gain essential English skills? Refugees arrive with little cultural and linguistic preparation to life in America. I am designing and implementing a learning platform that empowers refugees to gain esssential English communication skills & leverages the knowledge of volunteer tutors. The system consists of a web interface that allows tutors to rapidly create content & the ipod so refugees can download the lessons and practice them during the week.

The end-goal is to enable language learners: (a) to move through lessons at their own pace, (b) to manage learning environment, as the products can be used at home or on their daily commute, (c) and to encourage language learners to request learning modules that address their particular needs.

Meditation of The Word
Sarah Habib / BHA
Advisor(s): Ayanah Moor / Art & M. Stephanie Murray / BHA
Connan / 12-2:30

Spoken and written words are our main vehicles to share what we see and experience. Because of what is associated with certain words and definitions, words are often reductive in their descriptions. I address this concern by examining text as image, attempting to elicit the words' meanings from the image made. For this particular piece I created several different versions of the word meaning "remember" in a different language. I made the different abstract permutations by exploring both traditional calligraphy and my own writing aesthetic. I used different arrangements of these permutations to create a visual image. Since the letterforms are so abstracted, it is not meant for their meaning to be explicitly stated or understood, only that the image they form asserts a sense of rumination that accompanies the act of remembering. This piece is meant to be a small gesture to erase language barriers: the borders between those who understand and those who do not.

Music and Social Change: Carlos Mejia Godoy and the Nicaraguan Revolution
Nicole Rappin / BHA
Advisor(s): Robert Fallon / Music
Pake / 1:40

Although music is often acknowledged as a force that can serve political revolution, the mechanisms for how it does so remain poorly understood. In Nicaragua, composer Carlos Mejía Godoy's music spoke to the beliefs of revolutionary groups in the late 1970s. His music instructed and inspired the revolutionary movement. The key factors of Mejía Godoy's music that spurred political progress in Nicaragua are the pre-existence of an oral tradition, song's role in collective memory, his music's appeal to religious practices, and its recontextualization of tradition in order to resonate with current struggles.

Resurrecting Pittsburgh: The Syria Mosque
Samuel Lavery / BHA
Advisor(s): Diane Shaw / Architecture
Connan / 3-5

How can we apply cutting-edge technology to the traditional practices of historic preservation? Can we recreate a building that has been demolished for almost twenty years? Is such an endeavor worth the trouble—does a building that only exists in the memory of some people have any meaning for people who don't know it ever existed? My project seeks to answer these questions through the use of research and the creation of an installation. I will use the Syria Mosque as a case study to look at significant structures in Pittsburgh that have long since been destroyed but have a lasting memory and influence on the city. The installation I am proposing will use QR codes placed around the site where the Syria Mosque once stood (now a parking lot at the corner of Fifth Ave and

Bigelow Blvd.). QR codes are barcodes that, when read by a cell phone camera, reveal a website link, audio clip, or image. The QR codes will be linked to archival images of the building and recordings made by the many famous groups that played in this historic music venue. The locations of the images will be matched to the points where the codes are placed. The QR codes can only be read by Smartphones; my project will intentionally be focused on attracting the attention of young professionals and students in Oakland—people who would not know that the parking lot they are passing by was once home to a spectacular piece of architecture. As someone who is very interested in the preservation of built structures of the past, I hope that my project creates some interest in historic preservation among the people who will interact with it. I also hope my project will join in a larger dialogue about how new technology and social media can be applied to the art of preservation.

The Aftermath of Heavy Metal
Meaghan Callen / BHA
Advisor(s): Terrance Hayes / English
Class of '87 / 3:00

"The Aftermath of Heavy Metal" is a manuscript of poems curated from the oeuvre generated during my undergraduate career.

The Colour Space
Hannah Gilchrist / BHA
Advisor(s): Kristin Hughes / Design
Hoch Commons / 2nd Floor, Window side / 12-2:30

Colour affects every person, every day. From subliminal environmental cues to web development to art, colour is a foundational component in our emotional reactions and our ability to impose visual order on our surroundings. The purpose of this research project was to investigate what four core disciplines, Chemistry, Physiology, Psychology and Anthropology, had to say about the nature of colour. Surprisingly, each perspective is very unique; each discipline emphasizes a specific set of colour's aspects. The results show how a comprehensive, interdisciplinary approach to colour would be useful for current research into colour. Most importantly, this universal approach could engender new questions and revitalize old questions about our interaction with a coloured world. My goal, in this and future research, is to create a "colour space" where interaction with concepts across disciplinary boundaries is both efficient and intuitive.

TODAY, I
Kristen Staab / BHA
Advisor(s): M. Stephanie Murray / BHA
Connan / 12-2:30

TODAY, I addresses the nature of our recording of time and events. Our systematic organization of such data into blocks (i.e. today) renders them analogous, even identical. With this distancing from actual events and the subsequent categorical documentation thereof, we forget the specificity of the present as it becomes the past. What we are left with is the evidence of time: static, monochrome, textual fragmentation.

You say you want a revolution: The rhetoric of classical music educators
Maria Raffaele / BHA
Advisor(s): Robert Fallon / Music & Ludmila Hyman / English
Pake / 3:40

Everyone has identity crises. Such upheavals of self-doubt, self-examination, and self-transformation are a painful but essential component of growth and innovation, whether an individual or nation, a small business or an entire professional field. Among classical music professionals, many take it for granted that their field is in the throes of just such an identity crisis. Students, educators, professionals, and loyal concert-goers all debate and deplore classical music's impending demise, goaded on by the alarmist articles, books, and lectures that frequently circulate through the community and the public media. As an undergraduate music major looking to build my future in classical music, understanding this controversy is fundamental to my personal growth and my professional career.

In order to face this controversy, I chose to investigate the status of the debate among classical music educators—those tasked with the training of future generations of classical music professionals—using the tools and techniques of rhetorical analysis. I interviewed four of my Carnegie Mellon music professors—a performer, a composer/music administrator, a conductor and a journalist/historian—on this and other related topics, and then analyzed the transcribed interview texts to determine my professors' perceptions of their field, the origins of these perceptions, and the connections between their perceptions and their teaching philosophies and methods. As my investigation progressed, I discovered direct correlations between my professors' perceptions of their own careers and their perceptions of the future careers of their students. While each recognized significant changes in their field and the surrounding societal and global contexts, and each acknowledged the need for systematic transformation, my professors were ultimately unable to separate their own identities and past experiences from their visions of their field's future. This suggests that drastic changes in the classical music profession (or indeed any profession) must originate with outsiders or members of younger generations, as only they can invent fundamentally new practices and objectively evaluate the past and present. I conclude that the future and survival of classical music depend upon the cultivation of external champions, a process that will require classical musicians to move actively engage with the broader society, moving past their prejudices to seek out and enlist unconventional and unorthodox allies in their struggles for professional reinvention and revolution.

BIOLOGY & PSYCHOLOGY

Communal Coping Between Persons with Diabetes and Their Partners: An Exploratory Study
Emily Chao / Biology and Psychology & Jillian Cheng / Biological Sciences
Advisor(s): Vicki Helgeson / Psychology
Kirr Commons / 1st Floor, Window side / 12-2:30

My group and I would like to get a greater understanding of how partners of persons with diabetes help or hinder self-care behaviors. The study aims to explain the role of the social environment, and in particular, the partner's role in facilitating self-management among persons with Type 2 diabetes. The results of the study will benefit health care practitioners by informing them of ways in which couples can work together to enhance diabetes self-care, which is key to preventing diabetes-related complications. We will first conduct an exploratory pilot study that consists of adults over the age of 18 who have Type 2 diabetes and have been married or living with a partner for at least two years. Participants will participate in an in-depth phone interview.

Cue weighting in speech categorization based on short-term cue variabilities
Howard Soh / Biology and Psychology
Advisor(s): Lori Holt / Psychology
Kirr Commons / 1st Floor, Window side / 12-2:30

Native English speakers differentiate the vowel in "set" from that in "sat" using two different auditory cues, vowel spectrum and vowel duration. The purpose of the present experiments was to determine the effect of short-term statistical irregularities in these two cues on the degree to which listeners rely on each cue for vowel identification. In Experiment 1, vowel identification patterns were measured after short-term exposure to stimuli with one cue held constant and the other cue exhibiting the full range of variability. Results reveal that listeners shift their cue weighting, relative to baseline, to rely more heavily on the highly variable cue for categorization. In Experiment 2, weighting of vowel duration was measured after manipulating the correlation between the vowel spectrum and vowel duration values to be inconsistent with what is typically found in English. Results show that, as a result, listeners down-weight their use of duration cue. This suggests that vowel spectrum (the dominant cue) is acting as a "teacher" signal, and when duration is no longer correlated properly, listeners stop using it as a cue to vowel identification. Collectively, these data suggest that long-term representations of how acoustic cues map onto vowel indentification are highly flexible. Listeners are able to adapt and retune perception to adjust to short-term statistical regularities.

PCIT and AF-CBT: Efficacy and Dissemination of Two Evidence Based Treatments for Disruptive Behavioral Disorders and Child Abuse
Devin McGuier / Biology and Psychology
Advisor(s): Beth Christiano Zimick / Psychology
Rangos 1 & 2 / Sigma Xi Group 8 / 11:30

Two evidence-based treatments were taught to community clinicians. Alternatives for Families, a Cognitive Behavioral Therapy (AF-CBT) is a cognitive behavioral therapy aimed at increasing

parent-child relationships and decreasing aggressive incidents in child abuse populations. Parent-Child Interaction Therapy (PCIT) is a therapy aimed at increasing the quality of parent-child interaction as well as decreasing symptoms of disruptive behavioral disorders while increasing parental skills. Both treatments have a strong evidence base and have been shown to be effective in numerous studies. The goal of this research is to both track efficacy of these treatments as well as to determine how to best teach treatment protocol to community clinicians. By determining mechanisms by which to increase clinician competence and adherence to protocol, it will be possible to train more clinicians in the use of the evidence-based treatments and by extension provide them to more children in need.

The Effect of Musical Expectation in Background Music on Short-Term Phonological Memory
Elizabeth Aguila / Biology and Psychology
Advisor(s): Richard Randall / Music
Rangos 1 & 2 / Sigma Xi Group 8 / 10:45

This study examines the effect of musical expectation on short-term phonological memory. Working from the premise that the processing of diatonic melodies with expectation violations requires greater cognitive resources than the processing of melodies with no violations, this experiment asked subjects to perform a simple memory task while listening to a melody in the background. If a melody violates an expectation, we hypothesized that the increased cognitive demand would draw resources away from the foreground memory task and negatively effect short-term phonological memory. Specifically, we isolate the melodic expectations of pitch proximity and post-skip reversal (Huron, 2006). Pitch proximity is when listeners expect a following pitch to be near a current pitch. Post-skip reversal is when listeners expect a large interval to be followed by a change in direction. For each trial, subjects were shown a series of seven random numbers ranging from 1 to 7 for one second for each number. The numbers were presented with a background diatonic melody of 16 notes (major mode and beginning and ending on scale-degree 1). The melodies used included a control melody, three types of broken pitch-proximity melodies, two types of post-skip reversal violation melodies, and two post-skip reversal lure melodies. The background melodies played were randomized within the entire experiment. Following the presented number series, the subjects were asked to remember the numbers in the exact order they were presented. After all the tasks were completed, subjects were asked to complete a survey. There were a total of 28 subjects, including 13 males and 15 females. Although there was no significant effect of music condition on percent error of the memory task, there was a significant effect of serial position. Also, there were significant interactions between one melody with a broken pitch proximity expectation and the two post-skip reversal lure melodies.

BSA

Determining Rate of Acid Production in Cellulose Based Paper
Rebecca Reed / BSA
Advisor(s): Paul Whitmore / Chemistry
Hoch Commons / 2nd Floor, Window side / 3-5

The life expectancy of a sheet of paper depends in large part on its acidity, for acids will catalyze the breakdown of the cellulose composing the paper fibers. It is believed that some of that acidity is created in the paper as it degrades to form sugar compounds, which are then converted to acids. In this project the rate of that acid generation from sugar compounds in paper will be measured as a function of temperature, humidity, pH (acidity), and fiber substrate. Sugar compounds known to be created during paper deterioration (glucose, xylose, cellobiose) will be added to designed paper substrates, which will then be thermally aged. The production of small molecular weight acids, such as acetic acid, will be measured using gas chromatography/mass spectrometry.

OPA! Greek Performance & Cooking Show
Alia Poonawala / BSA
Advisor(s): Jed Harris / Drama & M. Stephanie Murray / BHA
Class of '87 / 4:40

This project seeks to demonstrate Greek culture and educate about its cooking traditions (the passing down of ancestral recipes, family-style eating) and food sciences (the process of curing olives, a diet based on the land, etc.) This will be conveyed through the family dynamics of a cooking show, which will be presented by a main host who is the head of a traditional Greek family. The filmed cooking show will be treated as a performance in the sense that a script will be used to carry a plotline and move the show along. However, its purpose is to educate about food and cooking and therefore, is a fusion of my background in science and theatre. My aim with this show is to provide a fun and personal aspect to educating my audience. I've decided to use food as a medium because in addition to being a human necessity, it is rich with meaning. It can represent whole cultures and their history, families and their recipes, and the natural resources of a country made edible by sophisticated processes. This endows food with the power as an effective medium to educate. Using actors from the university, a interdisciplinary production team (Drama, Creative Writing, etc) the show will be filmed in a Roselawn Apt. and will be funded by the BXA Program.

ECONOMICS
HUMANITIES & SOCIAL SCIENCES

Accuracy of Pittsburgh Bus Timetables Used by CMU Students
Matthew Belenky / Economics, Timothy Higgins / Economics & Science and Humanities Scholars, John Sperger / Social & Decision Sciences, Chao Wang / Electrical & Computer Engineering, Tian Wu / Business Administration
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

Many students and Professors at Carnegie Mellon rely on the public transit system to get to work, however students frequently complain about the PAT bus system. The most common complaints are late buses, inaccurate schedules, and the frustration that occurs after waiting for a bus only to have multiple buses of the same route arrive at the same time1. Waiting wastes time, causes frustration, and in the long run could lead commuters to choose to find a way to travel that doesn't involve public transportation. To aim of this study is to first measure the degree to which these complaints are accurate, and if buses are systematically late develop a model for predicting expected arrival time. This study will be build on a strong general literature base on public transportation and

investigate the accuracy of bus time tables for the Forbes and Morewood intersection which is the most commonly used bus stop for commuters at Carnegie Mellon University. Bus departure times will be observed and compared to posted bus schedules. A number of potential factors that influence bus punctuality will also be measured including the weather, the time of day, and the level of light. Using these factors and the information collected on bus arrival times, a model will be created to predict when a bus will arrive given the scheduled arrival time.

An Assessment of 33% RPS in California and Projection of its position and CO2 Emissions from the Electricity Sector in 2020

Ya Qi Niu / Economics & Science and Humanities Scholars Karen Yu / Civil and Environmental Engineering

Advisor(s): Ines Azevedo / Engineering and Public Policy

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

The CPUC and the California Energy Commission are responsible for implementing the state's Renewables Portfolio Standard Program. They have established a 33% renewable goal to help California meet its climate change targets established in AB 32, which requires that California's statewide GHG emissions to be reduced to the 1990 level by 2020 (a reduction of about 25%). The objective of our research is to determine the feasibility for California to achieve the aims of AB 32. In addition, we aim to extrapolate, given current data of carbon dioxide emissions, the extent of emission reductions in 2020 and to predict if the quota of 33% RPS could be attained from current policies and effort by the Californian legislation.

Homicide Trends in America, 1850-1950

Megan Sasinoski / Economics

Advisor(s): Karen Clay / Economics

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

Since roughly the 1850s, homicide rates in America have been on the rise. If the upward trend were to continue in the same way, it would be important to look at demographic, cultural and societal influences on the increases and decreases of homicide rates in different parts of the country. The ability to predict what factors are important for reducing homicide can have tremendous public policy implications for the future and may provide information for law enforcement officials to be able to reduce or deter homicide. This project will document homicide trends in America and present historical interpretations of the data.

Impact of Social Risk Aversion and Audience Effects on Generosity to the Poor

Shweta Suresh / Economics

Advisor(s): Christina Fong / Social & Decision Sciences

Pake / 1:20

This paper is focused on understanding the impact of social risk aversion and audience effects on generosity from the relatively well-off to the poor. By conducting dictator games, I have collected data that measures how much people decide to donate to a disabled person or a drug or alcohol user under different situations. My experiment modifies Christina Fong and Felix Oberholzer-Gee's prior experimental design in order to better identify how the two separate phenomena of social risk aversion and audience effects work to alter donors' decisions, especially when they are given the option to purchase information about the welfare recipient. Understanding these motivations behind

people's decision to donate is important because this information allows governments and NGOs to better structure transfer programs.

Student Consumption of Caffeine On Campus
Prerna Agarwal / Economics,
/ Economics and Statistics, Abigail Daughtrey / English,
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

Numerous health studies have demonstrated the damaging effects of excessive caffeine consumption on cardiac wellbeing in addition to psychological and mental health. There is significant concern that students today consume large amounts of caffeine to keep up with their academic workload or enance their performance in soprts activiites. We have surveyed the Carnegie Mellon University undergradate population in order to determine types and amounts of students' caffeine consumption. Further, we measured students' perception of acceptable caffeine usage.

Studying the Effect of Payment Medium on Spending
Dina Megretskaia / Economics
Advisor(s): Elif Incekara Hafalir / Economics
Pake / 2:00

Much interest has been directed towards the credit card industry in the past several years, in part because of households' increasing debt levels. I am interested in whether credit cards inspire higher spending, not for liquidity reasons but merely due to lack of salience of the amount being spent. It is my hypothesis that method of payment affects how much consumers spend, specifically that paying with credit card leads to higher spending than paying with cash. By conducting a field experiment with random assignment of payment medium, I intend to study whether there is a causal relationship between payment medium and spending amount.

Studying the Effect of Payment Medium on Spending
Dina Megretskaia / Economics
Advisor(s): Elif Incekara Hafalir / Economics
Pake / 2:00

Much interest has been directed towards the credit card industry in the past several years, in part because of households' increasing debt levels. I am interested in whether credit cards inspire higher spending, not for liquidity reasons but merely due to lack of salience of the amount being spent. It is my hypothesis that method of payment affects how much consumers spend, specifically that paying with credit card leads to higher spending than paying with cash. By conducting a field experiment with random assignment of payment medium, I intend to study whether there is a causal relationship between payment medium and spending amount.

Survey of Carnegie Mellon Faculty Regarding Attendance Policy and Student Performance
Emily Boncek / Science and Humanities Scholars, Christopher Chang / Statistics, Kelly Chang / Electrical & Computer Engineering, Stephanie Sindler / Economics
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 3-5

We are conducting a survey of members of the Carnegie Mellon faculty community in order to determine if there is a relationship between whether or not a class has mandatory attendance and students' performance in the class. This topic is interesting because there is a large disparity in the way classes are structured across various departments of the university, and thus it is possible for two students of different majors to have entirely opposite classroom experiences. This survey is interested in determining if requiring attendance has an effect on or can improve students' performance in classes. We are distributing a self-administered online survey to Carnegie Mellon faculty who taught undergraduate courses in the Fall 2010 semester. Data collected about each course includes department, class size, attendance policy information, and distribution of final grades. We will compare the distribution of final grades for attendance mandatory versus attendance optional courses to determine the effect of attendance policy on student performance. Although we are still in the data collection process, we expect to find that attendance mandatory courses will have better student performance. While we will definitely be able to make conclusions within academic departments, we also hope to generalize these comparisons within and across colleges.

Undergraduate Prospects After Graduation
JeWoo Sun / Statistics, Erika Tang / Economics, Zhiyi Tang / Statistics, David Zimmerman / Statistics
Advisor(s): Brian Junker / Statistics
Rangos 1 & 2 / Sigma Xi Group 8 / 12:00

Given the recent scandal revealing the over optimistic prospects for graduating law school students, the statistics produced by universities and published in the US News and World Report are being brought into question. These misleading statistics encourage hopeful JD seekers to pursue startling loans with the expectation that their debts will be paid off with relative ease upon graduation thanks to the supposed 84% job placement ratings. While the production of undergraduate college rankings has often been criticized for its accuracy in measuring the actual quality of education, Carnegie Mellon University and other universities have long bolstered their reputations for producing intelligent, motivated, and successful students with the use of these faulty lists. However, this raises the question of how measurably successful Carnegie Mellon University undergraduate alumni are. Where do alumni relocate? What occupations do they practice? What graduate programs do they choose to pursue? And, according to the common man's perception of comparative success, how do Carnegie Mellon University undergraduate alumni stack up when compared to graduates of other universities? This study analyzes the data collected and evaluated by the Carnegie Mellon University Career Center (http://www.studentaffairs.cmu.edu/career/students_alumni/post-grad-survey/index.html) in order to answer such questions as: Are alumni—successful by Carnegie Mellon standards—well received by employers and graduate programs? Do alumni display a tendency to remain near to Pittsburgh or to relocate elsewhere? Do alumni successfully attain employment relevant to their subject(s) of study? How accurately do national and international rankings systems gauge the value of a Carnegie Mellon Undergraduate degree? The data collected from the Carnegie Mellon University Career Center is will also be used to test the effectiveness of various survey methods. The Career Center has nearly perfected its collection data collection methods as response rates generally run somewhere in the 90th percentile (with the exception of College of Fine Arts classes where response rates are as low as the 70th percentile). This has yielded results near to that of census data. As such, this study assesses the effectiveness of certain types of sampling schemes (stratified and clustered sampling) to produce results representative of

the target population so that future statistical researchers can visually apprehend the significance of various survey designs. Few have had the data provided or the opportunity to conduct a study on accurate census data in order to optimize survey results to population parameters.

ECONOMICS & STATISTICS

Exploring Learning Rates: Do Students Learn at Different Rates?
Emily Boncek / Science and Humanities Scholars, Yinglu Yao / Statistics, Xiaoyu Zhu / Economics and Statistics
Advisor(s): Rebecca Nugent / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

As emerging curiosity and excitement in learning behavior gives rise to educational data mining, learning scientists are exploring how people learn. The Pittsburgh Science of Learning Center (PSLC) maintains an open data repository, the DataShop (https://pslcdatashop.web.cmu.edu/), of learning data coming primarily from an interactive tutoring system. Our primary goal is to model differences in student learning rate so that PSLC could potentially design programs to improve learning in the future. To achieve this goal, we are using a Geometric Area dataset collected from 1996 to 1997, where students were prompted to solve various problems related to geometric area step by step. We will develop an algorithm to compare students' learning rates using this data set, and apply the method to other data sets from PSLC.

Faculties Attitude toward Plus/Minus Grading System
Hye Jung Cho / Economics and Statistics, Erica Choi / Science and Humanities Scholars, Aiena Garg / Economics and Statistics, Dong Seob Kim / Chemistry, John Shoup / Statistics
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

In Carnegie Mellon University, students work very hard to get high GPAs. Students are concerned about GPAs since they have high impact on chances of getting a job or admissions to graduate schools. Carnegie Mellon University currently implements grading system without plus or minus letter grades. Students' opinions on the current grading system vary. Previous research from Carnegie Mellon students from "Sampling, Survey and Society" in 2008, surveyed 341 students' opinion regarding implementation of plus/minus grading in CMU. In this study, 18 percent of the respondents supported the implementation of plus/minus system, 68 percent were against it and 14 percent were undecided. Our research analyzes faculties' attitude toward the implementation of plus/minus grading system. We distributed on-line surveys to randomly selected 578 faculties. The survey questions constitute several demographic questions as well as view on current grading system in CMU and implementation of plus/minus grading system. After carrying out an exploratory data analysis, we ran analysis of variance on our data. Then, we compared our result to the previous research done in 2008. Our result suggests that faculties from different departments have varying opinions regarding the implementation of plus/minus system.

Investigation of the results from the Content Focusing Coaching study and evaluating alternative Hierarchical Models

Brittanie Boone / Economics and Statistics, Erica Choi / Science and Humanities Scholars, Thomas Todd / Statistics

Advisor(s): Rebecca Nugent / Statistics

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

One of the current problems facing low income districts is high teacher mobility in classrooms. This may be affecting students' reading comprehension development since many teachers have different methods of teaching. One possible solution is Content-Focused Coaching, a program that pairs trained coaches with classroom teachers for the purpose of improving reading comprehension instruction. Previous research from Marsh et al. (2008) found coaching has positive effects on reading achievement for students. The most current research from Matsumura et al. (2010) found that the CFC program had a positive effect for students who were English language learners. Our research analyzes data from the Matsumura et al. (2010) longitudinal randomized field trial, conducted between 2006 and 2009 to determine the effectiveness of a Content-Focused Coaching program on districts with high teacher mobility. The data came from an urban school district in Texas where fifteen schools were randomly assigned to have the CFC program and 14 schools were randomly assigned to be the control group. Due to ethical issues, control schools were also allowed to have literacy coaches. We used this data to verify the model Matsumura found and investigate more efficient models for the data. Due to the already embedded level structure of the data, schools within a district and teachers within the school, we used hierarchical level model analyses. After running Markov Chain Monte Carlo methods with schools as our level and testing multiple random intercept and random slope hierarchical models, we found no isolated positive effect for the CFC program. We then investigated non-linear models to show the effect of CFC on students in the data and found similar results. It appears that the CFC program does not have a positive direct effect on students' test scores without the interaction with other student variables. This suggests that other programs may be needed in order to improve the test scores for all students.

Student Consumption of Caffeine On Campus

Prerna Agarwal / Economics, Yong-Gyun Choi / Economics and Statistics, Abigail Daughtrey / English, Christopher Loncke / Mathematics, Bassem Mikhael / Economics

Advisor(s): Brian Junker / Statistics

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

Numerous health studies have demonstrated the damaging effects of excessive caffeine consumption on cardiac wellbeing in addition to psychological and mental health. There is significant concern that students today consume large amounts of caffeine to keep up with their academic workload or enance their performance in soprts activiites. We have surveyed the Carnegie Mellon University undergradate population in order to determine types and amounts of students' caffeine consumption. Further, we measured students' perception of acceptable caffeine usage.

The Connection Between Ultra High Energy Cosmic Rays and Active Galactic Nuclei

Jingyi Mo / Statistics, Michael Rednor / Statistics, Kyra Singh / Economics and Statistics

Advisor(s): Peter Freeman / Statistics

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

Ultra high energy cosmic rays are charged particles that collide with the Earth's atmosphere at relatively infrequent rates. These particles differ from medium and low energy particles as they occur less frequently and much is unknown about the nature of their origin. Recent research by the Pierre Auger Collaboration has suggested that the origin of these particles may be nearby extragalactic matter known as active galactic nuclei (AGN). This research project aims to determine if and what the relationship is between the ultra high energy cosmic rays and the known AGN. The data set is comprised of 69 observed cosmic rays from the Pierre Auger Observatory and a catalog of 1,132 AGN. Using a series of simulations that compare the minimum distances between each cosmic ray and the AGN for observed and simulated data sets, the Kolmogorov-Smirnov test returned results that indicated we have evidence that cosmic rays come from a non-isotropic distribution of matter in the galaxy. The research also addresses the known limitation of the incompleteness of the AGN catalog in order to further study the relative non-isotropic nature of the cosmic ray occurrence. Additional data on the cosmic rays may be needed in order for future research to determine the exact origins of the cosmic ray occurrences.

ENGLISH

A Writer's Journey
Jana Arredondo / English

Advisor(s): Sharon Dilworth / English
Class of '87 / 1:20

A filmed exploration of the writer's journey as discussed by aspiring writers and published authors. Is every writer's journey different?

Akoma
Godwina Titus / Social & Decision Sciences & Efi Turkson / English

Advisor(s): Edda Fields-Black / History
Connan / 12-2:30

In an increasingly globalized world the dissemination of cultural and artistic influences is inevitable. However, it seems as if one continent has largely been ignored in the globalized world of fashion. Inspired by Conde Nast's decision to reject a Vogue Africa; we seek to determine why the world ignores Western Africa's importance and potential in the fashion industry. To determine this we will assess globalization's far reach in the "dark" continent. We will create a collection of clothing that highlights Western Africa's rich tradition of print fabrics and ceremonial attire and merges Western influence with African traditions. We will also create an art booklet that highlights the collection we created and attempts to disseminate knowledge about Western Africa and its place in the fashion world.

Even this Shadow has Weight: Collected Poetry
Dominique Davis / English

Advisor(s): Jane McCafferty / English
Class of '87 / 1:40

Collection of original works that i have written and revised over the past four years.

Fumbling in the Marrow: Poems by Shannon Azzato Stephens
Shannon Stephens / English

Advisor(s): Yona Harvey / English
Dowd / 4:00

My Senior Honors Thesis is a creative project: a chapbook-length collection of poems. In it, I explore the formulation of personal identity through relationships with others, the mark of memory, the importance and richness of place, and the critical role of language in a world where language is not enough. During this oral presentation, I will read selections from my thesis. I will also discuss the process of writing it, and its place in contemporary poetry. Ultimately, I will establish that my work exists in a new era of poetic discourse that values the intersection of introspection and public observation, cherishes image and language but respects its limitations, and accepts that certain narratives can only be expressed in poetic form.

Ghostwalk
Anabelle Lee / English

Advisor(s): James Daniels / English
Hoch Commons-2nd Floor, Window side / 12-2:30

A H&SS Senior Honors Thesis. A novel exploring the relationships and distance between people in a post-apocalyptic setting.

Happiness as a Multi-voice Narrative
Ellene Mobbs / English

Advisor(s): James Daniels / English & Karen Berntsen / Computer Services
Connan / 3-5

This project seeks to combine visual and verbal elements to create a complex, but cohesive, narrative treating the topic of happiness. The form -- a box containing a number of inter-related, hand-made books that can be grouped and read in many different ways -- is designed to mirror the overlapping and multi-voice nature of the content -- a series of interviews and journal entries. The project encompasses creative writing, interviewing, document design, typography, and book making.

Home is Behind, The World Ahead
Chloe Perkins / English

Advisor(s): Hilary Masters / English
Dowd / 12:20

"Home is Behind, The World Ahead" is a collection of original feminist fairy tales completed as part of Chloe Perkins' Senior Honors Thesis in Creative Writing. All ten of the tales are set in different cultures and adhere to a feminist theoretical framework Perkins has developed from the essays of Kay F. Stone, Marcia R. Lieberman, Ruth B. Bottigheimer, and Karen E. Rowe. She will speak briefly on the origins of this project and the theoretical framework that supports it, then she will conclude with a reading of one of her shorter tales.

Ideographic Analysis of Israel Prime Minister Rhetoric during the 2008-09 armed conflict with Hamas in Gaza
Calvin Pollak / English

Advisor(s): David Kaufer / English
Dowd / 12:40

From December 27th 2008 through January 18th 2009, the Israel Defense Forces engaged in hostilities in the Gaza Strip. Official discourse explaining and justifying the effort ubiquitously employed the word "terror", in its various forms, in descriptions of Israel's enemies. The prevalence of this linguistic feature alone suggests that it is rhetorically significant. As we will see, its discourse function is consistent with patterns previously observed by scholars of American war rhetoric. My analysis contributes to that scholarship by showing that ideographs such as "terror" can emerge from any nationalistic ideology. In my work, I ask: how did an ideology of nationalism inform wartime discourse during Israel's Gaza offensive? How does "terror" function as an ideograph in Israeli public discourse? And more generally, I seek to contribute to the central question of ideological criticism (Foss 2004), how does discourse legitimize some ideologies while de-legitimizing others? Equipped with the awareness my work seeks to foster, we can predict that political rhetors who seek to justify state violence anywhere will do so from a dichotomizing stance juxtaposing "us" (those within our culture) and "them" (those outside of it).

Journal of 21 year old
Aliesha Jones / English

Advisor(s): Charlee Brodsky / Design
Hoch Commons / 2nd Floor, Window side / 3-5

I travelled and recorded my time spent in India for four weeks, documenting how life is different for an American college student in a new culture. Here is what I learned.

Last Train to the Midnight Market
Marci Calabretta / English

Advisor(s): James Daniels / English
Dowd / 1:00

"Last Train to the Midnight Market" is a manuscript of prose and poetry inspired by the privacy and emotion of the multicultural domestic space. The first explores the emotional upheaval of a biracial family as they return to Korea after years of avoidance and denial. The second part explores the familiar yet slightly unhinged psyche of a college student's experience with an emotionally divided household. The juxtaposition of these two very different spheres is to draw out the richness of the multicultural experience, and to thread its consistencies throughout both foreign and familiar relationships. The South Korean midnight market grounds the experience for readers and creates an additional layer to the characters' conflicted states. Initiated as a senior honors thesis to prepare the author for the creative productivity necessary to pursue a graduate degree in Creative Writing, the project was inspired by the author's own experiences both as an Asian-American and as a volunteer living abroad and teaching ESL to South Korean orphans.

Midnight Radio: a Short Story Collection
Emily Nagin / English

Advisor(s): James Daniels / English
Dowd / 1:40

Midnight Radio is a collection of connected short stories set in Pittsburgh. It follows two groups of friends over the course of eight years. Pittsburgh is such a small city that concept of six degrees of separation can often be whittled down to three. This collection attempts to reflect that reality: all of the characters know each other, at least superficially. They step in and out of each other's lives, sometimes affecting major changes, sometimes not. The collection attempts to show the reader each character from several angles, to demonstrate that there is always more than one version not only of every story, but every person.

Rooms of Their Own: Autonomous Feminist Squats of the 1980s
Kelly Bescherer / English & Science and Humanities Scholars
Advisor(s): Donna Harsch / History
Dowd / 4:20

Experimentation in the realm of daily life had already been a major battle ground for New Left German groups of the 1960s. This paper traces the post-1968 expansion of the idea of autonomy, as it developed through the countercultures of the women's and the squatter's movements. Both movements defined themselves with the term "autonomous," an idea which for them implied a desire to take control of their own lives by throwing off all forces which threatened their ability for self-rule. I will focus especially on these two movements' point of intersection: the many all-female squats which simultaneously sought autonomy from men, the state and hegemonic culture, at the same time as they sought to create a physical space in which this autonomy would be possible.

RR - A Novel
Gabriel Routh / English
Advisor(s): Sharon Dilworth / English
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

RR is a novel which explores a writer's dreams, how each of us deals with grief, and how each of our lives is in itself a hero's journey.

Sitting for Success: The Effect of Self-Embodied Cognition on Stereotype Threat
Laura Alfonso / English, Katherine Cuti / Psychology, Cze-Ja Tam / Psychology
Advisor(s): John Creswell / Psychology
Kirr Commons / 1st Floor, Window side / 12-2:30

Stereotype threat occurs when an individual is concerned about fulfilling a negative stereotype about a group he or she is a part of and fulfills that stereotype because of this concern, which can hinder the individual's performance. However, the self-embodied cognition theory states that certain cues, such as bodily movements, can also influence the way individuals respond to certain situations. In this study, we examine the effect of self-embodied cognition on stereotype threat as it pertains to performance on a math test. Participants were randomly assigned to a male embodiment condition (straddling a chair; holding a fist) or to a neutral condition (sitting normally; holding palm out) while they completed a math assessment. Our data demonstrated that female participants were able to overcome stereotype threat and perform equally well by embodying male characteristics. Our experiment suggests that self-embodied cognition is an effective way of countering the effects of stereotype threat.

Small Talk: A Collection of Personal Essays
James Berndt / English
Advisor(s): Hilary Masters / English
Dowd / 4:20

A good personal essay should be like a good conversation: it should flow as gracefully as a river. In this collection, each essay follows the interest of the writer, much like a conversation follows the interest of each participants. Through the use of anecdotes, quotations, and contemplation, these essays intend to entertain and educate the reader in the same way a conversation might.

Student Consumption of Caffeine On Campus
Prerna Agarwal / Economics, Yong-Gyun Choi / Economics and Statistics, Abigail Daughtrey / English, Christopher Loncke / Mathematics, Bassem Mikhael / Economics
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

Numerous health studies have demonstrated the damaging effects of excessive caffeine consumption on cardiac wellbeing in addition to psychological and mental health. There is significant concern that students today consume large amounts of caffeine to keep up with their academic workload or enance their performance in soprts activiites. We have surveyed the Carnegie Mellon University undergradate population in order to determine types and amounts of students' caffeine consumption. Further, we measured students' perception of acceptable caffeine usage.

The Appalachian Trail: Understanding its Impact and Meaning in Pennsylvania Communities
Mackenzie Smith / English
Advisor(s): Jane McCafferty / English
Peter / 3:20

The Appalachian Trail, a 2,178 mile hiking trail managed by the National Park system, is the oldest scenic trail in the United States and an important cultural and wilderness landmark. Approximately four million people utilize the Appalachian Trail each year; these hikers rely on a diverse network of communities nestled among the fourteen states that traverse the trail to meet their food, fuel and rejuvenation needs. This project combines ethnographic field research methods with the literary genre of creative nonfiction to craft a collection of essays focusing on the impact that the Appalachian Trail and its hikers has on two Pennsylvania communities, Boiling Springs and Duncannon. Themes and areas of exploration include understanding the cultural meaning that each community associates with the other, the communal relationship between hikers and members of these communities, and the social and economic role of the Appalachian Trail in Boiling Springs and Duncannon. This project explores the cultural meaning of the Appalachian Trail for both its hikers and those who live and work in the communities surrounding the trail.

The Naked Note Taker
Mackenzie Smith / English
Advisor(s): Jane McCafferty / English
Peter / 3:40

The Naked Note Taker, a nonfiction essay collection and writing blog, seeks to explore the world by exposing myself and my writing to new ideas, people and places. Topics covered in the essays and

on the blog include hitchhiking in the Appalachian mountains, and conducting research in Moroccan hammams. Please visit the blog, The Naked Note Taker: http://thenakednotetaker.wordpress.com/

Zombie College Musical
Stefan Dezil / Drama, Spencer Diaz / Art, David Grabowski / Music, James Krahe / Art, Yulin Kuang / English, Lachlan McKinney / Drama, Alexander Rothera / Art & Benjamin Welmond / Art
Advisor(s): Kristina Straub / Art
McConomy Auditorium / 11:00

The objective of this project is to create a five-episode musical webseries on a low budget, through student collaboration across the art, music, drama, and creative writing fields. We hope to produce a project that represents the creative talents of students at Carnegie Mellon University. By using an online platform, we hope to fully take advantage of this decade's democratization of storytelling and gain national exposure for our work.

ETHICS, HISTORY & PUBLIC POLICY

Historical Understandings of Derivative Works and Modern Copyright Policy
Jessica Dickinson Goodman / Ethics, History & Public Policy
Advisor(s): Jay Aronson / History
Dowd / 12:00

The Fair Use Doctrine allows unauthorized uses of copyrighted works by scholars, reporters and parodists but does little to protect creative critics, non-commercial transformative works, or the fan communities that blossomed in the digital age. To better protect these works and people, fair use must be modified in two ways. First, creative criticisms of non-technical works should receive stronger protection. Second, non-commercial derivative and transformative works should be presumptively fair use. These modifications will be a start towards protecting a large and vibrant community producing both creatively critical and entertaining works inside the sandboxes of other authors. The current Fair Use policy chills the speech of hundreds of thousands of writers, does little to help established authors, and does not "promote the progress of Science and useful Arts" (U.S. Constitution). The following historical analysis and policy argument is supported by an analysis of three works of historical derivative literature, namely Shakespeare's Troilus and Cresceda, Publius Vergil's Aeneid, and Homer's Iliad. This paper will also briefly cover the social, cultural, and economic benefits of the policy proposal.

The Female Crisis in the Democratic Republic of the Congo: The Persistence of Rape as a Weapon of War-1994-Present
Neha Mittal / Ethics, History & Public Policy
Advisor(s): Laurie Eisenberg / History
Pake / 3:20

This paper examines the varying causes for violence against women in the Congo to go unpunished. It particularly takes a look at the female exclusion from political social institutions, the negative stigma attached to raped women, and the military promotion of rape as a weapon of war. This paper emphasizes that the political, cultural, and military traditions of the Congo effectively allow violence against women to continue and go unpunished. Further, this paper highlights the current state of war and the gender imbalance in the Congo as major factor contributing to lasting violence against females. It concludes with a suggestion for reconstruction of the Congo's policies including more rights for women.

Undergraduate Involvement at Carnegie Mellon University
Ellen Gurary / Statistics, Bruce Jackson / Statistics, Margaret Soderholm / Ethics, History & Public Policy, Jennifer Sung / Social & Decision Sciences, Christina Swierkocki / Statistics

Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

We are attempting to quantify the factors that have an effect on campus involvement of Undergraduate students at Carnegie Mellon.

HISTORY

An Analysis of American Foreign Policy Towards an Independent Palestinian State, 1982-2002
Ian Epperson / History

Advisor(s): Laurie Eisenberg / History
Peter / 4:40

This paper will track the US policy position towards an independent Palestinian state from the years 1982-2002. Using the opposing speeches of Presidents Reagan and Bush as bookends, this paper will be able to pinpoint the emergence of US support for a Palestinian state. This paper will use an analysis of primary sources such as state of the union addresses and presidential memoirs together with appropriate secondary sources to track and explain the evolution of US policy regarding the establishment of an independent Palestinian state. This paper will begin with a thorough introduction to explain the US position from 1948 -1982 to establish context, and will then focus on the four administrations from 1982 to 2002. For decades US policy refuted the desirability of Pal state to solve the Arab-Israeli conflict, as firmly stated by President Reagan in 1982; since the George W. Bush administration indicated support in 2002, the Palestinian state has become the preferred US Arab-Israeli peace option. I want to understand what happened in between to lead to such a drastic switch in policy.

Blacks, Golf, and the Emerging Civil Rights Movement
Sanjeev Baidyaroy / History

Advisor(s): Steven Schlossman / History
Dowd / 1:20

A look into the efforts of black citizens, golfers, and journalists from 1947-1954, and the implications that their struggles for equal rights in golf had on the budding civil rights movement.

Broken Promises: The French Expulsion of Emir Feisal from Syria in 1920 and the Failed Struggle for Syrian Independence
Anthony Kuhn / History

Advisor(s): Laurie Eisenberg / History & Timothy Haggerty / Humanities Scholar Program
Class of '87 / 4:20

For well over a century, global powers have sought to exert their influence over the peoples and the resources of the Middle East. This paper analyzes how Emir Feisal, son of the Sherif of Mecca and leader of the Arab Rebellion during World War I, failed to navigate either the demands of the Syrians who proclaimed him king in March 1920 or the political realities imposed by the Paris Peace Conference. Using primary and secondary source material in English, French, and Arabic, this paper argues that Feisal's diplomatic, political, and military resistance to the French Mandate caused the French Government to evict him from the country in July 1920, terminating his brief rule as King of Syria. These sources detail the broken promises made by the Allies to supporters of Arab independence and the lost promise of an independent Syrian state after World War I.

INFORMATION SYSTEMS

Challenges of Building Information Modeling In a Construction Company in Qatar
Salwa Al-Mannai / Information Systems

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

Lusail Real Estate Development is a company that uses Building Information Modeling (BIM) as a support for it's complex operations of building and managing its real estate developments. Lusail is using BIM to build a new city including its infrastructure, underground trains, skyscrapers, island and more. BIM is a solution for companies to increase efficiency and productivity. BIM uses technology to model an artifact using 3 dimensional modeling with information stored in the fourth dimension. The software that enable a company to fully use BIM require intensive training for the stakeholders involved in a project. BIM also involves changing the process of work in a company. The purpose of this study is to explore BIM and its impact on companies. We studied the challenges that the company faces while using BIM. We observed that the process of submitting designs and clash detection meetings should be improved in order to save time and resources.

Cultural Influences and New Programs Affecting Women in Technology
Pooja Shah / Information Systems

Advisor(s): Jeria Quesenberry / Information Systems
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

As technology becomes more prevalent in our daily lives, the technical job field continues to grow. However, women still hold only a small percentage of these technical jobs. What is the reason for this occurrence? What cultural and social influences do women face that hinders them from opting

for technology? These are precisely the questions I strove to answer with my thesis, titled, "Cultural Influences and New Programs Affecting Women in Technology." This thesis was an empirical based research project comprised of multiple methodologies. Survey questions were sent to various women in different technical majors attending Carnegie Mellon University. A total of 37 women responded to the survey, out of which 10 volunteered to participate in follow up interviews. After analyzing this data, it was discovered that women are typically influenced by two major factors: family and teacher experiences. For instance, if a parent is in technology, most girls receive exposure to computers very early on and thus, may become interested in the field. Moreover, if teachers are unbiased and display enthusiasm for technology, women may feel more encouraged to pursue technical fields. My thesis demonstrates that a women's selection of a technical degree of study is not due to innate gender qualities, but rather due to social influences related to the type of exposure to computers received.

The Impact of Manufacturing Offshore on Firm Technology Trajectories
Sandeep Patel / Information Systems
Advisor(s): Erica Fuchs / Engineering and Public Policy
Kirr Commons / 1st Floor, Window side / 12-2:30

Research focuses particularly on the impact of offshoring on the innovative capabilities of the firm, and the continued advance of technology within the same or other US institutions. To do so I plan to study the optical electronics industry in period from 1990 to 2010, allowing me to observe the firms before and after the burst of the telecommunications industry. The results are intended to draw out characteristics of innovation ecosystems that would make such systems resilient against future shocks like an entire industry going offshore. This project is part of a two-part research project guided by my advisor Dr. Erica Fuchs at CMU's Engineering and Public Policy department. Research was conducted over the period covered by the SURF as well as the semesters before and after the summer.

LINGUISTICS

The Linguistic Impact of Brand Creation & Lexicalization
Jasmine Friedrich / Linguistics
Advisor(s): Thomas Werner / Philosophy
Kirr Commons / 1st Floor, Window side / 3-5

A study of the process of brand creation and lexicalization from a historical linguistics perspective. Examining instances of registration limitation due to trademark law and the spread of these terms over time, we see the interaction that brand has with language and the legal vulnerability that brand names have by way of entering the lexicon as a generic word.

MODERN LANGUAGES

Ronald Does Rio: McDonald's in Brazil
Karalyn Baca / Modern Languages

Advisor(s): Therese Tardio / Modern Languages
Hoch Commons / 2nd Floor, Window side / 3-5

McDonald's has long been one of the world's most recognized brands. After dominating the fast food market in the United States, the company set its sights on other parts of the world. From its humble beginnings in 1940 in San Bernadino, California as a small drive-in, McDonald's is now "… serving more than 60 million people in 117 countries each day." (1) McDonald's entered its 25th country, Brazil, in 1979 and opened a store in Copacabana that was also the first McDonald's in all of South America. Currently, McDonald's controls an impressive 25 percent of the dining market in Brazil, the largest by any one company. (2) How did McDonald's become so successful in Brazil when Bob's, founded 20 years earlier, was already present selling burgers and fries? The multinational McDonald's was still foreign to South American markets yet eventually overcame Bob's, the very first fast food chain in Brazil, to capture the fast food market. This project examines the entrance of the McDonald's brand into the Brazilian economy, the factors that led to its success and the current state of the Brazilian fast food market.

(1) "Getting to Know Us." aboutmcdonalds.com. McDonald's, n.d. Web. 14 Jan. 2011.
(2) Luxner, Larry. "Golden Arches over Brazil." Latin CEO: Executive Strategies for the Americas March-April (2002): n. pag. B Net. Web. 2 Feb. 2011.
<http://findarticles.com/p/articles/mi_m0OQC/is_2_3/ai_100409402/?tag=content;col1>

The Rising Adolescent Suicide Rate in Japan
Erica Peaslee / Modern Languages

Advisor(s): Yasufumi Iwasaki / Modern Languages
Class of '87 / 12:40

During my time at Carnegie Mellon University and abroad at Japan's Waseda University, I have learned a great deal about the Japanese educational system. Recently, the adolescent suicide rate in Japan has risen to be twice as high as the same rate in the United States. When studying this discrepancy, one topic that is irrevocably tied to adolescent suicide is the issue of bullying in Japan; although many school officials would prefer to push it under the rug, the fact remains that bullying is a serious issue that many youths face as they make their way through the educational system. According to the Japan Times Online, 91% of Japanese students who committed suicide between 2004-2007 mentioned school related problems as one of the main reasons for their untimely deaths, many of which undoubtedly include bullying. To further develop my critical analysis, I analyzed the cultural factors in both countries that shape the way in which bullying occurs and determined which factors contribute to the fatality of bullying in Japanese schools, such as why American teachers are so quick to intervene while their Japanese counterparts either ignore offenses or, in some rare cases, take part. Certainly, many Japanese students face bullying

without committing suicide; however, concurrent with the rise in suicides, school refusal and rates of hermit-like behavior have also skyrocketed in the past few decades. Thus I hypothesize that the difference between both the physical means through which the bullying occurs and certain cultural factors and phenomena in both America and Japan are the main causes behind the discrepancy. I was invited to apply for a senior honors thesis, and I decided to use that outlet as a means of completing my research on this subject. Although this issue is openly discussed in the U.S., Japan's social construct is such that issues regarding adolescent suicide are not openly researched and discussed. Therefore, although my final project includes a 30-page research paper written in English, I am subsequently translating important sections into Japanese for online publication so that my research will be able to reach multiple audiences.

The Use of English in Japanese Advertising
Douglas Goldstein / Modern Languages & Science and Humanities Scholars
Advisor(s): Yasufumi Iwasaki / Modern Languages
Wean Commons / 1st Floor, Connan side / 12-2:30

The incredible prevalence of English in Japan – both in written and spoken form – is at first baffling to a native English speaker. Phrases that seem to make no sense (i.e. "Drink Concert") are nevertheless seen everywhere: on t-shirts, as part of television advertisements, and in the Japanese language itself, in the form of loan words. In this paper I intend to focus on television and print advertisements that feature the use of English and try to understand why English is used rather than other forms of communication, and then in what ways it is used and in what ways it is perceived by Japanese people.

PHILOSOPHY

A Defining Conflict: The Obama Administration vs. The Robert's Court
Andrew Robb / Philosophy
Advisor(s): Mary Jo Miller / Social & Decision Sciences
Pake / 1:00

The Constitution gave the judiciary no substantive check on the executive branch. However, after the 1803 case Marbury v. Madison established the Supreme Court's power of judicial review, the Court suddenly had a powerful tool through which it could directly subvert executive authority. Throughout the 19th and 20th Centuries, the Court issued numerous decisions that struck at the heart of the executive's prerogative. Today, with President Obama in the White House and Justice John G. Roberts, Jr. leading a conservative majority on the Court, the potential for conflict between the two branches seems inevitable. In fact, as lawsuits challenging the President's health care bill make their way to the Supreme Court, the relationship between the Obama administration and the Roberts Court could become a defining conflict in the current administration.

Senior Honors Thesis: The Socratic Method as an Approach to Learning
Faith Lam / Philosophy

Advisor(s): Andy Norman / Philosophy
Dowd / 3:00

The Socratic Learning Method (SLM) is a constructivist learning approach consisting of four key steps: eliciting relevant preconceptions, clarifying preconceptions, testing a proposition, and deciding whether to accept a proposition. The Socratic Learning Method is particularly useful when one has to evaluate a proposition contradictory to one originally held belief, or when one has to generate and evaluate one's own hypothesis in the face of new information. Drawing the connection between the steps of the Socratic Learning Method and the results of studies in cognitive science, developmental psychology, and education, this thesis argues that the Socratic Learning Method enhances students' learning as it reduces the impact of misconception, aids students in organizing knowledge, cultivates higher order thinking skills, and helps students to monitor their own learning. While the Socratic Learning Method functions as a teaching method as teachers first introduce it to students in the classroom, the thesis emphasizes its use as an approach to learning that individuals must cultivate, with practice, into a vigorous thinking habit.

PSYCHOLOGY

A Study on Students' Change of Majors, What They Choose and Why
Oliver Lam / Psychology, Michael Len / Computer Science, Go Okumura / Mechanical Engineering, Dunyang Wang / Materials Science Engineering, Wentian Zhu / Science and Humanities Scholars

Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

Selecting a major is an important decision for an undergraduate. What a student chooses to study often determines their future career by providing them with a knowledge base that will enable them to succeed in that field. At Carnegie Mellon University (CMU), students are allowed to change majors as they wish in accordance to certain influences in their life, including but not limited to perceived academic success, future job prospects, personal interests, and social pressures. This study aims to determine the retention rates of each major at CMU, which majors are most popular to switch to, and the prevailing factors that influence a students decision to change or not to change their major. Our results lend insight to what CMU departments can do to affect the popularity and retention rates of their majors by identifying what influences an undergraduate's decision on changing majors the most.

Attention development in Children
Christopher Mather / Psychology

Advisor(s): Anna Fisher / Psychology
Hoch Commons / 2nd Floor, Window side / 12-2:30

This study examined allocation of visual attention in 5-year-old children in a dynamic task using eye tracking methodology. Children participated in a task which involved visually following target objects moving amidst various types of distracters around a plane and reporting where the target object stopped and disappeared on the plane. Gaze data were collected using Tobii eye tracker.

Children's Analogical Reasoning
Emma Adair / Psychology

Advisor(s): David Klahr / Psychology
Wean Commons / 1st Floor, Connan side / 3-5

An important developmental learning mechanism is analogical reasoning: the ability to abstract relational correspondences from cases with a common structure. Recent research has suggested that factors that prompt comparison between analogous cases also support the abstraction of relations. For example, Christie & Gentner (2010) found that when young children compared category exemplars – as opposed to learning them sequentially – they were more likely to make inferences based on relationally similarity rather than a perceptual similarity. However, while comparison is an effective prompt for analogical learning, much less is known about whether and how contrasts affect children's reasoning. In the present study, we compare relative affects of comparisons and contrasts on children's category learning, using the identical paradigm of Christie & Genter (2010). The results will be discussed in relation to their implications for early education.

Effect of Pretests on Children's Numerical Magnitude Representations
Lauren Gumbel / Psychology

Advisor(s): Robert Siegler / Psychology
Kirr Commons / 1st Floor, Window side / 3-5

An accurate sense of numerical magnitude is crucial for children to develop an understanding of mathematics. As children begin learning about numbers, they develop a logarithmic sense of number magnitudes- one where the numbers they can't understand or count to are just considered "big" and are fairly indistinguishable- but as they learn more numbers, they shift to a linear, 1:1 representation of numbers. Some researchers suggest that in studies of the logarithmic to linear shift in numerical magnitude representation, strategy choice during the study's pretest could be influencing their data. In studies where children complete an unguided pretest, subjects have to choose a particular strategy to utilize for each problem, a choice that is influenced by whether they have a more linear or logarithmic sense of the numbers in the pretest's range. If these strategies are incorrect or inappropriate, they prevent subjects from acquiring or reinforcing new strategies learned during a feedback stage of the study because the "bad" strategy is forefront in their minds. Our study investigates this relation between pretest strategies and posttest performance. Subjects were tested on a basic number line task for the pretest, feedback stage, and posttest, with the pretest differing between randomized groups; one group was tested on a number line ranging from 0-10, another was tested on 0-20, and the control group had no pretest. The results suggest that the children tested with a 0-10 number line on the pretest learned more from the feedback than children tested on a 0-20 number line. However, the randomized groups differed in their pre-experimental number magnitude knowledge, which may have affected our results.

Hemispheric Differences in Higher-Order Object Processing and Effect of Expertise: Modular vs. Distributed Perspectives

Cynthia Peng / Psychology
Advisor(s): Marlene Behrmann / Psychology
Class of '87 / 12:20

What is the process by which our brains recognize higher-order visual objects, like faces, words and foreign scripts? What are the neural mechanisms underlying the processing of these very important real-world stimuli, and what are the implications for human behavior? We are interested in exploring the extent to which face processing and word processing are independent functions or parallel actions, and the effect of language expertise on hemispheric specialization. To do so, two experiments test for competition and cooperation across hemispheres. Two groups of participants were recruited: those who have never formally studied Chinese, termed "novices"; and those whose native language was Chinese, termed "experts." Both groups participated in the same set of experiments. The first experiment examines interhemispheric interaction by asking the participant to decide whether a target object - faces, words, and Chinese characters - is presented in the left or right visual field. We compare the accuracy and reaction time for a left visual field presentation to a right visual field presentation to determine hemispheric gradation for these three classes of stimuli. The second examines the corresponding electro-physiological response as the participant completes the same task in the EEG. Results have implications for perceptual expertise, perceptual learning, and the role of experience in object representation.

Learning by Comparing: Effects of Direct Instruction, Discovery and Delay on Analogical Transfer

Pasha Gill / Psychology
Advisor(s): David Klahr / Psychology
Wean Commons / 1st Floor, Connan side / 3-5

Previous research on analogy has suggested that asking subjects to compare two instructional examples promotes analogical transfer. However, one disadvantage in having subjects engage in unguided comparison is that they may unintentionally abstract irrelevant relationships across instructional examples. The present study describes two experiments, the first designed to test the efficacy of directly instructing participants about common relational structure between analogous problems and the second designed to explore the effect of temporal delays on successful analogical transfer. In the first experiment which has a 2 X 2 design, subjects are either directly told how two story problems are similar (direct comparison), or they are asked to abstract common relationships between two story problems on their own (discovery comparison). In two control conditions, subjects are provided with the same story problems without instructions to compare, and are either asked to summarize each story (discovery no-comparison) or they are directly provided with a summary of each story (direct no-comparison). In the second experiment which has a 2 x 2 x 2 design, four of the conditions receive a delay before being asked to solve the target analog and the other four control conditions receive the target problem right after having attempted to solve the base analog. Subjects' analogical reasoning is operationalized as their ability to solve a relationally similar target problem which requires mapping of relevant concepts from the two base problems. We predict that in Experiment 1. (i) analogical transfer will be strong for both comparison conditions and (ii) direct instruction will lead to more efficient use of instructional time and for Experiment 2. in addition to the first two hypotheses, (iii) delay will lead to a higher rate of solving transfer problems than no delay.

Neural Mechanisms of Unconscious Thought
James Bursley / Psychology
Advisor(s): John Creswell / Psychology
Peter / 3:00

Unconscious cognitive processes have been shown to facilitate many higher-level human behaviors. For example, brief periods of unconscious processing improve a decision when that decision is complex (e.g., purchasing a car). We reveal how the brain guides unconscious processing of complex decisions. In an initial fMRI experiment, we found that the same regions active during encoding of complex decision information (right ventrolateral prefrontal cortex and bilateral intermediate visual cortex) continued to be active during a subsequent two-minute unconscious processing period. This effect, which we refer to as unconscious neural replay, was predictive of improved subsequent behavioral decision making. A second behavioral experiment confirmed that we could block the unconscious processing advantage in decision making by behaviorally co-opting unconscious neural replay circuits.

Sitting for Success: The Effect of Self-Embodied Cognition on Stereotype Threat
Laura Alfonso / English, Katherine Cuti / Psychology, Cze-Ja Tam / Psychology
Advisor(s): John Creswell / Psychology
Kirr Commons / 1st Floor, Window side / 12-2:30

Stereotype threat occurs when an individual is concerned about fulfilling a negative stereotype about a group he or she is a part of and fulfills that stereotype because of this concern, which can hinder the individual's performance. However, the self-embodied cognition theory states that certain cues, such as bodily movements, can also influence the way individuals respond to certain situations. In this study, we examine the effect of self-embodied cognition on stereotype threat as it pertains to performance on a math test. Participants were randomly assigned to a male embodiment condition (straddling a chair; holding a fist) or to a neutral condition (sitting normally; holding palm out) while they completed a math assessment. Our data demonstrated that female participants were able to overcome stereotype threat and perform equally well by embodying male characteristics. Our experiment suggests that self-embodied cognition is an effective way of countering the effects of stereotype threat.

Strategies Used in Fraction Magnitude Comparisons
Melissa Dewolf / Psychology
Advisor(s): Robert Siegler / Psychology
Wean Commons / 1st Floor, Connan side / 12-2:30

In the current study, we seek to gain a better understanding of 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, in press; Meert, Gregoire, Noel, in press) 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 (in press) argue that these assessments cannot be made independently from understanding the strategies for comparison that a particular pair of fractions elicits. The current study will extend

prior research by comparing strategies that CMU students, high math proficiency, use to compare fraction magnitudes to the strategies that CCAC students, lower math proficiency, use to compare fraction magnitudes. Our goal is to identify the strategies that adults use, their relation to overall math knowledge, and how the strategies influence accuracy and speed of performance.

The Beginnings of Deductive Reasoning Abilities in Infants
Rosanna Breaux / Psychology
Advisor(s): David Rakison / Psychology
Kirr Commons / 1st Floor, Window side / 3-5

There is wide disagreement over when children begin to show deductive reasoning skills that adults use daily. Preschoolers have previously demonstrated deductive reasoning skills (Dias & Harris, 1988, 1990, Hawkins, Pea, Glick, & Scribner, 1984; Richards & Sanderson, 1999) through verbally presented hypothetical syllogisms. The present study employed a habituation paradigm with 18-, 22- and 26-month olds. Infants were presented visual stimuli with external parts and dynamic motions to assess when they begin to deduce the relation among static and dynamic features. The findings of this research were minimized by sample size and effect magnitude. There appears to be a gender difference with females being able to deduce such relations. This is a new area of research, future research needs to replicate the current findings and to determine what other manipulations can help facilitate the demonstration of deductive reasoning abilities.

The Effects of Parent Attchament Style and Parent Socialization Strategies on Preschool and Kindergarten Children's Behaviors
Ashley Herrick / Psychology
Advisor(s): Brooke Feeney / Psychology
Hoch Commons / 2nd Floor, Rangos side / 3-5

The role that parent-child attachment styles play in the development of children's behavior is thoroughly researched and understood. However, less is understood about how parent's own working style of attachment in conjunction with their other lifestyle factors effects their choice in parenting strategies. This study investigates the affects of parent's own working style of attachment, their perceived stress, as well as their marital harmony on the ways in which they socialize their children. Parents and children from The Children's School at Carnegie Mellon University were recruited to participate in the study. Researchers hypothesized that parents who experience secure attachment styles, high levels of marital harmony and low levels of perceived stress would use productive socialization strategies enforcing high levels of prosocial behavior and exploration, increased intimacy in peer relationships, and low levels of aggression in their children. In contrast, parents who experienced anxious/ambivalent or avoidant attachment styles along with low marital harmony and perceived stress would use unproductive socialization strategies resulting in low levels of prosocial behavior, minimal exploration, shallow peer relationships, and increased levels of aggression. Parents completed the appropriate scales to address the variables of interest, and children were observed in a variety of situations both in a laboratory setting and also in the class to assess their behaviors. (Results as of the development of this abstract are yet to be determines)

The Zen Mozart: Effect of Mindfulness Meditation and Classical Music on Visuospatial Skills
Cynthia Peng / Psychology & Science and Humanities Scholars
Advisor(s): Lori Holt / Psychology
Rangos 1 & 2 / Sigma Xi Group 8 / 11:45

Performance on visuospatial tasks can be enhanced via different mechanisms. Here, we study how classical music and mindfulness meditation can differentially affect visuospatial skills. Participants completed two markers of visuospatial skill - the Paper Folding and Cutting (PF&C) task and the Mental Rotations Task (MRT) - in order to assess the respective effects of music and meditation on these tasks. Participants served as their own baseline controls in order to compare pre-exposure to post-exposure scores. Behavioral results showed that music led to enhanced performance the PF&C more so than the MRT, assessed by an increase in accuracy. Conversely, meditation led to enhanced performance on the MRT but a decrease on the PF&C. This is perhaps due to the inherent nature of the two conditions, in which the music of Mozart is upbeat and fast, leading to an arousal in mood, while the meditation is calming and slow, leading to relaxation. Thus, it is shown that although both can lead to a temporary boost on visuospatial skills at large, they selectively affect different types. These findings have many implications and applications for education, intelligence testing, cognitive control, and mental health.

SELF-DEFINED

Creating Meaning out of Difference: The Discourse of Alternative Relationships
Julian Imbrescia / Self-defined
Advisor(s): Linda Flower / English
Class of '87 / 12:00

This inquiry serves as an experiment for understanding how young gay men talk about love and find meaningful relationships. It explores the need to interpret an emerging discourse around the relationships of these men, a discourse that does not fit the stereotypes and conventions of hetero-sexual dating, marriage, or romantic love. An equally important need motivating this study involves finding ways to explain the discourse to others, in ways that hope to transform popular understandings of what a "relationship" is. After identifying critical aspects of this discourse and wrestling with powerful counterarguments in current public discussions, this inquiry finds ways to situate problems within a larger debate. The basis of research here involves an extensive collection of data from young gay men – from formal interviews, to notes on conversations, to reflective prose. The perspectives these men offer include how they negotiate both the need to create a shared understanding and the need to discuss the inevitable tensions in relationships. This combination of serious reflective engagement with a very real social issue, and close observation based on an experimental way of knowing, will aid in the goal of creating a discussion built around discourse, shared concerns, and different perspectives.

Magical Realism in Modern Japanese Fiction: Dreaming in Isolation
Ida Mayer / Self-defined
Advisor(s): Jane McCafferty / English
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Magical realism as a literary genre is considered to have roots in South America; however the blend of the supernatural and the mundane that is required of magical realism can also be found in works of contemporary Japanese fiction, notably through wildly popular authors Murakami Haruki and

Yoshimoto Banana. A careful literary analysis of these authors' works reveals an approach to the magical realism genre with themes of isolation and dreaming at its core. This unique perspective is born out of Japanese literary history and contemporary culture. The characters in Murakami's and Yoshimoto's novels are so emotionally isolated that magic is required to break them out of their isolation and connect them to other people. This magic must be placed in the personal realm of dreams in order to break the barriers between public and private in the characters' lives. The way in which dreams are treated in Murakami's and Yoshimoto's stories, which works by locating the magical as a seamless part of the normal, is categorical of the magical realism genre.

The Influence of Sociopolitical and Economic Factors in the Formation of Caribbean Creoles and Dialects
Emily Ferri / Self-defined
Advisor(s): Kenya Dworkin y Mendez / Modern Languages
Dowd / 3:40

This project examines linguistic change in the Caribbean and analyzes the effect of socio-political and economic influences on the creation of Creole languages. Examples that will be covered include Haitian Creole, Papiamento, and Palenquero.

SOCIAL & DECISION SCIENCES

Accuracy of Pittsburgh Bus Timetables Used by CMU Students
Matthew Belenky / Economics, Timothy Higgins / Economicsm, John Sperger / Social & Decision Sciences, Chao Wang / Electrical & Computer Engineering, Tian Wu / Business Administration
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

Many students and Professors at Carnegie Mellon rely on the public transit system to get to work, however students frequently complain about the PAT bus system. The most common complaints are late buses, inaccurate schedules, and the frustration that occurs after waiting for a bus only to have multiple buses of the same route arrive at the same time1. Waiting wastes time, causes frustration, and in the long run could lead commuters to choose to find a way to travel that doesn't involve public transportation. To aim of this study is to first measure the degree to which these complaints are accurate, and if buses are systematically late develop a model for predicting expected arrival time. This study will be build on a strong general literature base on public transportation and investigate the accuracy of bus time tables for the Forbes and Morewood intersection which is the most commonly used bus stop for commuters at Carnegie Mellon University. Bus departure times will be observed and compared to posted bus schedules. A number of potential factors that influence bus punctuality will also be measured including the weather, the time of day, and the level of light. Using these factors and the information collected on bus arrival times, a model will be created to predict when a bus will arrive given the scheduled arrival time.

Akoma
Godwina Titus / Social & Decision Sciences & Efi Turkson / English

Advisor(s): Edda Fields-Black / History
Connan / 12-2:30

In an increasingly globalized world the dissemination of cultural and artistic influences is inevitable. However, it seems as if one continent has largely been ignored in the globalized world of fashion. Inspired by Conde Nast's decision to reject a Vogue Africa; we seek to determine why the world ignores Western Africa's importance and potential in the fashion industry. To determine this we will assess globalization's far reach in the "dark" continent. We will create a collection of clothing that highlights Western Africa's rich tradition of print fabrics and ceremonial attire and merges Western influence with African traditions. We will also create an art booklet that highlights the collection we created and attempts to disseminate knowledge about Western Africa and its place in the fashion world.

Consumer Responses to 2009-2010 Toyota Camry Recall: Insights from NHTSA Complaints Database
Hee Yeon Shin / Social & Decision Sciences
Advisor(s): Paul Fischbeck / Social & Decision Sciences
Hoch Commons / 2nd Floor, Rangos side / 3-5

This research examines the trends of consumer complaints filed to the federal National Highway Traffic Safety Administration regarding Toyota Camry vehicles. I examine the trends across 10 Model Years and investigate the responses of consumers in relation to the highly publicized 2009-2010 Toyota recall following the fatal accident in August 2009.

---

iSTEP 2011: Uruguay
Jonathan Beebe / Computer Science, Afnan Fahim / Computer Science, Elise Gonzales / Computer Science, Meghan Nahass / Social & Decision Sciences
Advisor(s): Yonina Cooper / Computer Science & Mary Bernardine Dias / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 9 / 10:30

The iSTEP (innovative Student Technology ExPerience) internship program offered by TechBridge-World at Carnegie Mellon University brings together students from the Pittsburgh and Doha campuses to conduct technology field research in developing communities. The 2011 iSTEP team is working with the Administración Nacional de Educación Pública and schools located in Montevideo, Uruguay on three projects: (1) a computer tool for teachers to customize literacy content; (2) an online computer tool for students to practice their literacy skills; and (3) a mobile phone game for motivating students to enhance their literacy skills. In the Spring 2011 semester, the team's research included creating a country review investigating the history, culture, and technology infrastructure in Uruguay. Needs assessment and evaluation plans were developed to ensure that the team appropriately identifies the needs of the community and evaluates the projects' sustainability and effectiveness. Furthermore, the team conducted literature reviews to compare different platforms and technologies as well as tested open-source projects. A media outreach plan has also been developed to promote and advertise iSTEP's work to different communities. The results of this research will be carried out and continued during the summer 2011 in Uruguay.

Self and Society: How Personal Valence Affects Perceived Impact
Cora Goldstons / Social & Decision Sciences

Advisor(s): Carey Morewedge / Social & Decision Sciences
Pake / 3:00

When attributing praise or blame for events, people exhibit an interesting asymmetry. People are more likely to attribute praise for positive events to themselves than to chance or another person, and are more likely to attribute negative events to other people than to themselves or chance. Much research has examined the role of self-serving biases in the attribution of positive events to the self (Miller & Ross, 1975), but the discovery of attribution of negative events to other people is relatively new and faces many open questions (Morewedge, 2009). The proposed research would examine why people are more likely to attribute negative events to other people rather than to themselves or chance, examining several likely psychological processes that may give rise to this phenomenon.

Similar Policies, Different Outcomes: US Policies toward Haiti and the Dominican Republic
Margaret Hamlin / Social & Decision Sciences
Advisor(s):Silvia Borzutzky / Social & Decision Sciences
Dowd / 3:20

Since gaining its independence from French rule in 1804, Haiti has constantly struggled to achieve political and economic stability and viability. On the other hand, the Dominican Republic, which shares the island of Hispaniola with Haiti as well as a similar colonial history under Spanish rule, was finally able to sustain democratic governance and economic growth in recent history. The United States has long played a significant role in the economics and politics of both the Dominican Republic and Haiti, but despite similar policies, we have seen dramatically different outcomes. In this thesis, I will argue that the United States' policies designed to promote economic development in Haiti will continue to be wholly ineffective until political stability is accomplished and basic infrastructure has been built in Haiti.

Undergraduate Involvement at Carnegie Mellon University
Ellen Gurary / Statistics, Bruce Jackson / Statistics, Margaret Soderholm / Ethics, History & Public Policy, Jennifer Sung / Social & Decision Sciences, Christina Swierkocki / Statistics
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

We are attempting to quantify the factors that have an effect on campus involvement of Undergraduate students at Carnegie Mellon.

STATISTICS

Classroom Salon: Text Mining and Clustering
Yi Xiang Chong / Mathematics, Christine Ibaraki / Statistics, Chun Wa Mok / Mathematics
Advisor(s): Rebecca Nugent / Statistics
Wean Commons / 1st Floor, Connan side / 3-5

Classroom Salon (CLS) is a web-based platform developed at Carnegie Mellon University that is designed to encourage reading and collaboration through the annotations of various text

documents. When students participate in CLS, they are able to read and annotate course material, view others' annotations, and submit personal work for review. CLS promotes active rather than passive interaction with the text and facilitates a sense of community among users. The goal of our research is to determine how students relate to each other in terms of their commenting and annotation behavior. We explore and compare different clustering algorithms, which are used to group students according to the following similarity measures: word frequency, tone, and annotation area. We retrieved the user annotation data from both technical and non-technical classes. We first perform text preprocessing (including stripping, stemming, and eliminating stop-words), and then construct a Document-Term Matrix using TF-IDF, where each document corresponds to the annotations of a user. A distance matrix is constructed by computing the cosine distance between users in the Document-Term Matrix, and is subsequently analyzed using Hierarchical Agglomerative Clustering, Multidimensional Scaling, K-means Clustering, and Principal Components Analysis. Graphical visualizations are presented in order to further examine possible group structure in the data. In order to summarize the clusters, we explore patterns found in the original annotation data, and also consider how the use of tone varies between groups. Clustering Algorithms find groups of similar students based on their annotation tones, areas, and word frequencies. This information can help students find classmates with whom they may wish to collaborate, and may also allow instructors to form discussion groups based on student similarities and differences. The results of our research provide new ways for CLS users to track how they relate to their peers.

Dynamic Monte Carlo Renormalization Group
Maxwell Hutchinson / Physics, Robert Lee / Physics, Karpur Shukla / Statistics & Science and Humanities Scholars
Advisor(s): Robert Swendsen / Physics
Hoch Commons / 2nd Floor, Window side / 3-5

Monte Carlo methods and renormalization group (RG) analysis are often used in statistical physics to study properties of phase transitions. We explore extending the RG analysis to study the dynamic correlations of a simulated 2D Ising system evolving in time. The simulation software is optimized for performance by using CUDA GPGPU technology and by updating the Ising spins using the Swendsen-Wang cluster algorithm.

Estimating Survival Distribution of Aluminum Processing Pots
Emily Butler / Statistics
Advisor(s): Joel Greenhouse / Statistics
Class of '87 / 1:00

Aluminum smelting is a very complex and sensitive process. The process uses specialized large carbon lined steel pots which contain a carbon rod and a monton cryolite bath, all of which contribute to the aluminum production. At the end of this complex process, the aluminum settles to the bottom of the pots and is collected to be manufactured into commonly known products. The problem arises in the sensitivity of the smelting process. Aluminum needs to be in production constantly because if the pots are unable to reach a certain temperature (or when they "fail") the molten aluminum hardens, which results in not only wasted product, but also wasted time and resources to clean and remove the pots. In this paper, I investigate different parametric models for the time-to-failure distribution for aluminum pots. Ultimately, I would like to identify covariates that will help predict when a pot will fail. The hope is that such a model will make the aluminum smelting process more efficient by indicating which pots are likely to fail.

Exploration of Imputation Methods for Missingness in Image Segmentation
Christopher Makris / Statistics
Advisor(s): Rebecca Nugent / Statistics
Class of '87 / 2:00

Within the field of statistics, one of the hardest problems to deal with is "missingness." Statisticians often have trouble deciding what should be done with missing values, as the missing information may be crucial. If the values are missing completely at random, they can be disregarded; however, many times the values are missing for a reason and additional precautions must be taken. In this project we attempt to explore the restoration of missing pixels in an image, where ignoring missingness is not an appropriate solution. Any damaged or lost pixels and their attributes are analogous to missing values of a dataset, thus we must determine what types of pixels would best replace the damaged areas of the image. This type of problem extends across both the arts and sciences. Specific applications include, but are not limited to: photograph and art restoration, hieroglyphic reading, facial recognition, and tumor recovery. Our exploration begins with examining various spectral clustering techniques using semi-supervised learning. We compare how different algorithms perform under multiple changing conditions. Next, we delve into the advantages and disadvantages of various numerical data representations of pixel color and location in respect to image segmentation. Finally, we inspect how the algorithms perform on damaged image data and attempt to impute the missing values.

Exploring Learning Rates: Do Students Learn at Different Rates?
Emily Boncek / Science and Humanities Scholars, Yinglu Yao / Statistics, Xiaoyu Zhu / Economics and Statistics
Advisor(s): Rebecca Nugent / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

As emerging curiosity and excitement in learning behavior gives rise to educational data mining, learning scientists are exploring how people learn. The Pittsburgh Science of Learning Center (PSLC) maintains an open data repository, the DataShop (https://pslcdatashop.web.cmu.edu/), of learning data coming primarily from an interactive tutoring system. Our primary goal is to model differences in student learning rate so that PSLC could potentially design programs to improve learning in the future. To achieve this goal, we are using a Geometric Area dataset collected from 1996 to 1997, where students were prompted to solve various problems related to geometric area step by step. We will develop an algorithm to compare students' learning rates using this data set, and apply the method to other data sets from PSLC.

Faculties Attitude toward Plus/Minus Grading System
Hye Jung Cho / Economics and Statistics, Erica Choi / Science and Humanities Scholars, Aiena Garg / Economics and Statistics, Dong Seob Kim / Chemistry, John Shoup / Statistics
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

In Carnegie Mellon University, students work very hard to get high GPAs. Students are concerned about GPAs since they have high impact on chances of getting a job or admissions to graduate schools. Carnegie Mellon University currently implements grading system without plus or minus letter grades. Students' opinions on the current grading system vary. Previous research from

Carnegie Mellon students from "Sampling, Survey and Society" in 2008, surveyed 341 students' opinion regarding implementation of plus/minus grading in CMU. In this study, 18 percent of the respondents supported the implementation of plus/minus system, 68 percent were against it and 14 percent were undecided. Our research analyzes faculties' attitude toward the implementation of plus/minus grading system. We distributed on-line surveys to randomly selected 578 faculties. The survey questions constitute several demographic questions as well as view on current grading system in CMU and implementation of plus/minus grading system. After carrying out an exploratory data analysis, we ran analysis of variance on our data. Then, we compared our result to the previous research done in 2008. Our result suggests that faculties from different departments have varying opinions regarding the implementation of plus/minus system.

Increasing reliability: Attracting more clients to microfinance institutions
Akshay Upadhyay / Statistics

Advisor(s): Stephen Spear / Economics
Peter / 1:00

Dr. Muhammad Yunus was awarded the Nobel Peace Prize in 2006 for his efforts to break large population groups out of poverty, through the formation of Grameen Bank. Grameen Bank provided small loans to the poorest of the rural population in Bangladesh. Its goal was to spur economic development from the bottom of the income chart. Dr. Yunus felt that making this credit available to the poor would serve as a catalyst for improving their socio-economic conditions. Economists say that, "Bottom-up initiatives like microcredit allow rural-based development," which will help halt the cycle of poverty that the poor are forced to deal with. October 2, 1983 marked the formation of the Grameen Bank, the first official bank for the rural poor. Since then, the industry has grown to approximately 10,000 microfinance institutions serving over 113 million clients worldwide. Approximately 32.6% of the world population, or 2.2 billion people, are below the poverty line. The availability of microfinance institutions is known by close to 750 million of these people. But only approximately 15% of these people are actually clients of microfinance institutions despite the arising of financial needs. This presentation provides an analysis of existing policies on microfinance loans. Also, behavioral economic anomalies will be used to propose a new policy on microfinance loans in the hope of attracting more clients to microfinance institutions.

Investigation of the results from the Content Focusing Coaching study and evaluating alternative Hierarchical Models
Brittanie Boone / Economics and Statistics, Erica Choi / Science and Humanities Scholars, Thomas Todd / Statistics

Advisor(s): Rebecca Nugent / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

One of the current problems facing low income districts is high teacher mobility in classrooms. This may be affecting students' reading comprehension development since many teachers have different methods of teaching. One possible solution is Content-Focused Coaching, a program that pairs trained coaches with classroom teachers for the purpose of improving reading comprehension instruction. Previous research from Marsh et al. (2008) found coaching has positive effects on reading achievement for students. The most current research from Matsumura et al. (2010) found that the CFC program had a positive effect for students who were English language learners. Our

research analyzes data from the Matsumura et al. (2010) longitudinal randomized field trial, conducted between 2006 and 2009 to determine the effectiveness of a Content-Focused Coaching program on districts with high teacher mobility. The data came from an urban school district in Texas where fifteen schools were randomly assigned to have the CFC program and 14 schools were randomly assigned to be the control group. Due to ethical issues, control schools were also allowed to have literacy coaches. We used this data to verify the model Matsumura found and investigate more efficient models for the data. Due to the already embedded level structure of the data, schools within a district and teachers within the school, we used hierarchical level model analyses. After running Markov Chain Monte Carlo methods with schools as our level and testing multiple random intercept and random slope hierarchical models, we found no isolated positive effect for the CFC program. We then investigated non-linear models to show the effect of CFC on students in the data and found similar results. It appears that the CFC program does not have a positive direct effect on students' test scores without the interaction with other student variables. This suggests that other programs may be needed in order to improve the test scores for all students.

Semi-Automated Collection of Pitch Location and Intent in Baseball
Andrew Klein / Statistics

Advisor(s): Rebecca Nugent / Statistics, Andrew Thomas / Statistics
Dowd / 2:00

An analysis of the pitcher's intent in baseball should ideally depend upon information given by the catcher before the pitch is thrown. Expert judgment has already identified the importance of this factor (e.g. the pitcher is ``missing his spots" when unsuccessful in hitting the target). We describe the underpinnings of an automated video analysis system that uses semi-supervised learning methods to identify the catcher position -- specifically, the catcher's glove position. The analysis begins with video of a single pitch, supervised by a human controller; this information is then incorporated into one of a selection of learning algorithms and applied to subsequent pitches with minimal involvement from the controller. This project is designed to be the first step in creating a public database of pitch intent, to be coupled with existing sources of pitch physics, so that analysts may better evaluate pitcher performance.

Survey of Carnegie Mellon Faculty Regarding Attendance Policy and Student Performance
Emily Boncek / Science and Humanities Scholars, Christopher Chang / Statistics, Kelly Chang / Electrical & Computer Engineering, Stephanie Sindler / Economics

Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 3-5

We are conducting a survey of members of the Carnegie Mellon faculty community in order to determine if there is a relationship between whether or not a class has mandatory attendance and students' performance in the class. This topic is interesting because there is a large disparity in the way classes are structured across various departments of the university, and thus it is possible for two students of different majors to have entirely opposite classroom experiences. This survey is interested in determining if requiring attendance has an effect on or can improve students' performance in classes. We are distributing a self-administered online survey to Carnegie Mellon faculty who taught undergraduate courses in the Fall 2010 semester. Data collected about each course includes department, class size, attendance policy information, and distribution of final

grades. We will compare the distribution of final grades for attendance mandatory versus attendance optional courses to determine the effect of attendance policy on student performance. Although we are still in the data collection process, we expect to find that attendance mandatory courses will have better student performance. While we will definitely be able to make conclusions within academic departments, we also hope to generalize these comparisons within and across colleges.

The Connection Between Ultra High Energy Cosmic Rays and Active Galactic Nuclei
Jingyi Mo / Statistics, Michael Rednor / Statistics, Kyra Singh / Economics and Statistics

Advisor(s): Peter Freeman / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

Ultra high energy cosmic rays are charged particles that collide with the Earth's atmosphere at relatively infrequent rates. These particles differ from medium and low energy particles as they occur less frequently and much is unknown about the nature of their origin. Recent research by the Pierre Auger Collaboration has suggested that the origin of these particles may be nearby extragalactic matter known as active galactic nuclei (AGN). This research project aims to determine if and what the relationship is between the ultra high energy cosmic rays and the known AGN. The data set is comprised of 69 observed cosmic rays from the Pierre Auger Observatory and a catalog of 1,132 AGN. Using a series of simulations that compare the minimum distances between each cosmic ray and the AGN for observed and simulated data sets, the Kolmogorov-Smirnov test returned results that indicated we have evidence that cosmic rays come from a non-isotropic distribution of matter in the galaxy. The research also addresses the known limitation of the incompleteness of the AGN catalog in order to further study the relative non-isotropic nature of the cosmic ray occurrence. Additional data on the cosmic rays may be needed in order for future research to determine the exact origins of the cosmic ray occurrences.

Undergraduate Involvement at Carnegie Mellon University
Ellen Gurary / Statistics, Bruce Jackson / Statistics, Margaret Soderholm / Ethics, History & Public Policy, Jennifer Sung / Social & Decision Sciences, Christina Swierkocki / Statistics

Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

We are attempting to quantify the factors that have an effect on campus involvement of Undergraduate students at Carnegie Mellon.

Undergraduate Prospects After Graduation
JeWoo Sun / Statistics & Science and Humanities Scholars, Erika Tang / Economics, Zhiyi Tang / Statistics, David Zimmerman / Statistics & Science and Humanitites Scolars

Advisor(s): Brian Junker / Statistics
Rangos 1 & 2 / Sigma Xi Group 8 / 12:00

Given the recent scandal revealing the over optimistic prospects for graduating law school students, the statistics produced by universities and published in the US News and World Report are being brought into question. These misleading statistics encourage hopeful JD seekers to pursue startling loans with the expectation that their debts will be paid off with relative ease upon graduation thanks to the supposed 84% job placement ratings. While the production of undergraduate college rankings has often been criticized for its accuracy in measuring the actual quality of education,

Carnegie Mellon University and other universities have long bolstered their reputations for producing intelligent, motivated, and successful students with the use of these faulty lists. However, this raises the question of how measurably successful Carnegie Mellon University undergraduate alumni are. Where do alumni relocate? What occupations do they practice? What graduate programs do they choose to pursue? And, according to the common man's perception of comparative success, how do Carnegie Mellon University undergraduate alumni stack up when compared to graduates of other universities? This study analyzes the data collected and evaluated by the Carnegie Mellon University Career Center (http://www.studentaffairs.cmu.edu/career/students_alumni/post-grad-survey/index.html) in order to answer such questions as: Are alumni—successful by Carnegie Mellon standards—well received by employers and graduate programs? Do alumni display a tendency to remain near to Pittsburgh or to relocate elsewhere? Do alumni successfully attain employment relevant to their subject(s) of study? How accurately do national and international rankings systems gauge the value of a Carnegie Mellon Undergraduate degree? The data collected from the Carnegie Mellon University Career Center is will also be used to test the effectiveness of various survey methods. The Career Center has nearly perfected its collection data collection methods as response rates generally run somewhere in the 90th percentile (with the exception of College of Fine Arts classes where response rates are as low as the 70th percentile). This has yielded results near to that of census data. As such, this study assesses the effectiveness of certain types of sampling schemes (stratified and clustered sampling) to produce results representative of the target population so that future statistical researchers can visually apprehend the significance of various survey designs. Few have had the data provided or the opportunity to conduct a study on accurate census data in order to optimize survey results to population parameters.

BIOLOGICAL SCIENCES

MELLON COLLEGE OF SCIENCE

An Initial Study of Ovarian Cancer Stem Cells and the Cytokine Network
Yuanting Lu / Biological Sciences
Advisor(s): Dr. Vera Levina / Hillman Cancer Center
Rangos 1 & 2 / Sigma Xi Group 1 / 10:00

Cancer stem cells (CSC) are a rare subpopulation of undifferentiated cells. They have the ability of self-renewal and are able to generate a progeny of differentiated cells that constitute a large majority of all tumor cells. It is believed that CSC's cytokine network plays an important role in tumor proliferation and protection from endogenous and exogenous antagonists. There are three types of ovarian tumors. Epithelial ovarian cancers (EOC) represent the origin of 90% of all ovarian cancer types. EOC are derived from cells on the surface of the ovary. Germ cell ovarian tumors are derived from the egg producing cells within the ovary, and stromal ovarian tumors produces steroid hormones. Ovarian cancer has an overall mortality rate of 75%. Although CSCs have been identified in malignancies such as breast, lung, and pancreatic cancers, ovarian CSC remain poorly studied. Knowledge of the markers for ovarian CSCs and its efficient cytokine network has the potential to determine whether certain cytokine receptor axes in ovarian CSCs could be targeted for improvement of anti-cancer therapy. The results show that epithelial cell surface markers (CD-133 and CD-44) where present on ovarian CSC. There also indicated upregulation of transcription factors Sox-2,

Oct4, and beta-catenin that contribute to the CSCs' pluripotency. Lastly, the results indicated increased levels of major human aniogenic and growth factors and their receptors (VEGFR2, FGFR2, CXCR1, and CXCR4). Monoclonal antibodies and receptor tyrosine kinase inhibitors (presently used in clinical practice) could potentially inhibit or neutralize such receptors and growth factors as a means to enhance ovarian cancer therapeutic modalities.

Analysis of APC2 Phosphorylation on Actin Furrow Formation in the Drosophila Syncytial Embryo
Kelly Shibuya / Biological Sciences & Science and Humanities Scholars

Advisor(s): Brooke McCartney Biological / SciencesRangos
Rangos 1 & 2 / Sigma Xi Group 2 / 10:00

The colon cancer tumor suppressor, Adenomatous polyposis coli (APC), is a multifunctional protein that is not only involved in Wnt signaling, which has been extensively studied, but also in the organization of the cytoskeleton. We are investigating the role of APC proteins on the actin cytoskeleton in order to further discover links between APC and tumor development. Like humans, Drosophila have two APC isoforms that are highly conserved. The Drosophila syncytial embryo provides a great model system to study dynamic cytoskeletal events. During this time of development, embryos undergo synchronous nuclear divisions without cytokinesis, and actin-based pseudocleavage furrows act as physical barriers between neighboring cells to provide the mitotic fidelity. Previously, it has been shown that APC2 localizes to these actin furrows, and loss of APC2 activity (APC2 null) leads to furrow extension defects. Our lab also showed that APC2 can form a complex with the actin nucleator Diaphanous (Dia) during furrow formation, possibly regulating its activity. Additionally, APC proteins are highly phosphorylated, a mechanism commonly used to regulate protein functions. In this study, we are investigating the role of phosphorylation of APC2s 20 amino acid repeats (20Rs) on furrow formation. Based on the mammalian studies mutant versions of the protein that are nonphosphorylatable (Ser to Ala) or phospho-mimetic (Ser to Asp) were generated. Drosophila APC2 has five 20Rs with 20R3-R5 having the highest homology to the human APC. Thus, we generated two versions of the phosphorylation mutants, one mutating the relevant residues in 20R1-R5, and one mutating only 20R3-R5. We are testing the ability of these mutants to rescue the furrow defects in APC2 null background. This study will provide a better understanding on the importance of phosphorylation of APC2 on regulating the actin cytoskeleton.

Analysis of BRCA2 protein level in pancreatic cancer patients by Western Blotting method
Eun Hwa Lee / Biological Sciences

Advisor(s): Dr. David C. Whitcomb / University of Pittsburgh
Rangos 1 & 2 / Sigma Xi Group 1 / 10:15

BRCA2 mutations that have been reported in the Pittsburgh cancer registry were chosen as a screening panel in a single 35-plex taqman assay, also including 6 common SNPs for haplotype analysis. Over eight hundred blood samples were collected from the Pittsburgh area. The blood was processed and DNA was extracted. DNA sample was diluted down to appropriate concentration and analyzed at a core facility. BRCA2 genotyping was completed on a total of 358 documented adenocarcinoma patients, 113 healthy controls, and 184 subjects with other cancers or GI disease. According to the result, 687 of the 768 tested samples gave results in at least 30 of the 35-plex. Of these, three samples were heterozygous carriers of a deleterious mutation in BRCA2, two healthy controls with a family history of pancreatic cancer each carried 6174delT, and one patient with

adenocarcinoma carried 30334delAAAC. 613 samples had full haplotyping information, common benign BRCA2 SNPs were not overrepresented in either patients or controls. From this BRCA2 sequenome data, protein analysis on BRCA2 protein can be done by western-blot. The purpose of the project is to quantify BRCA2 protein in whole blood, serum, plasma, and tissue samples from control and pancreatic cancer patients and compare the protein level in different sources. We expect that pancreatic cancer patients would display low BRCA2 protein concentration in each sample compared to the controls.

APC2 and the Rescue of Brat11 Mutants in Drosophila Neuroblasts
Allyson Koyen / Biological Sciences

Advisor(s): Brooke McCartney / Biological Sciences & Vincent Stepanik / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 2 / 10:15

Wnt signaling is one biological pathway that regulates cell to cell interactions during embryogenesis in many organisms, including Drosophila. Studying the Wnt signaling pathway is of interest because perturbations in this pathway have been shown to cause developmental defects as well as tumorogenesis. Mechanistically, when Wnt signaling is turned on, the transcription factor -catenin enters the nucleus, activating target genes that regulate proliferation of stem cells and differentiation of their progeny. Adenomatous polyposis coli (APC) is a protein encoded by the Apc gene that was first discovered as a tumor repressor in humans. It is now known that APC plays a role in the negative regulation of Wnt signaling. Along with other proteins, APC forms a destruction complex that targets -catenin for degradation by the proteasome when Wnt signaling is turned off. Research has shown that mutations in APC can lead to tumor formation but the precise mechanism as to why is still a mystery. We do know that APC2 plays a role in the asymmetric division of stem cells in the brain. Another protein that plays a role in the asymmetric division of stem cells is Brat (brain tumor). Mutations in the brat gene in Drosophila cause the over-proliferation of stem cells in the brain, resulting in tumor formation. Recent studies have shown that brat mutants have reduced levels of the protein APC2. Furthermore, when APC2 is over-expressed in brat mutants, the mutant over-proliferation phenotype is rescued. There is still a great deal that remains unknown with regard to the function of the APC2 gene in regulating brain stem cell proliferation. For my research project, the levels of APC2 that are necessary and sufficient to rescue the mutant brat phenotype are in the process of being identified. We will also be identifying which domains of APC2 are responsible for the appropriate regulation of stem cell proliferation in brat mutants. This will be accomplished by introducing various transgenes expressing mutant forms of APC2 into the genome of brat mutants. This will allow us to determine which function of APC2 is required for proper proliferation of neural stem cells in the Drosophila brain.

Breast cancer migration via BDNF endothelial expression outside of blood vasculature
Heather Lynn / Biological Sciences

Advisor(s): Dr. Qiuhong He / University of Pittsburgh
Rangos 1 & 2 / Sigma Xi Group 1 / 10:30

While cancerous cells are known to migration via the body's circulatory and lymphatic system, we have proposed that these cells could possibly migrate long distances outside of the vasculature. This proposed method of metastasized breast cancer migration is similar to that already observed by neural progenitor cells in the adult brain. The neural signal of BDNF, which is released from blood

vessels, may guide the neurons along the brain vascular to their intended destination. The hypothesis proposed is that metastasized tumor cells may migrate in the same manner in the body using signals released by the endothelial cells to move outside of the blood vessel and lymphatic system. The main methods of testing this hypothesis are twofold. The primary investigation is to construct a 3D blood vascular network of endothelial cells (fluorescent protein labeled) and image fluorescently tagged cancerous cells migration in vitro. This 3D blood vessel network expressed BDNF and GFP, so it may be imaged using time lapse microscopy. The breast cancer cell line used (MDA-MB-123) expresses RFP or GFP, so the cells are visible in contrast to the 3D vasculature network. The second method of investigation is to use luciferase imaging of live mice to view the migration of metastasized tumor cells in vivo, as well as study GFP-labeled MDA-MB-231 cells or MMTV-tva/RCAS-PyMT tumor cell migration in fresh tumor tissues.

Challenging infectivity of phage
Alice Basin / Biological Sciences

Advisor(s): Alex Evilevitch / Physics
Rangos 1 & 2 / Sigma Xi Group 3 / 10:00

The goal of this work is to elucidate the role of the internal genome pressure on virion synthesis and viral infectivity. The genome pressure was varied by changing DNA length packaged within a bacterial virus (bacteriophage lambda). The terminase motors of bacteriophages have been shown to be among the strongest active machines in the biomolecular world, being able to package several tens of kilobase pairs of viral genome into a capsid within minutes. Yet these motors are hindered at the end of the packaging process by the progressive build-up of a force resisting packaging associated with already packaged DNA. In this experimental work, we raise the issue of what sets the upper limit on the length of the genome that can be packaged by the terminase motor of phage lambda and still yield infectious virions. While the number of plaques reflects the efficiency of virus assembly in vitro, the size of the viral plaque is related to the rate of virus particle assembly in vivo – the faster (more efficiently) the virus replicates in vivo, the larger the plaque. The plaques resulting from 78%, 94%, WT (100%), 105%, and 110% l genome mutants yield progressively smaller size. As all other factors remain unchanged, and since genome packaging is the rate-limiting step in the concerted viral assembly process, we interpret the dramatic reduction in replication rate as a reflection of a decrease in the rate of genome packaging in vivo. This suggests that the length of the packaged genome has been evolutionarily optimized to DNA packaging densities where packaging is more robust and less prone to changes in the cellular environment. Most importantly, these findings demonstrate that slight changes in the internal pressure induced by variation in the DNA length, will have fatal consequences for virus synthesis and the spread of infectious particles. This sheds light on the decade-old debate of whether genome pressure has any consequences for in vivo infectivity. For the first time, we were able to quantitatively measure a dramatic reduction in the phage production rate associated with the packaging of DNA longer than the WT genome in the phage lambda capsid. These measurements reveal important biological implications of internal genome pressure on in vivo viral replication.

Communal Coping Between Persons with Diabetes and Their Partners: An Exploratory Study
Jillian Cheng / Biological Sciences & Emily Chao / Biology and Psychology

Advisor(s): Vicki Helgeson / Psychology
Kirr Commons / 1st Floor, Window side / 12-2:30

My group and I would like to get a greater understanding of how partners of persons with diabetes help or hinder self-care behaviors. The study aims to explain the role of the social environment, and in particular, the partner's role in facilitating self-management among persons with Type 2 diabetes. The results of the study will benefit health care practitioners by informing them of ways in which couples can work together to enhance diabetes self-care, which is key to preventing diabetes-related complications. We will first conduct an exploratory pilot study that consists of adults over the age of 18 who have Type 2 diabetes and have been married or living with a partner for at least two years. Participants will participate in an in-depth phone interview.

Creation of Septin Mutants in Candida albicans via Transposon Mutagenesis
Mike Khan / Biological Sciences

Advisor(s): Jill Blankenship / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 11:15

Septins are a family of GTP-binding proteins that establish and maintain asymmetry during cell morphogenesis. In addition, they play roles in other cellular processes such as bud site selection, cell cycle regulation, and cell wall stress response. In order to investigate the role of septins in Candida albicans, I will create a library of septin mutants by inserting transposons into the open reading frame of the septin Cdc10, an integral component of the septin complex. I will transform these mutants into cdc10/ mutant and wild type strains and analyze the resulting phenotypes. In particular, I will be looking for mutations that demonstrate improper localization of the septins at the bud neck or those that alter the cell wall stress sensitivity of the parent strain.

Degradation of naphthalene using FeIII-TAML catalysts
Medini Annavajhala / Biological Sciences & Science and Humanities Scholars

Advisor(s): Terrence Collins / Chemistry
Kirr Commons / 1st Floor, Window side / 12-2:30

Naphthalene, named a possible carcinogen for humans and animals by the International Agency for Research on Cancer (IARC) and linked to other health effects related to blood poisoning, has a stable structure consisting of two fused benzene rings. With the emergence of naphthalene as a toxin of current interest, especially due to natural gas extraction methods in Pennsylvania, concern is growing regarding the possibility of the compound being found in groundwater systems. Due to the stability of naphthalene, it was previously regarded as a difficult molecule to degrade, including through oxidation methods. However, our project has shown through both high-performance liquid chromatography (HPLC) and nuclear magnetic resonance spectroscopy (NMR) analyses that the patented Fe-TAML catalysts have the ability to activate hydrogen peroxide and lead to significant degradation of naphthalene. One of the products of this reaction has been identified as formate, indicating a deep oxidation of the original compound. Optimizing these reaction conditions will potentially lead to the degradation of naphthalene to nondetection and a better understanding of the reaction mechanism, giving hope to the use of Fe-TAML catalysts in this application.

Designing and Testing Fluorogen Activating Protein (FAP) Biosensors for Thrombin and Matrix Metalloproteinases
Andrew McCoy / Biological Sciences

Advisor(s): Peter Berget / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 11:00

Proteases are proteins that cleave peptide bonds in other proteins. Thrombin and matrix metalloproteinases (MMPs) are proteases that have significant roles in normal and pathological physiology, including inflammation, blood clot formation and degradation, arthritis, and cancer. Thrombin is a serine protease in the blood coagulation pathway. It performs this function by cleaving soluble fibrinogen to produce insoluble fibrin, which is a component of blood clots. MMPs are a family of proteinases with multiple functions in the extracellular matrix. Creating a set of biosensors specific for thrombin and MMPs will allow for the detection and the direct measurement of enzymatic activity. Using a fluorogen activating protein (FAP) platform, sensors were designed and constructed for thrombin and MMP activity. This project involved designing and cloning the DNA sequences to code for the amino acid cleavage sequences for thrombin and MMP2, MMP9, and MMP14. The sensors were expressed in Escherichia coli (E.coli) and purified sensor was assayed in vitro using fluorometry. The goal is to develop and test this new technology for specific, direct detection of protease activity to provide improved tools for research and clinical studies.

Differential Expression of Genes Involved in Skeletogenesis in the Sea Urchin
Quinn Weisman / Biological Sciences

Advisor(s): Charles Ettensohn / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 2 / 11:00

The Ettensohn lab seeks to learn more about the Gene Regulatory Networks (GRNs) that are involved in the development of the skeletal system throughout embryonic development. The stages of embryogenesis can be carefully analyzed through the sea urchin model organism, specifically Strongylocentrotus purpuratus (sp). As the embryo develops, a particular subset of cells, primary mesenchyme cells (PMCs), exhibit differential expression of genes that have been known to play a role in skeletal development. Identifying gene expression in the embryo can be done primarily through in-situ hybridization. The objective of my project is to determine the differential gene expression patterns in the PMC ring as the embryo develops over time and organize a network of gene expression that supports the results.

Dominant mutations in myosin II heavy chain genes 6, 7, and 11 and their affect on myosin protein dimerization
Danielle Devine / Biological Sciences & Science and Humanities Scholars

Advisor(s): Peter Berget / Biological Sciences
Hoch Commons / 2nd Floor, Rangos side / 3-5

Dominant mutations in the myosin II heavy chain genes 6, 7, and 11 are known to cause a number of cardiac diseases. This project is designed to begin to investigate the molecular mechanisms behind these disorders by analyzing the ability of the mutant myosin II proteins to dimerize. Dimerization of myosin proteins is necessary for the formation of a functional motor protein molecule. Currently it is unclear if the mutant myosin heavy chains are able to dimerize with the wild type heavy chain proteins or if only mutant homodimers and wildtype homodimers are able to form in living cells. This project began by creating dominant mutations known to cause heart disease through overlap polymerase chain reactions (PCR) methods in wild type myosin genes and introducing these new mutant heavy chain sequences into cloning plasmids. The success of the

mutagenesis process was confirmed via commercial sequencing, and the confirmed mutations introduced into protein expression vectors. The success of the insertion of the mutated fragment into these expression vectors has been tested with restriction digests and the presence of the mutation confirmed again through commercial sequencing for several of the desired mutations. The mutated genes have been expressed in Escherichia coli (E. coli), and the resulting protein collected and purified. This knowledge could be the first step in understanding how cardiac diseases result from the mutations.

Effect of Intralipid on Iron Oxide Particle Labeling of Immune Cells during Organ Rejection
Devin Prior / Biological Sciences & Science and Humanities Scholars

Advisor(s): Chien Ho / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 10:00

Cellular MRI is a powerful technique for studying a range of diseases and treatments. The Ho laboratory is developing a new approach to use cellular MRI to monitor organ rejection by imaging infiltration of macrophages into a rejecting heart. This method is based on labeling immune cells with iron-oxide particles, particularly macrophages which will internalize the particles, thus allowing the cells to be detected in vivo by MRI. Iron oxide particles can have very short blood half-lives because they are quickly taken up by Kupffer cells of the liver. My previous studies have shown that iron-oxide blood clearance can be delayed by using intralipid, a clinically approved fat supplement, which is uptaken by the Kupffer cells thus inhibiting their ability to uptake iron-oxide particles. If more macrophages take up the iron-oxide particles, the sensitivity for detecting macrophage infiltration into the rejecting grafts will be improved. In this project, I investigated the effect of intralipid on micron sized iron oxide particle (MPIO) cellular labeling of macrophages by using flow cytometry and mass spectroscopy. I determined that not only does intralipid cause an increased number of cells to uptake MPIO but also causes each individual cell to uptake an increased number of particles which may drastically increase the sensitivity of detecting organ rejection in vivo with MRI.

Effects of Fluid Shear Stress on Heterochromatin Regulation in Endothelial Cells
Priyanka Venkatesh / Biological Sciences

Advisor(s): Kris Dahl / Biomedical Engineering
Rangos 1 & 2 / Sigma Xi Group 7 / 10:00

The nucleus has also been shown to remodel in stiffness in response to mechanical stress. Heterochromatin in often localized and anchored to the nuclear membrane, suggesting it plays a role in the force bearing properties of the nucleus and is possibly affected by mechanical stress. In this study, I show that in human umbilical vein endothelial cells (HUVECs) exposure to fluid shear stress results in an upregulation and localization of heterochromatin protein 1 alpha, a protein tightly associated with heterochromatin formation. As chromatin plays a key role in gene transcription, understanding the effect of shear stress on chromatin could shed light on the mechanism by which gene transcription is modulated through mechanical force.

Elucidating Growth Rates of the Perennial Herbaceous Plant Maianthemum
Adam Sinder / Biological Sciences

Advisor(s): Dr. Susan Kalicz / University of Pittsburgh
Rangos 1 & 2 / Sigma Xi Group 1 / 11:45

Despite extensive research studying the growth characteristics of woody plants and annual species such as Arabidopsis thaliana, little is known about growth dynamics in perennial herbaceous species. Many factors, both biological and practical, contribute to difficulties in measuring yearly plant size dynamics. Biologically, plants can undergo seed dormancy, whereby they do not produce above ground structures for one or more years. Using a large enough sample size, however, allows these effects to be isolated and still give statistically significant results. Instead of dormancy, the effects of white-tailed deer herbivory and selective removal of the invasive species Garlic Mustard (Alliaria petiolata) have been tested though analysis of growth rates in specific deer access vs. exclusion plots. Deer herbivory and invasive species both exert pressures on native plant species such as Maianthemum. Previous research has shown negative effects on the abundance of native species from these pressures. The work done with growth rates sought to understand the mechanism by which Maianthemum responds to deer browsing and invasion by Garlic Mustard. Further research must be done to characterize the role of dormancy in a plant's physiological response to competitive and non-competitive pressures.

Examination of cell autonomous and non-autonomous effects of APC loss in the developing Drosophila wing

Kellie Kravarik / Biological Sciences
Advisor(s): Brooke McCartney / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 2 / 10:30

Adenomatous Polyposis Coli (APC) is a negative regulator of the Wnt signal transduction pathway whose loss is implicated in >80% of human colon cancers. However, the early cellular effects of APC loss in polyp initiation are not well understood. Like humans, Drosophila have two APC homologues, APC1 and APC2, which function together in partially overlapping roles throughout development. To better understand the effects of both APC1 and APC2 loss in a model epithelial tissue, we are examining clones of APC2 APC1 (APC) null tissue in the developing Drosophila wing. We have previously shown that APC null clones exhibit dramatic Wnt dependent apical constriction and invagination in the wing disc that requires the activation of Rho1 and Myosin II. We are now examining how APC loss and activation of Wnt signaling affects tissue morphology, cell death and cell fate specification throughout wing development. In the pupal wing, preliminary data suggests that clones may exhibit an increase in apoptosis. Further, APC null clones exhibit both cell autonomous and non-autonomous fate changes leading to alterations of bristle and vein development. To better understand the temporal organization of these effects, we are also utilizing a new live-imaging technique to observe changes in APC null clones during the larval and pupal stages. This characterization of the effects of APC loss in the developing wing will contribute to our understanding of how Wnt signaling can affect epithelial tissues and may help us understand the cellular changes that accompany the development of colon cancer.

Functional Analysis of Essential Genes in Candida albicans

Chelsea Weber / Biological Sciences
Advisor(s): Aaron Mitchell / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 11:30

This project aims to study essential genes in the diploid pathogen Candida albicans by using the Decreased Abundance by mRNA Perturbation (DAmP) allele method. This method creates alleles that have the 3' UTR of the gene of interest switched from the wild type sequence to a bacterial

sequence. This bacterial sequence lacks information for poly adenylation, transcription termination, and other signals that give stability to the mRNA. Without this stability, there is a decrease in the amount of mRNA and amount of protein produced. This decreased amount is expected to be enough to maintain viability, but also different enough from the wild type to have a noticeable phenotype. This project focuses on protein kinases that are thought to have a role in cell wall regulation, as the cell wall is an important factor in therapeutic treatments for C. albicans infections. The first five genes to be altered as DAmP homozygous are SNF1, IRE1, YPK1, DBF2, and ORF19.5376. These are generated from homologous recombination with the DAmP bacterial sequence and URA3 marker. UAU1 cassettes are then inserted into the URA3 gene, and homozygous strains are generated from homologous recombination events with the ura3 sequences and selected for on –ARG –URA media. This procedure has been confirmed, and can now be used on other essential genes. This project next looks at phenotypic assays of these five DAmP strains, as well as confirmation of reduced mRNA levels with RT-PCR.

Further Exploration of Non-Skeletogenic Mesoderm of the Sea Urchin Embryo
Stephanie Guerra / Biological Sciences & Science and Humanities Scholars
Advisor(s): Charles Ettensohn / Biological Sciences
Pake / 12:00

The non-skeletogenic mesoderm (NSM) of the sea urchin embryo gives rise to four cell subpopulations including the pigment, blastocoelar, coelomic pouch, and circumesophageal muscle cells. At the hatched blastula stage, the NSM cells are present in a ring at the vegetal plate that surrounds the presumptive primary mesenchyme cells (PMCs). The PMCs are a critical cell subpopulation in the sea urchin embryo because they give rise to the embryonic skeleton. Without functional PMCs or PMC-like cells, the embryo of the sea urchin does not develop normally. When PMCs are removed from the embryo at the mesenchyme blastula stage, the embryo is still able to develop normally due to transfating. Transfating is when one cell population takes on the function of another. It has been shown that this transfating population is part of the NSM (Ettensohn 2007). Research in the Ettensohn laboratory has identified the blastocoelar cells of the NSM as the transfating candidate. This project aims to further explore the possible connections between the gene regulatory networks of PMCs and the blastocoelar cells to learn more about the specification of the blastocoelar cells and their potential transfating properties. In addition, examination of the blastocoelar cells in comparison to pigment cells will be conducted to identify keys to the specification process.

Heme Oxygenase Expression Under Various Conditions of Oxidative Stress and Lipid Exposure in Rat Liver Sinusoidal Endothelial Cells and Human Microvascular Endothelial Cells.
Jason Stearns / Biological Sciences
Advisor(s): Dr. Donna Stoltz / University of Pittsburgh
Rangos 1 & 2 / Sigma Xi Group 2 / 11:45

Recent research has shown that nitro-fatty acids mediate an anti-inflammatory response via up-regulation of Heme Oxygenase-1 (HO-1). HO-1 is an important enzyme that catalyzes protective responses during oxidative stress and inflammation in cells. My research focused on evaluating the signaling properties of various lipids by evaluating HO-1 and Heme Oxygenase-2 (HO-2) expression levels. HO-1 is an enzyme that is induced by oxidative stress and HO-2 is a constitutive form of Heme Oxygenase. The goal was to determine the effects of certain lipids including nitro-fatty

acids and various environmental conditions on signaling in liver sinusoidal endothelial cells (LSEC) versus human umbilical vein endothelial cells (HUVEC) and human microvascular endothelial cell line (HMEC-1).

Identification of New Candida albicans Adherence Genes
David Huang / Biological Sciences
Advisor(s): Aaron Mitchell / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 11:45

The diploid fungus Candida albicans is a commensal fungus that is generally benign. However, C. albicans becomes pathogenic when one's immune function is impaired or if an environmental niche becomes available. Pathogenicity of C. albicans is in part attributed to its ability to form surface-bound microbial communities called biofilms. Biofilm formation on medical devices causes severe impacts for human health by providing both an entry to the body and a sanctuary for invasive pathogens. In addition, biofilms have increased resistance to many antifungal agents compared to free floating planktonic cells. C. albicans biofilm formation begins with the adhering of yeast form cells to a substrate, such as a medical device or a catheter. This adherence provides the foundation for the development of a mature biofilm. The goal of my project is to identify genes that function in C. albicans' adherence to a substrate. Using an established adherence assay, a transcription factor (SNF5) was identified as a potential adherence gene. A homozygous SNF5 deletion mutant and an isogenic complemented strain were created using PCR methods for comparison. SNF5 deletion strains showed defect in both yeast form cell adherence and filamentation, and were sensitive under caspofungin, sodium chloride and congo red conditions. These results may suggest a global cell wall defect upon the deletion of SNF5. In addition, these deletion strains were unable to adhere inside the catheter lumen in an in vivo biofilm assay. All defects were restored upon the complementation with a SNF5 allele. Data from gene expression quantification also provided insight regarding SNF5 responsive genes, and how its regulation governs each phenotype. The knowledge gained from the identification of new C. albicans adherence genes can identify targets for drug development that will aid in the treatment of patients who suffer from systemic C. albicans infection.

Increasing the Efficacy of Cross-Linking Agents in Lung Cancer
Katherine Fu / Biological Sciences
Advisor(s): Christopher Bakkenist / Assistant Professor, Radiation Oncology / The Hillman Cancer Center
Rangos 1 & 2 / Sigma Xi Group 1 / 10:45

Lung cancer is the most common cause of cancer death and accounts for over 1.3 million deaths worldwide as of 2004. Current treatment methods include radiotherapy and the use of cross-linking agents. However, these treatments are still inadequate and strategies to improve their efficacy should be explored. The Fanconi anemia pathway promotes homologous recombination repair in cells containing DNA interstrand crosslinks. This pathway is important for the therapeutic response of cancer cells to DNA crosslinking agents and has been shown to be defective in certain cancers (pancreatic, breast, and ovarian). Ataxia telangiectasia mutated (ATM), is a kinase critical for the induction of DNA damage responses and DNA double strand break repair. Inhibition of ATM kinase activity using the small molecule inhibitor, KU60019, has been shown to radiosensitize cells. Recently, it has been shown the Fanconi anemia pathway is synthetic lethal with ATM. Therefore, we hypothesize that ATM kinase inhibition with KU60019 can induce cell death in lung cancer cell

lines deficient in the Fanconi anemia pathway. A panel of nine lung cancer cell lines, provided by the University of Pittsburgh Cancer Institute Lung Cancer SPORE, have been tested for an intact ATM kinase pathway, of which three show constitutively active ATM signaling (201T, 343T, 239T), potentially indicating a defect in their FANCD2 pathway. Clonogenic survival assays were also conducted for four cell lines, of which two (201T, 239T) showed increased sensitivity to ATM kinase inhibition upon treatment with mitomycin C, a cross-linking agent. Therefore, we identified two model cell lines for studying the synthetic lethality relationship of ATM and the Fanconi anemia pathway in lung cancer. The hope is to build a rationale for treating cancers with defects in the Fanconi amenia pathway with ATM kinase inhibitors. This treatment method would exploit the genetic mutations of a tumor cell to improve their therapeutic response.

Infants' detection of recurrent evolutionary threats
Dasha Adamchik / Biological Sciences & Jennifer Frazier / Civil and Environmental Engineering
Advisor(s): David Rakison / Psychology
Wean Commons / 1st Floor, Connan side / 12-2:30

In a recent study, (Rakison & Derringer, 2008) found evidence that infants possess an evolved spider detection mechanism that may have aided in our early ancestors' ability to learn about and avoid these predators to ensure survival. We are continuing this research to determine if 5-month-old infants have a detection mechanism for rats. We expect to find a detection mechanism for rats because they (along with spiders) are a top phobia among adults, and they have been present throughout the evolution of humans. To determine if infants have such a mechanism, we showed infants a schematic rat, a partially scrambled rat, and a fully scrambled rat. If infants do have a detection mechanism for rats, then they will look longest at the schematic rat than the other two images. This interest in potential threats would allow them to make a connection between that threat and the emotional response of an adult. This connection could potentially lead to the child fearing that threat, and therefore help them to be safe in a future encounter. The findings will aid in the understanding of developmental, cognitive, and evolutionary psychology.

Investigating the Role of Pwp1 in 60S Yeast Ribosome Assembly
Ian Campbell / Biological Sciences
Advisor(s): John Woolford / Biological Sciences
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Ribosome assembly is an essential process for growing and dividing cells. Ribosomes are responsible for building all the proteins that are used for cellular function. The yeast species Saccharomyces cerevisiae provides a model for ribosome assembly that is similar to humans.The yeast protein Pwp1 is a conserved, nuclear protein that functions as an assembly factor in 60S ribosome biogenesis. To explain the role of Pwp1 in ribosome assembly, it must be determined: when Pwp1 associates with preribosomes, what proteins and RNA Pwp1 associates with, and what is the effect on ribosome assembly of depleting Pwp1. Determining the answers to these questions will elucidate the function of Pwp1 in ribosome assembly and advance knowledge of the ribosome biogenesis pathway.

Investigating the role of signaling in establishing axial patterning in the sea star ectoderm
Claire Koechlein / Biological Sciences

Advisor(s): Veronica Hinman / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 2 / 11:15

The early embryonic ectoderm of sea star blastulae is extremely well patterned as evidenced by both nested, concentric domains of transcription factor expression along the animal-vegetal axis as well as distinct domains of expression along the dorsal-ventral axis. In larvae, these same transcription factors that were expressed throughout the ectoderm, are expressed specifically within the ectoderm of the animal pole domain and ciliary bands, two territories associated with the larval nervous system. This is distinct from sea urchin development, in which orthologous gene transcripts are already localized within the animal pole domain and ciliary band ectoderm by the blastula stage, and suggests that specification of body axes occurs more quickly in sea urchin embryos as compared to those of sea stars. We investigate the role of signaling in establishing the axial patterns of ectodermal transcription factor expression observed in the sea star by disrupting the pathways that are known to pattern metazoan embryos and using in situ hybridization to visualize the effect of this on the spatial expression of transcription factors within the sea star ectoderm. From a comparison of our work to the known mechanisms that specify the embryonic axes in the sea urchin, we can begin to understand how signaling might influence developmental timing and explain the differences in the early expression patterns observed between these echinoderm embryos. In addition, understanding the interplay among signaling and transcription factors involved in ectodermal patterning in the sea star will not only contribute to our preliminary ectodermal gene regulatory network, but also will provide mechanistic insight into the ontogeny of the larval nervous system.

Investigation of debranching enzyme
Andre Hersan / Biological Sciences
Advisor(s): Mark Macbeth / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 11:00

In splicing, exons are joined together and introns removed to generate the correct RNA for translation. The byproduct of splicing is the removed lariat intron. Processing of the lariat intron is performed by debranching enzyme Dbr1, a 2'-5' phosphodiesterase that is well conserved among all eukaryotes. Dbr1 may also have alternative cellular functions, as S. cerevisiae Dbr1 mutants are defective in Ty1 retrotransposition. However, the function of Dbr1 in retrotransposition is unclear. Better systems are needed to characterize Dbr1 and gain more information about the structure and specificity of the enzyme. Previous reports on Dbr1 characterization use non-natural substrates – as the methods of synthesizing the RNA limited the sequence so that the substrates were not the consensus sequences of lariat RNA. Recently, we have developed the solid-phase synthesis of branched RNA that is a mimic of the lariat RNA, including the branched RNA with conserved sequences as well as unnatural branched RNA and DNA-RNA chimeric analogues. The cleavage and binding analyses of these branched RNAs and branched RNA-DNA chimera with Dbr1 offer insight into the substrate specificity of Dbr1. The use of these analogues and Dbr1 and mutants are being investigated for use in protein-RNA crystallization to further our understanding of debranching of RNA and its role in cellular processes.

Investigation of the activity dependent expression of the 4 subunit of the BK channel
Akanksha Vaidya / Biological Sciences

Advisor(s): Alison Barth / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 10:45

BK channels are large –conductance voltage and calcium gated potassium channels. Previous work in our lab showed that BK channel activity increases 24 hours after seizures are induced in mice. My project aimed at investigating the mechanism behind this post-seizure increase in BK channel activity. The BK channel consists of the pore-forming alpha subunit, and a regulatory subunit. There are four different subunits that can associate with the alpha subunit of the channel. 4 is widely expressed in the brain and studies have shown that this subunit inhibits the BK alpha subunit. I carried out in-situ hybridizations to study the expression of the 4 subunit before and after seizures in mice. The experiments showed that 4 expression decreases in the hippocampus of the brain 24 hours after seizures have been induced. Thus, a post-seizure increase in BK channel activity could be due to a decrease in expression of the 4 subunit of the BK channel.

Perceptions of Childbirth Among American Expatriate Mothers in Switzerland: A Standard for Comparative Maternal Healthcare Systems in Two Countries
Katherine Fu / Biological Sciences
Advisor(s): Marie Norman / History
Peter / 2:00

The United States, currently undergoing a healthcare reform and considering alternative healthcare models, has looked to Switzerland as a possible medium between completely socialized medicine and privately owned medicine. However, the element of culture ultimately plays an important role in how successful a healthcare model is received in a country. Herein lies the importance of expatriate's experiences living abroad. Their beliefs and reactions to certain elements of healthcare can give a good prediction of how well received a new healthcare model will be. In this presentation, American expatriate mothers living in Switzerland are interviewed and asked about their childbirth experience in relation to what they have already experienced or know about in the US healthcare system. Aside from the act of childbirth itself, areas of healthcare such as pre and post birth care are also addressed. The most acute differences observed were the Swiss approach to intervention medicine and post-partum care. In a country where the culture places emphasis on quality of life and wellness, intervention medicine for mothers was looked negatively upon while post- partum resources for mothers were expansive. These elements of maternal care can potentially be obstacles that the United States need to address appropriately or at least consider when implementing such a healthcare model.

Role of small RNA of unknown function (RUF6) in malaria pathogenesis
Subha Patibanda / Biological Sciences
Advisor(s): Kausik Chakrabarti / Chemistry
Rangos 1 & 2 / Sigma Xi Group 1 / 11:15

Malaria is an infectious disease affecting over 250 million people. Last year, the World Health Organization (WHO) reported 2-3 million deaths as a result of malaria. Malaria is a disease caused by the parasite Plasmodium, the most pervasive and deadly species being Plasmodium falciparum accounting for 80% of all malarial infections and 90% of all malaria related deaths. With the recent understanding that RNA, like proteins, can serve as a drug target when combating infectious diseases, an interest in identifying specific RNA sequences in the eukaryotic pathogen Plasmodium

Falciparum (PF) has served as a driving force for this project. RNA molecules, like proteins, fold into characteristic secondary and tertiary structures that account for their diverse functional activities. Many of these RNA structures, or certain structural motifs within them, are highly conserved and interact specifically with effector proteins or metabolites. RNA functional motifs are attractive targets since they are highly conserved and able to discriminate between closely related small molecule species. However, they are underutilized because there is limited information available about how RNA motifs interact with small molecules. To turn all the above information into novel anti-parasitic drugs, the relationship between interactions and functions of newly identified RNA elements in malaria parasites needs to be established. This project, in particular, stems from an unusual distribution of the RUF 6 non-coding RNA sequence within the PF genome. These RNA elements are part of a RNA multigene family, expressed abundantly in the intra-erythrocytic stages of Plasmodium falciparum. There are 15 copies of RUF6 genes in malaria genome and they are usually in close proximity or juxtaposed to malarial antigens. Thus, there is some curiosity as to what the role of the RUF6 is and whether or not it relates to the function of the malarial antigens. To investigate this phenomenon further, the focus of my work is to identify the structure and function of RUF6 by employing manytechniques and exploring a variety of possibilities in functionality, especially to shed some light on the inhibition of cell translation. My most recent research involves the analysis of double stranded RNA cleavage in Plasmodium falciparum. This will be the focus of my presentation at Meeting of the Minds.

Role of TLR signaling in the chemopreventive properties of naturally occurring isothiocyanates
Elizabeth Coyle / Biological Sciences

Advisor(s): Dr. Saumen Sarkar / University of Pittsburgh
Rangos 1 & 2 / Sigma Xi Group 5 / 10:00

Naturally occurring isothiocyanates (ITC) from cruciferous vegetables have been known for their cancer chemopreventive properties. However, the molecular targets responsible for these actions have not been very well understood. It was recently discovered that several ITC have differential inhibitory effects on innate immune signaling pathways. The effects of four ITC compounds (phenylethyl isothiocyanate, erucin, erysolin and sulfaoraphane) on Toll-like Receptor (TLR) signaling pathways were investigated. In a model system for TLR3 signaling, the mechanism of differential activity was investigated. These chemopreventive actions of ITC could provide a more complete understanding of the mechanistic basis of specific cancers.

SNP Mapping of C.elegans to identify an alpha 1-antitrypsin mutation
Chelsea Hoffman / Biological Sciences

Advisor(s): Stephen C. Pak, Ph.D. / University of Pittsburgh
Kirr Commons / 1st Floor, Window side / 3-5

The purpose of this project is to identify the mutation that blocks degradation of ATZ. First, the strain carrying the mutation will be crossed with a mapping strain (CB4856) and the chromosomal location of the mutation will be determined by bulk segregation analysis of 18 SNPs. Next, the mutation will have to be fine mapped to smaller intervals. Whole-genome sequencing will then be performed to determine the exact position of the mutation.

Structural Analysis of Crystal Violet Binding Single Gene Variable Fragments by NMR
Sarah Zuerndorfer / Biological Sciences & Science and Humanities Scholars

Advisor(s): Gordon Rule / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 10:45

Current common techniques for the detection and localization of cellular organelles, proteins and other macromolecules utilize tagging with radioactive isotopes and large fluorescent proteins like Green Fluorescent Protein (GFP). These methods are generally successful, but have distinct disadvantages, such as the inability to view two different proteins at once with radioactive isotopes (as they show up indistinctly in X-ray film), the potential disruption in protein function due to the attachment of GFP, and the decay of GFP fluorescence over time. However, these faults can be eliminated by using dyes that can be activated and refreshed as needed by the experimenter. In order to improve upon localization technology, we aim to produce a system that utilizes a single chain variable fragment (scFv) that can localize to the experimenter's choice of protein and fluoresce with the addition of an organic dye. The benefit of this protein it is twofold. First, the scFv does not need to be added at the level of DNA, so less disruption of function would occur, secondly, the dye could be re-applied and varied in color with a different version of the scFv to allow multiple proteins to be viewed simultaneously with no loss of fluorescence. In order to attain these benefits we created a scFv designed to attach to an epitope sequence in the cellular component of interest. The scFv also has a domain that contains a binding site for an organic dye (for my portion of the experiment the dye is crystal violet) which will fluoresce when bound. This allows for the experimenter to essentially turn on detection during a specific time in the cell's cycle. The dye could also be re-applied, thus diminishing the effect of photobleaching and cellular breakdown of the dyes, which would be essential for experiments tracking protein production and localization in the cell over its lifetime. We plan to create this scFv by starting with several plasmid DNAs each encoding one version of the scFv created by the Armitage lab. We will be using several versions of a similar scFv in order to choose one that works best under normal cellular conditions. The DNAs are encoded in a pAK400 vector which we will then subclone into the pET22+ vector. This construct will then be transformed into E. coli strain C3103 cells for optimum antibody expression. The scFv protein will be isolated from the E. coli cells and purified using a cobalt affinity chromatography column before its structure will be determined via NMR. The NMR experiments will be performed on both dye-bound (using crystal violet dye) and unbound states to analyze the structures of both complexes. The resulting NMR structure will give an idea as to how the protein binds its epitope and its general structure, so that these features can be documented and presented to others looking to use this system as a method for protein detection in their own experiments. The protein, once analyzed properly, should be effective in use for many future biological experiments.

Structural Analysis of Mutant Adenosine Deaminase that Act on RNA (ADAR)
Jane Lew / Biological Sciences
Advisor(s): Mark Macbeth / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 11:30

I am applying for a SURG grant to help sponsor my research on the RNA-editing enzyme, adenosine deaminase that acts on RNA (ADAR). The mechanism by which ADARs target certain adenosines for deamination is unknown; however, the lack of common RNA sequences among the known ADAR targets suggests that the mechanism is dependent on structural characteristics of the RNA. In order to further investigate this topic, I am proposing to study different mutant forms of

the ADAR protein to see if mutations at different areas of the catalytic domain will affect the normal function of the protein. Understanding the effects of the mutation, either in function or structure, will help us understand this protein in more detail.

Structure-Function Analysis of Adenosine Deaminase that Acts on RNA (ADAR) Substrates
Amy Wang / Biological Sciences
Advisor(s): Mark Macbeth / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 11:15

The Macbeth lab studies the RNA-editing enzyme, adenosine deaminase that acts on RNA (ADAR) and the mechanism by which it catalyzes the deamination of specific adenosines in double-stranded mRNA (messenger RNA) substrates. mRNA is transcribed from DNA and serves as an intermediary template that travels out of the nucleus into the cytoplasm of the cell for protein synthesis. The product of the deamination reaction is inosine, which is read by ribosomes during translation as the nucleotide guanosine. The deamination of inosine to guanosine by ADARs is therefore a form of RNA-editing. There are many different types of RNA-editing that occur after transcription that results in a mature mRNA such as an addition of a poly-adenosine tail, guanine cap, and RNA splicing. The mechanism by which ADARs target certain adenosines for deamination is unknown; however, the lack of common sequence motifs among the known ADAR substrates suggests that the mechanism is dependent on structural characteristics of the RNA.

The Role of Diaphanous in the Drosophila Syncytial Embryo
Shriya Venkatesh / Biological Sciences & Cindy Zhu / Biological Sciences
Advisor(s): Brooke McCartney / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 2 / 10:45

Diaphanous is a formin that aids in polymerizing actin in many cell functions such as cell polarity and cytokinesis. Dia is activated by Rho GTPase, which binds and relieves an auto-inhibitory domain, thereby activating Dia. The McCartney lab in the Department of Biological Sciences studies cell morphology with particular respect to the protein Adenomatous polyposis coli (APC), a known tumor suppressor associated with colorectal cancer. APC2 in Drosophila is required for the formation of psuedocleavage furrows during successful mitosis in the early embryo. APC-null mutant embryos show significant differences in cleavage formation. Previous work in the lab has shown that Dia not only colocalizes with APC2 during furrow formation and extension, but also the localization of APC2 is Dia-dependent. Significant impairments in furrow formation are seen in Dia-null mutant embryos. Our project focuses on the effect of mutations in Dia on actin nucleation, cell morphology and progeny viability. Several Dia transgenes with point mutations in conserved actin nucleation domains were created and inserted into a Dia hypomorph background to test their ability to rescue this lethal phenotype. These mutations completely abolished the actin nucleating function of FH1 domain in Dia or disrupted the dimer formation of the FH2 domain, which is known to be the functional state for promoting actin nucleation and elongation. We will examine the effects of these mutations in actin nucleation and early development in fixed and live syncytial embryos.

The Role of Golgin-45 in Ribbon Formation
Monalisa Ghose / Biological Sciences
Advisor(s): Adam Linstedt / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 10:30

The Golgi apparatus is a component of the cell that is responsible for cell secretion. Several proteins are known to aid in Golgi formation; golgin-45 is one such protein and the focus of my research. Golgin-45 is known to aid in Golgi ribbon formation and to help maintain compartmentalization of the Golgi. My research goals are to (1) map the functional domains of golgin-45 that allow the protein to attach to the Golgi and (2) to determine the specific role of golgin-45 in Golgi formation. I have attempted to answer these questions by studying the effects of deleting various segments of the protein or depleting golgin-45 completely from the cell. These results have led to the formation of a model that characterizes how Golgin-45 might complete its function in the cell.

The Single Molecule Study of Glutathione Transferases
Han Na Choi / Biological Sciences
Advisor(s): Gordon Rule / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 10:15

Glutathione Transferases (GST) are detoxification enzymes that play an important role in the protection of organisms from toxins. Mutations in GSTs have reportedly been related to many human diseases, such as Parkinson's disease, Alzheimer's disease, and human cancers of many organs. Despite its important function in our body, currently GST is fused to another protein to aid in the purification of another protein. Currently, the activity of a single GST molecule is unknown; its enzyme activity has been only studied in bulk, aqueous solution, at the so-called ensemble level. Through this project, I want to investigate the activity of single GST molecules, using one of the human GSTs, called A1-1. Single GST molecules will be imaged using a florescent microscope, and individual activity will be monitored in the presence of a product (a fluorescent Glutathione derivative) following the fluorescence emission of molecules in time. The single molecule study of this enzyme will greatly contribute to current biochemistry studies and medical research, potential leading to new disease treatments.

Towards a Bioadhesive Controlled-Release Microchip Drug Delivery System
Douglas Bernstein / Mechanical Engineering & Julia Lekht / Biological Sciences
Advisor(s): Lee Weiss / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:00

Orally administered drug treatments for many diseases, such as Parkinson's Disease, are inadequate due in part to the inability to achieve desired release profiles for the medication as a result of patient non-compliance and shortcomings of current drug-delivery technologies. In order to address these issues we have taken the first steps towards the development of a novel bioadhesive drug-delivery microchip that when ingested will be capable of providing prescribed release patterns of medication over a period of approximately one week. A microchip was designed based on biodegradable polymers that act as the active release component of the microchip and tomato lectin protein that acts as a bioadhesive agent to attach the chip to the intestinal wall. A scaled-up version of the chip was prototyped and tested to investigate the ability of various polymer blends to achieve desired release profiles in liquid media. In addition, the synthesis, attachment, and properties of the tomato lectin were investigated to quantify its viability as a bioadhesive agent. This initial research has provided the basis for a new drug-delivery technology that may overcome the current inability to achieve highly controlled release of medication.

Uncovering Domain Shuffling in the MAGUK Protein Family with Protein Domain Trees
Katherine Siewert / Biological Sciences
Advisor(s): Dannie Durand / Biological Sciences
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

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. Therefore, if domains from the same family have different phylogenetic trees, it is evidence of domain shuffling. As domains are shuffled over time, their sequences mutate, providing evidence of their evolutionary history. I am studying the history of domain shuffling in the membrane-associate guanylate kinases (MAGUK) protein family, which is involved in the regulation and creation of cell junctions. To do this I am using algorithms from the Durand laboratory that infer relationships between domains found in different proteins and species. The first step of this process is to align amino acid, DNA or RNA sequences from different instances of the same domain. Software is then employed to generate phylogenetic trees, which are used to infer evolutionary events in the history of the protein domain. I have used this method to generate an evolutionary history of several domains that are members of the MAGUK protein family. Because of its role in cell-to-cell interactions, understanding the evolutionary history for this family can ultimately help uncover the history of multicellularity.

Understanding Hypertension and Health Literacy in Pittsburgh neighborhoods
Eda Akyar / Science and Humanities Scholars & Devleen Baksi / Biological Sciences
Advisor(s): Caroline Acker / History
Hoch Commons / 2nd Floor, Rangos side / 3-5

High blood pressure is often an unnoticed and undiagnosed health condition that affects many Americans. In 2006, nearly one third of all Americans had hypertension (American Heart Association). Hypertension is a precursor to many other medical aliments, such as diabetes, heart disease and stroke. Therefore, considering the health issues that revolve around hypertension, we would like to conduct a research project in the South Side Flats neighborhood of Pittsburgh to understand health literacy concerning hypertension. We want to understand what community members know about hypertension, its causes, effects and treatment options. We also want to learn where community members get important health information. Finally, through the blood pressure screenings, we would like to determine the correlation of community members who may be identified as "at-risk" for hypertension with their understanding of medical knowledge about hypertension.

Understanding the Role of DEAD-Box Protein DRS1 in Ribosome Assembly
Lynley Doonan / Biological Sciences & Anna Park / Biological Sciences
Advisor(s): John Woolford / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 10:15

To further expand our knowledge of ribosome assembly in Saccharomyces cerevisiae we are focusing on the protein Drs1. Drs1 is a nucleolar DEAD-box protein and a ribosomal assembly factor essential for the production of 60S ribosomal subunits. To understand the function of Drs1 in ribosome assembly we are taking a genetic and biochemical approach. We have performed a

synthetic lethal (sl) screen and found 16 mutants so far that, in concert with mutant drs1 alleles (drs1-2 and drs1-5), cause lethality. By looking for mutants that are sl with drs1, we are hoping to characterize the role of Drs1, which we believe to be an RNA-dependent ATPase, while also further understanding its role in ribosome biogenesis. We will characterize our mutants from drs1-2 and drs1-5, by several tests to identify the gene product from which they originate. Growth assays, spotting tests, and sucrose gradients have been conducted on some of the mutants and have determined that the sl mutation has an effect on ribosome assembly. The next steps will be to clone these genes by transformation and complementation. We have already tested our mutants to ensure the mutation created in the sl mutants did not occur in the plasmids already present in the yeast by transforming the LYS2 drs1-5 plasmid into our candidates. To date, we have 3 of the 12 mutants that have been successfully transformed and appear to contain a mutation in the genome of the yeast. We will then characterize them using affinity purification assays to determine which proteins work with Drs1 in the ribosome assembly pathway.

Visualizing 3-Dimensional Structure in Biofilms of the Yeast Candida albicans
Starsha Kolodziej / Biological Sciences
Advisor(s): Jonathan Finkel / Biological Sciences, Shantanu Ganguly / Biological Sciences, Frederick Lanni / Biological Sciences & Aaron Mitchell Biological Sciences
Kirr Commons / 1st Floor, Window side / 12-2:30

The yeast Candida albicans forms tough, adherent biofilms that are often the source of infections in patients with implanted medical devices. Biofilm development involves a genetically regulated switchover in cell morphology from small ovoid cells to entangled chains of long, narrow, tubular cells known as hyphae. In some way, the stratified biofilm is a record of the developmental "algorithm" executed by growing Candida cells. Understanding the structure of these biofilms may reveal features of that program, and may provide critical insight for discovery of methods to prevent biofilm formation and dissemination. However, the thickness and opacity of the growth has so far inhibited the acquisition of this knowledge. We have developed an optical microscopy approach that utilizes fixed biofilms embedded in a clarifying polymer. Using a confocal fluorescence microscope, optical sections ranging to depths of more than 400 μm in wild type biofilms have been obtained. The resulting image data has been processed using ImageJ software [http://rsb.info.nih.gov/ij/], which has allowed for the compilation of image stacks, and computation of side-view projections and 3-dimensional reconstructions. The projections and reconstructions show at least three distinct "zones" or strata within a biofilm where cell morphology appears to change markedly. A number of approaches are being tested for tracking hyphal filaments over long distances, and for enumerating the proportion of yeast to hyphal cells. Our immediate goals are (1) to define the patterns of growth and cell-cell interaction in wild-type biofilms, and (2) to assay a panel of adhesion-defective mutant strains for alterations in biofilm structure.

CHEMISTRY

Characterizing the Critical Structures in Kinesin Regulation by Fluorescence Spectroscopy
Young Yeo / Chemistry
Advisor(s): David Hackney / Biological Sciences
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Conventional kinesin-1 (called kinesin) is a molecular motor protein that transports various cargoes towards the plus-ends on microtubules, thereby playing a central role in many cellular processes. One class of cargo is messenger RNAs, which require a specific localization within cells for proper function, including its role in translation. The motility generated by kinesin also plays a vital role in cellular activities such as mitosis and meiosis, as well as in axoplasmic transport in nerve cells. Kinesin is a heterodimer with ATPase-generated motor function that can be inhibited by folding into a compact conformation by the interaction of the heavy chain C-terminal tail region with the N-terminal motor (head) domains. Previous results in our lab have established that a tail peptide binds to a dimer of heads, causing a conformational change that inhibits the rate-limiting step of ADP release in ATP hydrolysis, hence inhibiting motility. The goals of this project were to develop a spectroscopic means to characterize the head-tail interactions of kinesin by attaching fluorophores to critical regions that would allow coupling of head-tail binding to observable changes in fluorescence. Tetramethylrhodamine (TMR) is a fluorophore that has a quenched absorbance at 518 nm when dimerized. Perturbation of this dimer results in monomeric TMR that absorb at 555 nm. When the perturbing TMR dimerization was coupled to head-tail interactions by strategic labeling, monitoring of the ratio of absorbances at 518nm:555nm allowed characterization of the relative dissociation constants (kd) of head-tail binding. The positively charged region (residues 929-938), was found to be critical for tight tail binding, with a disturbance of this region causing a ~20 fold increase in Kd. Furthermore, the end-region of tail domains (948-952) are required for tight binding to head domains. Thioredoxin-fused tail domains were shown to bind more tightly than non-fusion constructs.

Contact Development to AlGaN/GaN HEMT Chemical Sensors
Jane Herriman / Chemistry & Science and Humanities Scholars
Advisor(s): Lisa Porter / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

AlxGa(1-x)N is a wide band gap semiconducting alloy that is employed in UV-light emitting diodes (UV-LEDs) for military uses, sensors, and biomedical devices. It has been found that the 2D electron gas localized at AlGaN/GaN interfaces shows changes in conductivity in the presence of hydrogen. This has enabled the Porter research group at Carnegie Mellon to begin novel work on AlGaN/GaN HEMT hydrogen sensors, which have possible applications in microwave communications and gas sensors. This project focuses on understanding the conditions and device parameters necessary to better the performance of these chemical sensors. Specifically, the primary goal of this project is to heighten device performance through the development of virtually zero resistance (ohmic) contacts to these AlGaN-based sensors.

Creation and Testing of a Novel Iron-Platinum Nanoparticle Material for Use as a Magnetic Storage Medium
Steve Aro / Chemistry
Advisor(s): Sara Majetich / Physics
Rangos 1 & 2 / Sigma Xi Group 5 / 10:30

The proposed research presented here hopes to create a material for use in magnetic storage media, which exhibits high coercivity and has the capacity for high density data storage. The proposed material is a monolayer array of iron-platinum nanoparticles encompassed by a carbon matrix. Iron-platinum nanoparticles were shown by Sun et al. in Science to be capable of having high coercivity if properly heated, making them ideal for magnetic data storage applications. This project seeks to address the sintering problem encountered in reproducing Sun's work, in which the individual particles fuse during heating following the breakdown of the surfactants present thus removing their capacity for high density data storage. By encompassing the monolayer array of iron-platinum nanoparticles in a carbon matrix, it should be possible to heat the particles and prevent them from fusing thus preserving their capacity for high density data storage and improving their coercivity to that required for magnetic data storage applications.

Design and Synthesis of Ruthenium Tris-Bipyridine Peptide Nucleic Acid for Charge Transfer Studies
Alyssa Chinen / Chemistry
Advisor(s): Catalina Achim / Chemistry
Rangos 1 & 2 / Sigma Xi Group 5 / 11:00

Modification of natural peptide nucleic acid (PNA) monomers with metal-containing ligands allows for an increase in the electronic properties of PNA duplexes, which can be exploited in the development of molecular electronics devices. In order to expand the range of metal-modified PNA available, a ruthenium tris-bipyridine monomer (Ru(bpy)3) was designed and incorporated into the center of a 10-mer PNA duplex through solid-phase PNA synthesis using the Boc protection method. Ru(bpy)3 is a relatively bulky monomer, in comparison with the natural PNA nucleo-bases. Sequences complementary to the ruthenium-modified PNA strand were synthesized with either one or three ligand-free backbone units in the position corresponding to the ruthenium monomer to allow space to accommodate the large modification in the PNA duplex. Variable-temperature UV-visible spectroscopy was used to quantify the stability of the modified PNA duplexes, revealing that the modified ruthenium PNA duplex formed with one backbone unit is more stable than the corresponding duplex formed with three backbone units. Based on these results, the charge transfer properties of Ru(bpy)3-modified PNA can now be studied.

Elucidating the Regulation of SpC-lectin in Early Embryogenesis
Trevor Ellison / Chemistry
Advisor(s): Charles Ettensohn / Biological Sciences
Hoch Commons / 2nd Floor, Window side / 3-5

The project will focus on mapping the regulatory pathway for the SpC-lectin gene with the overall goal of contributing to the map of gene regulatory networks that control early development and differentiation in sea urchins. The network that regulates SpC-lectin will be probed by techniques that include the use of morpholinos to block expression of possible regulatory genes. Visualization of the expression of SpC-lectin via in-situ hybridization will then be used subsequently to determine whether these genes are involved in regulating SpC-lectin.

Emission Properties of Polyfluorene Monomers and Aggregates
Woong Young So / Chemistry
Advisor(s): Linda Peteanu / Chemistry
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Technology has been developed in the field of organic light emitting diodes to improve the performance of electronics and other optical devices. Compared to traditional light emitting diodes, which use inorganic semiconductors, organic light emitting diodes (OLED) are made of conjugated polymers, which are cheaper, thinner, and more flexible. Overall, they hold promise for the development of more energy efficient lighting sources. Thus, investigating conjugated polymers with high chemical and electrochemical stability is important in order to understand what types of molecules and chemical behaviors work optimally in OLEDs. Polyfluorene is one example of a class of organic polymers that show great promise in this application. Due to its chemical stability and electroluminescence, polyfluorene is regarded as one of the important components in OLEDs. In order to fully realize the potential of this material, it is necessary to understand how its properties are affected by the details of its chemical structure and by its morphological properties when cast into thin films used to make the light emitting devices. The focus of this project is to study the formation of phase (crystal phase) of polyfluorene. This goal will be accomplished by examining the effects on the photophysical characteristics of the material from formation of crystalline aggregates as a function of chemical substitution patterns on the polymer chain and of processing conditions. I will also determine if aggregates having-phase type characteristics would be formed from aggregating polyfluorene oligomers. Oligomers are short chain model compounds that mimic the properties of the long chain polymers. Once properties and chemical behavior of the conductive polymers are understood, other organic molecules with similar behaviors and aggregation type can be further explored. By studying the chemical properties of this material more deeply, the quality of OLEDs can be improved and other conducting polymers can be indeed further developed.

Growth of Iron Oxide Nanoparticles in Virus Capsid Templates
Steve Aro / Chemistry
Advisor(s): Sara Majetich / Physics
Hoch Commons / 2nd Floor, Window side / 3-5

This research will focus on the optimization of iron oxide nanoparticles grown in Virus Capsid Templates for biological applications, focusing on size control and high crystallinity, leading to high magnetic moments and uniform magnetic properties. Such particles would be potentially useful for medical applications such as magnetically controlled drug delivery and AC magnetic field hyperthermia.

Investigation of poly(ADP-ribose) polymerase-1 (PARP-1) Inhibitor Binding by Mass Spectrophotometry
Helen Piper / Chemistry
Advisor(s): Mark Bier / Chemistry
Hoch Commons / 2nd Floor, Rangos side / 3-5

PARP-1 inhibitors are recently developed cancer treatment drugs that can be used in combination with chemotherapy to allow for stronger treatments and less side effects for cancer patients by forcing cells through a natural cell death pathway. The goal of this project is to investigate the binding abilities of poly (ADP-ribose) polymerase-1 (PARP-1) inhibitors to the PARP-1 enzyme

using mass spectrophotometry beginning with the binding ability and location of the PARP-1 inhibitor BSI-201 developed by BiPar Sciences. The structure verification of BSI-201 was done using Electrospray Ionization Quadrupole-Time-of- Flight (ESI-QTOF). The verification of the mass of PARP-1 has since been performed by Dr. Bier using a macromizer in the Center for Molecular Analysis, and the project can continue by analyzing the binding ability and location of BSI-201 on PARP-1.

Investigation of Transparent Multilayer Films
Woong Young So / Chemistry
Advisor(s): Lisa Porter / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

We investigate the optical and electronic properties of multilayer films. The enhanced transmittance of such a structure in comparison to a comparable thickness of a pure Au film demonstrates the concept of optical resonant tunneling. The experimental results are also in fairly good agreement with data numerically simulated using MATLAB on provision of the known physical and optical parameters. These kinds of multilayer films show strong potential as versatile and cheap components for optical devices. Specific applications of these structures include sensor and eye protection devices, heat reflecting windows, ultraviolet blocking films, and transparent electrodes for light emitting diodes and liquid crystal displays. We have investigated a few materials in order to determine whether the conductivity and transparency can be improved for transparent conductor applications.

Silver Containing Inks for use in Printed Electronics
Rebecca Potash / Chemistry
Advisor(s): Richard McCullough / Chemistry
Rangos 1 & 2 / Sigma Xi Group 5 / 11:15

A series of inorganic silver complexes were synthesized that thermally rupture at low temperatures forming non-nanoparticle based, metallic silver films. These complexes were dissolved in organic solvents yielding metalizing “inks”, opening up new avenues for metal deposition. These avenues are less harsh than traditional deposition techniques allowing for the printing of silver onto a variety of organic substrates. These inks are currently being implemented in the fabrication of totally-printed organic solar cells.

Synthesis of Ester and Cyano Derivatives of Fluorogenic Dyes Based On Dimethyl Indole Red (DIR)
Katherine Chong / Chemistry
Advisor(s): Bruce Armitage / Chemistry
Wean Commons / 1st Floor, Connan side / 12-2:30

Fluorogenic dyes combine with their cognate proteins to form fluoromodules. These molecules are not inherently fluorescent, but become fluorescent when bound. The advantage to using these dye-protein pairs is their ability to be modified separately. Specific proteins can bind to a variety of dyes, leading to an enhanced spectral range across the near-IR and visible regions. Yeast and mammalian cells have been surface-labeled with these dyes. Further research in intracellular applications is being extended towards modifying the current library of dyes to become permeable across the cell membrane while maintaining selectivity towards binding specifically to their cognate protein and resistance to photooxidation. Specifically, this means the introduction of ester

substituents and electron withdrawing groups to the heterocycles of various dyes. These modified dyes can pass through the cell membrane but upon de-esterification by enzymes inside the cell, they cannot pass back through the membrane. The addition of the ester, which is hydrolyzed to the acid form in the cytoplasm, should provide steric hindrance and electrostatic repulsions strong enough to prevent the dye from interacting with nucleic acids inside the cell. Synthesis of these ester derivatives has already been explored with Dimethyl Indole Red (DIR) and Oxazole Thiazole Blue (OTB). Continued research will be invested in further modifying the library of dyes. The next step is then to reduce the reactivity of the dye molecule with any oxygen that can be found in cells during the imaging process. This process of photooxidation occurs when the electrons at the alpha carbon of the bridge between the heterocycles react with oxygen and can destroy the shape of the molecule, thereby reducing the amount of fluorescence observed. This can be prevented by attaching an electron-withdrawing cyano group to the alpha carbon. The cyano group pulls electron density away from the alpha carbon and effectively reduces its reactivity with oxygen. Further research will be invested in the introduction of the ester and cyano group to the dye in order to achieve a dye that is both cell permeable and resistant to photooxidation.

Synthesis of Poly(ethylene glycol methacrylate)-graft-siNPs via SI-ATRP for Pickering Emulsions
George Leonard / Chemistry
Advisor(s): Kris Matyjaszewski / Chemistry
Wean Commons / 1st Floor, Connan side / 3-5

Poly(oligo(ethylene glycol) methacrylates) (POEGMA) with different length oligo(ethylene glycol) chains have controllable hydrophoicity and correspondingly tunable low critical solution temperatures (LCSTs), making them attractive as emulsifiers. Well defined SiNP-g-POEGMA can be prepared by surface-initiated atom transfer radical polymerization. However, OEGMA cannot be directly grafted from the nanoparticle's surface due to steric hindrance if the side group is too large (Mn ~ 475). To minimize steric effects, a seed layer of the smaller (EG)2MA was first grafted from the nanoparticles in order to increase the initiator mobility and decrease the outer layer's curvature, facilitating polymerization of POEGMA475 as a second block. The final product, SiO2-g-P(EG)2MA-b-POEGMA475, was found to be an excellent emulsifier. Just 0.005 wt% has been found to be sufficient to form a stable Pickering emulsion in xylene.

The Kinetics and Reactivity of Fe(O)V-TAML
Jasper Thompson / Chemistry
Advisor(s): Terrence Collins / Chemistry
Rangos 1 & 2 / Sigma Xi Group 5 / 11:30

I studied the rate at which FeV(O)-TAML degrades thioanisole. FeV(O)-TAML is a key intermediate in FeIII-TAML oxidation pathways. Determining FeV (O)-TAML kinetic data can provide insights into the mechanisms in which FeV (O)-TAML is an intermediate. Much of the research for this project has been conducted over the 2011 spring semester and very promising results have been collected thus far. For this project the main piece of equipment is a UV-vis also but with a special apparatus connected. This apparatus cools the area around the cuvet using liquid nitrogen. The purpose for this apparatus is that FeV (O)-TAML is highly unstable and would almost instantly degrade at room temperature, so for each trial it must first be formed by oxidizing the iron in FeIII-TAML from Fe(III) to Fe (V) at -60 C. Once formed the degradation process is carried out and the UV-vis tracks the Fe(III)/Fe(IV) isosbestic point, which will tell how fast the Fe(V) is reacting. Once the reactivity of

FeV(O)-TAML has been determined comparisons between man-made Fe(V) compound and biological Fe(V) compound will be possible and will provide further insights into the mechanisms involving Fe(V).

Use of Tetramethylrhodamine dimerization to quantify pH dependence of Kinesin head-tail interaction
Margaret Kim / Chemistry
Advisor(s): David Hackney / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 12:00

Kinesin is a cellular motor protein that transports various cargoes along the microtubule, thereby mediating many biological processes such as cellular division and axonal transport. The head-tail binding plays a critical role in the regulation of kinesin motility, and previous experiments indicate pH dependence of the interaction. The presence of a charged histidine residue 136 at physiological pH was suggested to be the reason for this dependence. Tetramethylrhodamine iodoacetamine (TMR) is a fluorophore of reversible monomer and dimer state that absorbs at 555 nm and 518 nm, respectively. In this study, TMR dimerization was utilized to characterize the binding of the head and tail domains of kinesin, focusing on determining the role of histidine 136 on the pH dependence of head-tail interactions. TMR was attached to cys-light, Drosophila Kinesin head domain residues 1-392 (DKH392) with a reactive cysteine at position 156. The construct was cloned with a mutation of histidine 136 to glutamine (H136Q). Since DKH392 is a dimer, the TMRs on each monomer are brought in to close proximity to be dimerized. With tail binding, the TMR dimer interaction is perturbed. The influence of tail domain 910-952 on the ratio of absorbance at 518 nm and 555 nm was measured to determine dissociation constant (Kd) corrected for mutual depletion. Without tail binding, the ratio of absorbances of H136Q at 518:555 nm reaches a high of 1.3, indicating dimerized TMR. With tail binding, the 518:555 nm absorbance ratio drops below 0.9, indicating monomeric TMR, caused by the perturbation of dimerization by tail binding. The unaltered strength of binding from the H136Q at approximately physiological pH reveals that the mutant head construct can be used to examine the influence of histidine 136 on the pH dependence of head-tail binding. Future aims are to examine the tail-binding of the H136Q mutant in different pH—loss of pH dependence will indicate that histidine 136 is a critical region for the pH dependence of head-tail interactions.

MATHEMATICS

A Feasibility Study of Bio-Gas Digesters and Composting Systems at Carnegie Mellon University
Jule Carr / Civil and Environmental Engineering, Cynthia Clement / Mathematics, Carineh Ghafafian / Materials Science Engineering, Elissa Goldner / Civil and Environmental Engineering, Mahaesh Jayaraman / Chemical Engineering, Lane Kurkjian / Civil and Environmental Engineering, Anna Lenhart / Civil and Environmental Engineering, Kaiyang Liew / Mechanical Engineering, Agnieszka Marszalik /Civil and Environmental Engineering, Tejank Shah / Materials Science Engineering, Lauren Sittler / Chemical Engineering
Advisor(s): Paulina Jaramillo / Engineering and Public Policy
Rangos 1 & 2 / Sigma Xi Group 5 / 11:45

Our research examines the feasibility of building and operating a biogas digestion unit for Carnegie Mellon as a way to compost organic waste, offset energy use, and output a nutrient rich byproduct that could be used or sold as fertilizer. We analyze 3 potential alternatives, including a BioTHELYS digester at the Bellfield Boiler plant, a black water unit installed in a new campus building and an in-vessel compost system located in the University Center. We consider the collection of organic waste, the installation, operation and maintenance of the digester, and the uses for the final products. Our research was conducted based on interviews with Carnegie Mellon faculty and Housing and Dining Services staff, literary sources, and case-studies of other universities where biogas digesters are already in use. The study includes models that can be used to determine if each digestion unit method would be feasible, but also beneficial to our campus by examining the net monetary cost and payoff, the potential energy production, and the nutrient composition of the slurry output.

Classroom Salon: Text Mining and Clustering
Yi Xiang Chong / Mathematics, Christine Ibaraki / Statistics, Chun Wa Mok / Mathematics
Advisor(s): Rebecca Nugent / Statistics
Wean Commons / 1st Floor, Connan side / 3-5

Classroom Salon (CLS) is a web-based platform developed at Carnegie Mellon University that is designed to encourage reading and collaboration through the annotations of various text documents. When students participate in CLS, they are able to read and annotate course material, view others' annotations, and submit personal work for review. CLS promotes active rather than passive interaction with the text and facilitates a sense of community among users. The goal of our research is to determine how students relate to each other in terms of their commenting and annotation behavior. We explore and compare different clustering algorithms, which are used to group students according to the following similarity measures: word frequency, tone, and annotation area. We retrieved the user annotation data from both technical and non-technical classes. We first perform text preprocessing (including stripping, stemming, and eliminating stop-words), and then construct a Document-Term Matrix using TF-IDF, where each document corresponds to the annotations of a user. A distance matrix is constructed by computing the cosine distance between users in the Document-Term Matrix, and is subsequently analyzed using Hierarchical Agglomerative Clustering, Multidimensional Scaling, K-means Clustering, and Principal Components Analysis. Graphical visualizations are presented in order to further examine possible group structure in the data. In order to summarize the clusters, we explore patterns found in the original annotation data, and also consider how the use of tone varies between groups. Clustering Algorithms find groups of similar students based on their annotation tones, areas, and word frequencies. This information can help students find classmates with whom they may wish to collaborate, and may also allow instructors to form discussion groups based on student similarities and differences. The results of our research provide new ways for CLS users to track how they relate to their peers.

Deepening the Automated Search for Gödel's Proofs
Adam Conkey / Mathematics
Advisor(s): Wilfried Sieg / Philosophy
Hoch Commons / 2nd Floor, Window side / 12-2:30

G•odel's incompleteness theorems establish the stunning result that mathematics cannot be fully formalized and, further, that any formal system containing a modicum of number or set theory

cannot establish its own consistency. Wilfried Sieg and Clinton Field, in their paper Automated Search for G•odel's Theorems, presented automated proofs of G•odel's theorems at an abstract axiomatic level; they used an appropriate expansion of the strategic considerations that guide the search of the automated theorem prover AProS. The representability conditions that allow the syntactic notions of the metalanguage to be represented inside the object language, as well as the derivability conditions needed to prove the second incompleteness theorem were taken as axioms in the automated proofs. The concrete task I am taking on in this project is to extend the search by formally verifying these conditions. The syntactic notions inductively dened in the metalanguage lend themselves naturally to a direct representation in Zermelo's theory of sets. With the appropriate representation in place I will verify the conditions electronically using the Proof Lab, a proof construction environment auxiliary to AProS. Verication of the representability and derivability conditions is the rst step towards an automated proof thereof which, in turn, would provide foundational support to the automated proofs of G•odel's theorems at the abstract level.

Student Consumption of Caffeine On Campus
Prerna Agarwal / Economics, Yong-Gyun Choi / Economics and Statistics, Abigail Daughtrey / English, Christopher Loncke / Mathematics, Bassem Mikhael / Economics
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

Numerous health studies have demonstrated the damaging effects of excessive caffeine consumption on cardiac wellbeing in addition to psychological and mental health. There is significant concern that students today consume large amounts of caffeine to keep up with their academic workload or enance their performance in soprts activiites. We have surveyed the Carnegie Mellon University undergradate population in order to determine types and amounts of students' caffeine consumption. Further, we measured students' perception of acceptable caffeine usage.

Using Simulations to Reduce Distortions in Mice Brain Images
Antonios Tavlarakis / Mathematics
Advisor(s): William Eddy / Statistics
Rangos 1 & 2 / Sigma Xi Group 9 / 11:30

Two photon electron microscopy is a modern method used to take images of mice brains in vivo. However, due to the movement of the mouse brain during the scanning process, the brain images are distorted. The issue arises from the fact that 2-photon electron microscopes scan images in a linear fashion, pixel by pixel. As such, small movements of the brain result in scrambled or missing pixels. In this work we focus on reducing the distortions in these images by using statistical methods. In order to evaluate performance, we started from non-distorted images and then introduced noise with statistical models we have created. In this presentation, both the statistical method used as well as the ability to reconstruct the images will be presented.

PHYSICS

Determination of structure and properties of lipid membranes with the bioflavonoids genistein and daidzein using X-ray scattering and molecular dynamics simulations
Mohit Raghunathan / Physics
Advisor(s): Prof. Stephanie Tristram-Nagle / Physics
Rangos 1 & 2 / Sigma Xi Group 4 / 11:45

The bioflavonoids genistein and daidzein act as modifiers of ion-channels, phyto-oestrogens which protect bones, and tumor suppressors which inhibit a kinase that is needed for retroviruses to transform cells. In addition to these specific effects that require binding to proteins, bioflavonoids have also been shown to modulate ion channel activity in a non-specific way, by altering the properties of the lipid membrane surrounding the channel (1,2). It was hypothesized that genistein affected the protein-lipid coupling by changing the elastic properties of the membrane, which involve the lipid area compressibility modulus KA and the bending modulus KC. By contrast, daidzein had little or no effect on channel activity. In the present investigation, we measure the KC of two lipids, dioleoylphosphatidylcholine (DOPC) and diphytanoylphosphatidylcholine (DPhyCP) as a function of genistein and daidzein incorporation (up to 20 mole %) using x-ray methods. We also determine the interactions, the B modulus, between membranes containing genistein and daidzein. In addition, we measure the molecular volume and use a volume-conserving fit (SDP) of our electron density data to bilayer models to determine the position of both bioflavonoids in membranes. These structural and property results are then compared to similar results obtained using molecular dynamics (MD) simulations of our collaborators. 1. O. S. Andersen et al. 2005. Capsaicin regulates voltage-dependent sodium channels by altering lipid bilayer elasticity. Mol Pharmacol 68:680-689. 2. O. S. Andersen et al. 2003. Genistein can modulate channel function by a phosphorylation-independent mechanism: Importance of hydrophobic mismatch and bilayer mechanics. Biochemistry-Us 42:13646-13658.

Dynamic Monte Carlo Renormalization Group
Maxwell Hutchinson / Physics, Robert Lee / Physics, Karpur Shukla / Statistics
Advisor(s): Robert Swendsen / Physics
Hoch Commons / 2nd Floor, Window side / 3-5

Monte Carlo methods and renormalization group (RG) analysis are often used in statistical physics to study properties of phase transitions. We explore extending the RG analysis to study the dynamic correlations of a simulated 2D Ising system evolving in time. The simulation software is optimized for performance by using CUDA GPGPU technology and by updating the Ising spins using the Swendsen-Wang cluster algorithm.

Four Track Decays of the J/ Meson
Rebecca Krall / Physics
Advisor(s): Roy Briere / Physics
Rangos 1 & 2 / Sigma Xi Group 6 / 10:00

We study four decays of the J/: pp, KK, KKKK, and , with the use of data from the BEPCII electron-positron collider's BESIII detector. We use the full 2009 datasets of approximately 225 million J/ decays, and 105 million (2S) decays. With these datasets, the branching fractions of the J/ into the four final states are measured. From the (2S) data we obtain J/ tagged with two pions, which removes the need for continuum subtraction in the branching fraction measurements. We identify resonances in the four decay modes from plots of invariant masses of pairs of particles and Dalitz plots. The mass and full width at half-maximum of the K*(892) are measured by fitting the mass peak to a Breit-Wigner distribution. Additionally, the sources of the background events in the data are investigated.

GPU acceleration of VASP with application to the structure of elemental boron
Maxwell Hutchinson / Physics
Advisor(s): MichaelWidom / Physics
Rangos 1 & 2 / Sigma Xi Group 6 / 10:15

GPUs have been shown to provide order-of-magnitude performance improvements to a variety of scientific codes. We implemented hybrid functionals for the consideration of exact-exchange energies in VASP on GPUs. The GPU-accelerated code was used to study the energy of candidate structures of elemental boron. In this use-case, we observed up to 8-fold speedups. The exact exchange calculations pointed to a ground state structure with 141 partially occupied lattice sites.

On the Classification and Fitting Procedures of RR Lyrae, Supernovae, and Recurrent Novae
Alisa Rachubo / Physics
Advisor(s): Richard Holman / Physics
Hoch Commons / 2nd Floor, Window side / 3-5

We examine known astronomical transients with the goal of classifying objects provided by Pan-STARRS1. Specifically, we focus on RR Lyrae, supernovae, and recurrent novae. Classification of these transients are based on their respective light curves. We fit the data with templates or functions, and examine the various limitations encountered during the fitting process. Template fitting is used for supernovae and recurrent novae, while functional fitting is used for RR Lyrae. We find limited success fitting recurrent novae with template light curves. We recommend fitting RR Lyrae with functions for cases where light curve data is abundant.

Quantifying Grain Boundary Character Distribution of Nickel using High Energy Diffraction Microscopy and Forward Modeling Techniques
Benjamin Ellison / Physics & Science and Humanities Scholars
Advisor(s): Shiu Li / Physics
Rangos 1 & 2 / Sigma Xi Group 6 / 10:30

the grain boundary character distribution (GBCD) is a five parameter classification of the grain boundary network that composes polycrystalline microstructures. As a method of describing both the lattice mismatch across grains and the crystallographic planes that compose the grain interfaces, the GBCD can quantify the evolution of a microstructure as it responds to certain external stimuli. Using synchrotron based high energy x-ray diffraction microscopy (HEDM), a small volume of high purity nickel microstructure was measured after a sequence of grain growth anneals. Analyzing this data with the forward modeling software package, orientation maps can be produced and extended to three dimensions. The properties of the GBCD in each of these anneal states will be quantified and interpreted.

Radiative Cooling In Astrophysical Magneto-Hydrodynamics Simulations
Andrew Wesson / Physics
Advisor(s): Kunal Ghosh / Physics
Rangos 1 & 2 / Sigma Xi Group 6 / 10:45

We strengthen a magneto-hydrodynamics simulation by adding radiative cooling processes and observe its effects on test cases. We find that radiative cooling is an important effect in many situations, adding new features and accuracy, and will benefit future research that employs MHD simulations.

COMPUTER SCIENCE
SCHOOL OF COMPUTER SCIENCE

A Calibration Platform for Achieving Sensor Accuracy in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science
Advisor(s): George Kantor / Robotics Institute
Hoch Commons / 2nd Floor, Rangos side / 3-5

The Colony project researches cooperative problem solving using a flexible, low-cost swarm of robots. Currently, the largest hurdle to making new behaviors is the quality of our sensor data. Unreliable sensors hinder development and limit the complexity of possible behaviors. For this research, we built an automatic testing and calibration platform to measure sensor output. We then used this data to adapt existing software to mitigate hardware problems. The new system tested all sensors: the Bearing and Orientation Module, infrared rangefinders, wheel encoders, and line-detection sensors. With the output of each sensor standardized, we gained the accuracy of higher-end sensors without the increased cost.

A Study on Students' Change of Majors, What They Choose and Why
Oliver Lam / Psychology, Michael Len / Computer Science, Go Okumura / Mechanical Engineering, Dunyang Wang / Materials Science Engineering, Wentian Zhu / Science and Humanities Scholars
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

Selecting a major is an important decision for an undergraduate. What a student chooses to study often determines their future career by providing them with a knowledge base that will enable them to succeed in that field. At Carnegie Mellon University (CMU), students are allowed to change majors as they wish in accordance to certain influences in their life, including but not limited to perceived academic success, future job prospects, personal interests, and social pressures. This

study aims to determine the retention rates of each major at CMU, which majors are most popular to switch to, and the prevailing factors that influence a students decision to change or not to change their major. Our results lend insight to what CMU departments can do to affect the popularity and retention rates of their majors by identifying what influences an undergraduate's decision on changing majors the most.

Action Inferences from Given Scenarios Using Scone Knowledge-Base System: Kitchen Ontology
Apaorn Suveepattananont / Computer Science
Advisor(s): Scott Fahlman / Language Technologies Inst.
Wright / 12-2:30

The main goal of this project is to empower Scone, a high-performance, open-source knowledge-base (KB) system, with an ability to infer from given scenarios related to kitchen what have happened, e.g., given some ingredients, tools, and chef's actions, Scone can infer which possible dishes are being cooked. Additionally, users can search and make queries related to kitchen such as foods and kitchen tools. To achieve this goal, a knowledge-base file, representing knowledge related to kitchen, namely foods, dishes, kitchen tools, and cooking actions, is constructed using Common Lisp expressions and loaded into Scone. With the loaded knowledge-base file, Scone is now equipped with knowledge that can be used to make inferences based on user inputs. Multiple different knowledge-base files can be loaded into Scone and as a result, Scone can handle inputs that contain many different types of knowledge.

Action Selection via Learning Opponent Models in RoboCup
Can Erdogan / Computer Science
Advisor(s): Manuela Veloso / Computer Science
Wright / 3-5

The RoboCup Small Size League robot soccer competitions have successfully taken place for thirteen years with autonomous systems where a combination of centralized perception and control, and distributed actuation takes place. In a given game, teams of five robots move at high speeds in a limited space, actuating a golf ball, aiming to score goals. Although the teams perform in a compelling way in principle, running pre-planned strategies, adapting in real-time to the adversarial teams is still a big challenge. In this paper, we introduce a representation that models the spatial and temporal data of a multi-robot system as instances of geometrical trajectory curves. We then explain how to model the behavior of a multi-robot system by implementing a variant of agglomerative hierarchical clustering. Next, we provide an algorithm that classifies a behavior concurrently as it occurs, with respect to a given clustering. Subsequently, we define an algorithm that autonomously generates counter tactics. We evaluate our work on logs from real games and in simulation.

Arbitrage Trading - Using Futures and Trusts
Je Suk Cho / Computer Science
Advisor(s): John O'Brien / Business Administration
Wean Commons / 1st Floor, Connan side / 12-2:30

This research is about forecasting mathematically meaningful value for Mini Dow Jones Indus.-$5 ( ) futures in a Cost of Carry Model. If one can correctly forecast futures, then one can use it as an arbitrage trading. For the most of this research, it was about finding and calibrating that correct value.

Attitude Control of a Lunar Lander Emulator
Natalie Morris / Computer Science
Advisor(s): William Whittaker / Robotics Institute
Wean Commons-1st Floor, Connan side / 3-5

This project develops and evaluates an attitude controller for a testing platform designed to emulate a lunar spacecraft. The platform was built by the Carnegie Mellon LunarX team to serve as a preliminary test environment for sensing, guidance, and controls. Landing is a crucial part of the team's mission, which is to send a robot to the moon. The platform is equipped with thrusters and sensors to imitate the capabilities of actual spacecraft. It accomodates rotation about three axes up to 60 degrees and follows intended attitude changes to roll, pitch, and yaw. This project proves that the testing platform is controllable to any commanded attitude trajectory.

Bilingual Part of Speech Tag Induction with Markov Random Fields
Desai Chen / Computer Science
Advisor(s): Natalie Smith / Computer Science
McKenna / 12:00

Unsupervised multilingual learning has been shown to be effective for NLP(natural language processing) tasks such as POS(part of speech) tag induction and grammar induction. This thesis follows the work of Ben Snyder that improves unsupervised part of speech tags with the help of word alignments. Word alignments are useful for part of speech tag induction because there are very regular patterns for the tags of aligned words. Another focus of the thesis is that the model we use is an undirected Markov random field. The behavior and capacity of such undirected models are not well-understood. This thesis provides a comprehensive comparison between undirected models and directed models for unsupervised learning tasks.

CaFE Play: A Customizable Mobile Phone Game Framework for Enhancing English Literacy
Jonathan Harbuck / Computer Science
Advisor(s): Mary Bernardine Dias / Robotics Institute
McKenna / 12:00

English proficiency is an invaluable skill in many parts of the world. It often helps individuals improve their quality of life and contribute more to society. However, for various reasons, many individuals have difficulty learning English, often simply due to a lack of guided practice. To help address this issue, the TechBridgeWorld research group (www.techbridgeworld.org) through their TechCaFE program (http://www.techbridgeworld.org/techcafe/) has developed the CaFE Phone tool: a prototype mobile-phone-based game for enhancing English literacy. The purpose of this thesis is to improve and build upon the game by creating a game customization framework, CaFE Play, which can be used to not only customize the existing game, but also to create other such customizable games. Developers, teachers, and end users each play a role in the framework. Developers use an application programming interface to create games that use content created by teachers and offer customization and control to the users. These games should increase the user's motivation to practice English literacy, and thereby better improve the user's English proficiency, a hypothesis that this thesis also aims to test.

ColorMyGraph: Teaching Students How to Verify Proofs
Adam Blank / Computer Science

Advisor(s): Klaus Sutner / Computer Science & Luis A Von Ahn / Computer Science
Wright / 3-5

Traditionally, undergraduate mathematics and theoretical computer science courses evaluate students almost exclusively on their ability to solve mathematical problems and write up proof-based solutions to them. This project proposes a system that introduces a new avenue of simultaneously evaluating student understanding and reducing the course staff's work by assigning the students some of their peers' proofs to evaluate for correctness. In turn, a portion of their grade in the course would be based on the correctness and thoroughness of their evaluation of the proofs they were given. In this fashion, students would get valuable experience both reading and verifying proofs that are not their own. Furthermore, since students are doing some of the grading, the course staff could focus more on other aspects of the course such as helping struggling students. While most students are not a priori able to accurately check the correctness of mathematical proofs, the Teaching Assistants can "prime" each question by pre-completing a subset of the grading and telling the system common approaches and mistakes. The system will facilitate this in such a way that even novice students can effectively make a contribution.

Creating Relative Wine Taste Groupings via Machine Learning
Tyler Nighswander / Computer Science & Hudson Thrift / Computer Science
Advisor(s): Subha Das / Chemistry
Peter / 1:20

To date, no computer has been able to accurately judge what something will taste like based on its chemical composition. This project aims to simplify this difficult task by researching whether relative taste groupings can be generated by correlating chemical compositions against user preferences or publicized data via a machine learning algorithm. This approach of creating relative groupings rather than generating absolute ratings is unexplored in the field of computer taste and provides a promising new angle for exploration. Due to its subtle but influential chemical attributes, wine has been chosen as the medium of study for this project.

Creating Word Corpora with Human Computation
Jonathan Chu / Computer Science
Advisor(s): Anthony Tomasic / Language Technologies Inst.
McKenna / 12:40

Given a word within a sentence, how can a computer determine the meaning of that word? If there is only one given definition of the word, the solution can be easily determined. If multiple definitions exist however, this problem becomes magnitudes more difficult. The open problem of Word Sense Disambiguation, hereafter referred to as WSD, has yet to be adequately solved. The applicability of Machine Learning to this problem is obvious. However, the major issue with such an approach is a lack of data with which we can train a Machine Learning Algorithm that we develop.

Customization of Mobile Phone Games for Enhancing English Literacy
Wennie Tabib / Computer Science
Advisor(s): Mary Bernardine Dias / Robotics Institute
Hoch Commons / 2nd Floor, Rangos side / 3-5

The Deaf community has not benefited from many technological advancements for the purposes of education. The goal of customizing mobile phone games for enhancing English literacy is to design and implement technology that will enhance suitable and sustainable development in the Deaf community. The purpose of this research was to customize the TechCafe mobile phone game developed by TechBridgeWorld to suit the needs of students at the Western Pennsylvania School of the Deaf (WPSD). The game aids teachers and provides an interactive environment for the students to practice their English grammar skills. Furthermore, the game is highly customizable by the teacher in order to provide directed lessons for the students; for example, questions and themes can be uploaded to the game by the teacher to match the day's lesson plan. The game provides an alternative to traditional teaching methods by exploiting visual stimulation for the purposes of education in a setting where auditory stimulation is not sufficient for learning.

Decision Problems on Iterated Length-Preserving Transducers
Alan Pierce / Computer Science
Advisor(s): Klaus Sutner / Computer Science
McKenna / 1:00

Finite-state transducers are simple theoretical machines that are useful in expressing easily-computable functions and relations. This investigation considers the relations formed when transducers are iterated arbitrarily many times, a construction which is useful in model checking. In particular, we consider a number of decision problems over various classes of transducers, and attempt to determine whether each decision problem is decidable. For example, a Turing machine construction can show that the string reachability problem on arbitrary iterated transducers reduces from the halting problem, and is thus undecidable. This setup is useful for investigating how restricted a transducer must be before its iteration is no longer able to simulate a Turing machine (for different notions of simulation). The main result of the paper is that both reset transducers--which have a highly restricted concept of memory--and binary toggle transducers--which must express all letter transformations as permutations--are capable of simulating a Turing machine computation.

Design and Implementation of a Power-Aware Load Balancer
Ram Raghunathan / Computer Science
Advisor(s): Mor Harchol-Balter / Computer Science
McKenna / 1:20

Energy costs for data centers are doubling every 5 years, and are already more than $19 billion. Unfortunately, much of this energy is wasted. Servers are busy for about 5% to 30% of the time, but are left on. An idle server consumes as much as 60% of its peak energy demand. The primary goal for a data center is to meet its response time Service Level Agreements (SLA's). These typically take the form of a percentile guarantee. For example, a 95th percentile guarantee would mean that the data center serves at least 95% of the requests in at most the target response time. More recently, the secondary goal of reducing power consumption has been added. I introduce a load-oblivious and distributed load balancer that optimizes for power consumption, while meeting all SLA's.

Designing an Attacker Behavior for the NAO Robots
Wesley Myers / Electrical & Computer Engineering & Ryan Oksenhorn / Computer Science

Advisor(s): Manuela Veloso / Computer Science
Hoch Commons / 2nd Floor, Window side / 12-2:30

The Carnegie Mellon United Robots for Soccer (CMurfs) team's goal is to win the International RoboCup competition in Istanbul, Turkey. This year's addition of a fourth robot creates new flexibility in game strategy, differentiating attacker and defender roles. This challenge required new behaviors to be implemented. New kicks that are both faster and smarter were developed to account for more robots crowding the field. These include forward kicks in half a second, side kicks optimized for tight conditions, and backward kicks to clear the ball. A smart kicking behavior dynamically chooses which kick to use based on both the ball's current and intended positions. To further the aggressive intelligence of the robots, an efficient algorithm was developed for predicting where the ball would go after a kick. Even when we do not know where the ball is, a new algorithm was developed for finding the ball faster. As a result, we created a faster, more intelligent robot to play soccer.

Discriminative Pronunciation Learning for Speech Recognition for Resource Scarce Languages
Hao Yee Chan / Computer Science
Advisor(s): Ronald Rosenfeld / Language Technologies Inst.
McKenna / 1:40

Speech recognition is not readily available for languages that are not commonly used by rich people. Commercial packages such as Microsoft Speech Server are economically driven, and therefore focus on recognizing languages with a large base of rich users. Open source packages such as Carnegie Mellon University's Sphinx support customized training, which in principle allow the creation of speech recognition capability in any language. However, such packages require the trainer to have significant speech technology expertise. Moreover, standard speech recognition models need hundreds of hours of speech for training before an adequate level of accuracy is achieved. I developed pragmatic solutions that create small vocabulary speech recognizers at a fraction of the cost and time that current packages require. Little to no expertise in speech recognition is needed in training a recognizer for any language, and only a few audio samples per word are required. Hence, these solutions are ideal for targeting languages that have a small or economically disadvantaged user base which are typically ignored by the commercial world. In particular, building on previous work, I designed algorithms that utilize current speech recognition engines to generate pronunciations which map phonemes across languages. Using discriminative training techniques, I further improved the pronunciation generated, resulting in higher recognition accuracy.

Distributed Power Manager
Kenneth Kochis / Computer Science & Kevin Zhao / Computer Science
Advisor(s): Anshul Gandhi / Computer Science, Mor Harchol-Balter / Computer Science & Timo Mechler / Computer Science
Hoch Commons / 2nd Floor, Rangos side / 12-2:30

Utilizing prior research, we aim to create a power management system that that finds the lowest total power configuration across varying numbers of servers and different frequencies. We try to accomplish this by utilizing more servers on lower frequencies to save power. However, we also account for sudden spikes in requests by ramping up power usage only when needed.

Dynamic Casts in the Plaid Programming Language
Mark Hahnenberg / Computer Science
Advisor(s): Jonathan Aldrich / Computer Science
McKenna / 2:00

Gradual type systems assist programmers by allowing them to leverage the flexibility of dynamic typing as well as the safety and error checking of static typing without having to learn and use two separate languages. The addition of permission kinds to a type system helps programmers, and more importantly the compiler, reason about aliasing in programs. In most conventional type systems, runtime or dynamic casts must be introduced, either explicitly by the programmer or implicitly by the compiler, at certain points in a piece of code in order to ensure that the language is typesafe. This type of cast and the accompanying semantics have been examined with respect to gradually typed systems in previous work. However, the addition of aliasing information to a gradual type system raises several issues in the implementation of these dynamic casts. For example, in order to cast something to a type with a specific permission, aliasing information must be maintained at runtime instead of just at compile time. For my thesis I defined a static and dynamic semantics for dynamic casts in the Plaid programming language, incorporated these semantics into the Plaid compiler implementation, and to examine the impact of this implementation on the overall performance of compiled Plaid programs.

Efficient Algorithms for Nonparametric Online Prediction
Haijie Gu / Computer Science
Advisor(s): John Lafferty / Computer Science
McKenna / 3:00

A new approach to online prediction using nonparametric methods -- particularly the kernel density estimation (KDE) and kernel regression (KR) is described. The proposed algorithm has the computational advantage as other online algorithms; it also well addresses the variable bandwidth selection issue arising in the online scenario. In theory, these online estimators are proved to achieve the same asymptotically minimax rate O(n^{2k/(2k+1)}) as the standard batched estimators. In practice, we base single online estimators on the weighted-expert framework to adapt to the true optimal rate, resulting a globally smooth prediction.

Efficient Software for Tree Reconciliation
Deepa Sathaye / Computer Science
Advisor(s): Dannie Durand / Biological Sciences
Hoch Commons / 2nd Floor, Rangos side / 3-5

Notung-HGT is a modeling tool for inferring evolutionary pathways of genes based on known species data. Given a rooted gene tree and a rooted species tree, the software generates the most parsimonious history of gene duplication, loss, and transfer. Notung-HGT can also determine the root of an unrooted gene tree by minimizing the inferred history of events. Much of the information used for rooting the tree is drawn from the species tree and the previously generated evolutionary pathways. My project enhances Notung-HGT with improvements in both running time and functionality. First, the process for rooting with transfers is limited by high computational complexity. Shorter run times would allow this tool to be used on larger data sets thus giving users greater insight when exploring evolutionary pathways. I am applying a memoization technique that reduces computation time by storing and reusing partial subtree results when rooting gene trees containing

gene transfers. Second, at this time, the species trees are pruned to include only species that are found within the gene trees before analysis. Pruning reduces the number of losses incurred due to incomplete data. However, in certain data sets, the observation that a gene is missing may give insight. I have implemented a method to provide users with a way to control how much of the species tree is used for analysis.

Encoding Natural Priors in Neural Populations
Benjamin Poole / Computer Science
Advisor(s): Tai-Sing Lee / Computer Science
Rangos 1 & 2 / Sigma Xi Group 8 / 10:00

Bayesian theories of the brain have provided insights into perception, but the underlying neural mechanisms which could implement these computations remains unknown. To perform Bayesian inference, sensory information must be combined with prior information about the natural world. We investigated how these natural priors could be learned and encoded in populations of neurons in primary visual cortex. We found that the distribution of neuronal tuning properties for depth-tuned neurons was very similar to the distribution of depths occurring in natural scenes. This nding is consistent with the hypothesis that neurons are performing optimal sampling of the natural environment based on the information maximization principle. By using the priors encoded in the tuning properties of neuronal populations, we were able to develop a framework for performing Bayesian inference in the brain.

EteRNA
Minjae Lee / Computer Science
Advisor(s): Mark Stehlik / Computer Science
Wright / 3-5

Crowdsourcing game for folding RNA

Exploration and Mapping of Unstructured Environments using an Autonomous Quadrotor
Jeffrey Cooper / Computer Science, Jitu Das / Computer Science, Priyanka Deo / Computer Science, Daniel Jacobs / Electrical & Computer Engineering, Michael Ornstein / Mechanical Engineering, Harrison Rose / Biomedical Engineering, James Wahawisan / Electrical & Computer Engineering, Alexander Zirbel / Computer Science
Advisor(s): Sanjiv Singh / Robotics Institute
Peter / 1:40

Robots are an increasingly common sight in all areas of daily life, and are increasingly useful to humans. As their capabilities expand, they are able to move from strictly controlled environments into an uncharted and potentially dangerous world, where they can accomplish tasks humans would rather avoid. Exploration of hazardous locations like collapsed buildings, mines, and other disaster areas is left largely to humans because few modern robots have the capabilities to reliably replace human explorers. The quadrotor aerial platform provides an attractive solution to this problem: being extremely maneuverable, powerful enough to carry high-performance sensing equipment, and compact enough to fit through small gaps such as a broken window, a quadrotor can gather data about a location before humans or other robots enter it. Once this data is available and the terrain is mapped, robots and humans entering the environment can explore and travel much more efficiently. Applications for this information range from urban navigation to search and rescue maps that can help in quickly developing paths to areas of interest. This research team aims to tackle the problem of exploring and mapping unstructured environments using an autonomous quadrotor.

Filtering Crowdsource Data on Word Sense Disambiguation Tasks
Pablo Chavez / Computer Science

Advisor(s): Maxine Eskenazi / Language Technologies Institute
Hoch Commons-2nd Floor, Rangos side / 3-5

This poster presents the results from applying hueristic filters on data obtained by crowdsourcing, which was used to train a Word Sense Disambiguation (WSD) classifier similar to the one used in the REAder Practice (REAP) vocabulary tutor. An analysis of the traits of the data, and how that influenced the creation of the filters is also presented. An analysis of each filter type shows that time- based filters are the most effective, but not to a level that is statistically significant.

Fire Identification and Localization for Autonomous Firefighting Robotics
Philip Brown / Mechanical Engineering, Dev Doshi / Computer Science, Christopher Tomaszewski / Mechanical Engineering

Advisor(s): Illah Nourbakhsh / Robotics Institute
Kirr Commons / 1st Floor, Window side / 3-5

This two-stage project evaluates the viability of a household robotic firefighting platform. The first stage entails the development of a fire identification system which employs thermal and optical sensors to pinpoint the base of a fire. The future second stage will integrate the fire identification system with an autonomous, mobile extinguishing platform as part of a home firefighting solution.

Human-Like Understanding of Two and Three-Line Figures
Steven Hansen / Computer Science

Advisor(s): David Touretzky / Computer Science
Rangos 1 & 2 / Sigma Xi Group 9 / 10:15

We present a computational theory of mid-level vision within the Line Triplet micro-domain, implemented in Mathematica. The theory assumes that categorization is the fundamental aspect of understanding, and that binding, symmetry, regularity detection, and proportionality detection are the mechanisms by which we categorize instances. We discuss additional aspects of "understanding" the domain, and suggest other domains to which the theory might transfer.

Identifying Reasoning in Discussions through Phonetics
Margaret Schervish / Computer Science

Advisor(s): Carolyn Rose / Language Technologies Inst.
Wean Commons / 1st Floor, Connan side / 12-2:30

The purpose of this project is to investigate connections between phonetics of speech and collaborative discussion. This work is motivated by the theory of Speech Accommodation. In particular, we look for correlation between the similarity or difference of variants of a phoneme (sound) between speakers and the presence of transactive reasoning, speech that expresses reasoning and references an earlier contribution to the conversation. This involves using signal processing to isolate particular sounds and identify changes in their pronunciation through the conversation. We also create a coding manual to identify parts of a conversation that exemplify transactive reasoning.

Improving the Learning of Patterns of Pick-ups and Drop-Offs
Andrew Lee / Computer Science

Advisor(s): Anind Dey / Human Computer Interaction Inst.
Wright / 12-2:30

From the popularity of smartphones in recent years we have caught a glimpse of the future vision of ubiquitous computing, where computers are integrated into everyday objects and our environments to support our lifestyles. At the same time, we have also caught a glimpse of the immense challenges of processing and utilizing the information collected by multiple electronic devices over long periods of time. One previous step in addressing this problem has demonstrated how patterns of routines in picking up and dropping off children could be learned from GPS traces recorded from families over a period of six months. What can we learn from "ground truth" data about complexities in real life routines which affect learning of travel times? To answer this question we investigated the differences between collected data about travel times and travel time predictions available from Google Maps. This comparison revealed how distance, gender, location, and start/end times can affect the reliability of generic predictions. We also applied agglomerated hierarchical clustering to learn routine arrival times in travel to particular locations. These findings help us better understand current errors in predicting travel time and provide insight into real world factors which influence routines. In future explorations, we plan to analyze communication data within families in the same data set and implement a real-time routine learning system which we can deploy to families for evaluation.

Human-Like Understanding of Two and Three-Line Figures
Steven Hansen / Computer Science
Advisor(s): David Touretzky / Computer Science
Rangos 1 & 2 / Sigma Xi Group 9 / 10:15

We present a computational theory of mid-level vision within the Line Triplet micro-domain, implemented in Mathematica. The theory assumes that categorization is the fundamental aspect of understanding, and that binding, symmetry, regularity detection, and proportionality detection are the mechanisms by which we categorize instances. We discuss additional aspects of "understanding" the domain, and suggest other domains to which the theory might transfer.

iSTEP 2011: Uruguay
Jonathan Beebe / Computer Science, Afnan Fahim / Computer Science, Elise Gonzales / Computer Science, Meghan Nahass / Social & Decision Sciences
Advisor(s): Yonina Cooper / Computer Science & Mary Bernardine Dias / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 9 / 10:30

The iSTEP (innovative Student Technology ExPerience) internship program offered by TechBridgeWorld at Carnegie Mellon University brings together students from the Pittsburgh and Doha campuses to conduct technology field research in developing communities. The 2011 iSTEP team is working with the Administración Nacional de Educación Pública and schools located in Montevideo, Uruguay on three projects: (1) a computer tool for teachers to customize literacy content; (2) an online computer tool for students to practice their literacy skills; and (3) a mobile phone game for motivating students to enhance their literacy skills. In the Spring 2011 semester, the team's research included creating a country review investigating the history, culture, and technology infrastructure in Uruguay. Needs assessment and evaluation plans were developed to ensure that the team appropriately identifies the needs of the community and evaluates the projects' sustainability and effectiveness. Furthermore, the team conducted literature reviews to compare different platforms and technologies as well as tested open-source projects. A media outreach plan has also been developed to promote and advertise iSTEP's work to different communities. The results of this research will be carried out and continued during the summer 2011 in Uruguay.

Kernel Accommodations for I/O intensive Workloads
Nathan Wan / Computer Science
Advisor(s): David Andersen / Computer Science
McKenna / 4:00

Recent advances in storage technologies have lead to widespread availability of solid state storage devices. These devices are extremely different from their mechanical counterparts in that they can process I/O commands at a far superior rate. Suboptimal performance of nodes in the FAWN (Fast Array of Wimpy Nodes) project inspired this work, where Intel Atom processors could not saturate the random read rate of the solid state drive like an Intel X25-E. We probe the command rates that can be achieved by linux drivers and the kernel's I/O stack.

Learning a Low Dimensional Representation of Graspable Objects
Tudor Achim / Computer Science
Advisor(s): Siddhartha Srinivasa / Robotics Institute
Wean Commons / 1st Floor, Connan side / 12-2:30

Grasping and manipulating household objects is an important challenge that must be overcome in order for robots to operate in unstructured environments like peoples' homes and offices. Current approaches revolve around building complicated three dimensional models either by hand or through a slow, automatic process, and then deciding whether a novel object is "similar enough" to a precomputed model to use it for grasp planning. However, this model requires too much information about the object to be known ahead of time. Given a view from one angle, and given that this angle is close to a good enough grasp the robot has already seen for another, similar object, it should be possible to deduce in which direction to move to improve the chances of a good grasp. We present the results of learning a mapping from object views to a low dimensional manifold, in which we plan locally for grasps of novel object.

Learning Classifiers from a Relational Database of Tutor Logs
Bao Hong Tan / Computer Science
Advisor(s): Jack Mostow / Robotics Institute
McKenna / 4:20

A bottleneck in mining tutor data is mapping heterogeneous event streams to feature vectors with which to train and test classifiers. To bypass the labor-intensive process of feature engineering, we present a method to learn classifiers directly from a relational database of events logged by a tutor. It searches through a space of classifiers represented as database queries, using a small set of heuristic operators. We show how it learns a classifier to predict whether a child will finish reading a story in Project LISTEN's Reading Tutor, and compare against a previously reported classifier that uses hand-engineered features. The new method has the potential to learn classifiers with less effort and greater accuracy.

Lunar Rover Navigation
Wennie Tabib / Computer Science
Advisor(s): William Whittaker / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:15

Imagine a time in which ordinary people can navigate a robot on the surface of the moon. In order for this dream to become reality, it is necessary for the lunar rover to navigate using correct data measurements. Therefore, we must remove the errors from the measurement data output of the

Inertial Measurement Unit (IMU) through the use of a Kalman filter. The Kalman filter uses a weighted average in order to predict the state of a system, which creates values with better estimated uncertainty that can be "trusted" more, thus leading to more reliable navigation. This research will minimize any accidental loss of accuracy in data measurements, which will allow Red Whittaker's Lunar XPrize rover to navigate easily on the surface of the moon. The Kalman filter uses control inputs and sensor measurements from the rover in order to form an estimate of its state, which is a better estimate than by using any one measurement alone. Sensor data can be very noisy, or prone to contain error; approximations in the equations that describe how the rover's system changes; and external factors that are not accounted for can introduce uncertainty about the values of a system's state. Hence, in order to develop a lunar rover with reliable navigation techniques, we must implement a Kalman filter to guarantee accurate data.

Managing On-demand, Transient Virtual Machines
Adrian Trejo / Computer Science
Advisor(s): David O'Hallaron / Computer Science
Rangos 1 & 2 / Sigma Xi Group 8 / 10:15

The Autolab2 hosted grading service at CMU handles thousands of requests for grading assignments every semester. The server spawns a virtual machine for each request and executes an autograding function that professors write on a student's code. Once the job is finished, the machine is terminated and the results are uploaded to the grade book. The current implementation suffers from a lack of visibility into the status of the virtual machines as they run to completion. I spent the semester writing a new system called TANGO that adds the desired visibility into the backend by providing functions to check into the status of every running job, as well as an API that allows future users to add new functionality easily.

Market-Based Coordination of Recharging Robots
Victor Marmol / Computer Science
Advisor(s): Mary Bernardine Dias / Robotics Institute & Balajee Kannan Robotics Institute
McKenna / 4:40 & Rangos 1 & 2/Sigma Xi Group 9 / 10:00

Autonomous recharging is becoming increasingly important to mobile robotics as it has the potential to greatly enhance the operational time and capability of robots. Existing approaches however are greedy in nature and have little to no coordination between workers and between a recharging station and its workers. This leads to less efficient interactions which adversely affect the performance of the team of robots, especially as the ratio of worker robots to recharging stations increases. Therefore, improved coordination can greatly enhance the performance of such a team. The proposed senior thesis will advance the state of the art in autonomous recharging by developing, implementing, testing, and evaluating a market-based distributed algorithm for effectively coordinating recharging robots. This system will be recharge-aware and able to autonomously account for current and future battery state and act accordingly. The developed solution will be evaluated in a series of tasks run on a group of worker robots and recharging robots.

Mobile Cloud Computing for Data-Intensive Applications
Vincent Teo / Computer Science
Advisor(s): Priya Narasimhan / Electrical & Computer Engineering
Peter / 12:00

As the computational and storage capabilities of today's mobile devices rapidly match up with those of traditional desktop machines, these resources are mostly under-utilised and mainly used to process local data and programs only. With the use of local wireless networks, we can enable these phones to communicate with each other without utilising the resources of a global cellular network. This might enable collaborative data-intensive computing across a cloud of mobile devices without straining the bandwidth of global networks. We aim to do this through the use of Hyrax, a port of Hadoop (an implementation of Google's MapReduce) to mobile phones running the Android operating system, and discover the resource contraints and scalability aspects of performing cloud computing on mobile phones though a mobile multimedia share-and-search application.

Navigating Dynamic Traffic Environments in a Low-Cost Robot Colony
James Carroll / Computer Science, Willis Chang / Electrical & Computer Engineering, Jeffrey Cooper / Computer Science, Priyanka Deo / Computer Science, Megan Dority / Mechanical Engineering, Devendra Gurjar / Electrical & Computer Engineering, John Howland / Mechanical Engineering, Daniel Jacobs / Electrical & Computer Engineering, Alexander Lam / Computer Science, Joseph Lee / Electrical & Computer Engineering, Abraham Levkoy / Electrical & Computer Engineering, Matthew McKay / Computer Science, Nicolas Paris / Electrical & Computer Engineering, John Sexton / Electrical & Computer Engineering, Daniel Shope / Mechanical Engineering, Prashant Sridhar / Undecided, Vinay Vemuri / Computer Science, Benjamin Wasserman / Electrical & Computer Engineering, Mark Williams / Electrical & Computer Engineering, Alexander Zirbel / Computer Science
Advisor(s): George Kantor / Robotics Institute
Rangos 1 & 2 / Sigma Xi Group 7 / 11:30

The overarching goal of the Colony Project is to maintain a flexible yet inexpensive group of robots for researching emergent behavior and cooperative problem solving. With this research, the Colony Project emulated vehicular traffic in a city-like environment. The development of intelligent, networked cars is a growing field of interest in mobile robotics research, and we will show how we used our robots to study related algorithms and behaviors. Our goal is to enable the robots to autonomously navigate a dynamic environment and to handle interesting traffic objects and events such as lane changes, intersections, tollbooths, and obstacles in the road. This work is a continuation of previous Colony Project research, and it will serve as a foundation for future endeavors. We also hope to contribute to this rapidly growing area of robotics research.

Online Metric Matching on the Line
Kevin Lewi / Computer Science
Advisor(s): Anupam Gupta / Computer Science
Peter / 12:20

Given a metric space, a set of points with distances satisfying the triangle inequality, a sequence of requests arrive in an online manner. Each request must be irrevocably assigned to a unique server before future requests are seen. The goal is to minimize the sum of the distances between the requests and the servers to which they are matched. We study this problem under the framework of competitive analysis. We give two O(log k)-competitive randomized algorithms, where k is the number of servers. These improve on the best previously known O(log^2 k)-competitive algorithm for this problem. Our technique is to embed the line into a distribution of trees in a distance-preserving fashion, and give algorithms that solve the problem on these trees. Our results are

focused on settings for the line, but these results can also be extended to all constant-dimensional metric spaces.

Personalized Navigation Routes
Sebon Koo / Computer Science
Advisor(s): Anind Dey / Human Computer Interaction Inst.
Wright / 12-2:30

An Android-based application that provides personalized driving route and location based search.

Prior Knowledge Assessment using Salon
Dev Doshi / Computer Science
Advisor(s): Ananda Gunawardena / Computer Science
Wright / 3-5

This project investigates the effectiveness of various methods of Prior Knowledge Assessment (PKA) in a computer science course at Carnegie Mellon University. Each PKA is evaluated based on the investment of time and effort required for taking and grading the assessment and how well it predicts performance on the standard course assessments. Salon (http://www.classroomsalon.org:6969) is used to facilitate and analyze the assessments.

Restaurant Data use in Natural Language Processing
MichaelWang / Computer Science
Advisor(s): Natalie Smith / Computer Science
Hoch Commons / 2nd Floor, Rangos side / 3-5

This project explores how restaurant data can be used in Natural Language Processing applications.

RoboBuggy - Fully autonomous robotic buggy
Nathaniel Barshay / Computer Science & Alex Klarfeld / Electrical & Computer Engineering
Advisor(s): Mark Stehlik / Computer Science
Pake / 12:40

Autonomous driving is a problem at the cutting edge of robotics research, with the potential to save countless human lives. Current approaches utilize arrays of advanced sensors, including GPS, laser rangefinding, radar, and inertial navigation, as well as racks of computing power. We intent to build a robot to compete in a soap box derby style race on the streets around carnegie mellon univeristy, utilizing only low budget sensors and an small embedded computer. Our pursuit has clear commerical applications in cutting the cost of autonomous driving or driving assitance.

SkyeFS: An implementation of the Giga+ algorithm for distributed metadata on PVFS
Anthony Chivetta / Computer Science
Advisor(s): Garth Gibson / Computer Science, Swapnil Patil / Computer Science
Wright / 12-2:30

There is growing set of large-scale data-intensive applications that require file system directories to store millions to billions of files in each directory and to sustain hundreds of thousands of concurrent directory operations per second. Unfortunately most cluster file systems are unable to provide this level of scale and parallelism. In this research, we show how the GIGA+ distributed directory algorithm, developed at CMU, can be applied to real-world cluster file systems. We

designed and implemented a user-level file system, called SkyeFS, that efficiently layers GIGA+ on top of the PVFS cluster file system. Our experimental evaluation demonstrates how an optimized interposition layer can help PVFS achieve the desired scalability for massive file system directories.

Slick: A Framework for High Throughput Network Applications in the Kernel
Alexander Gartrell / Computer Science
Advisor(s): David Andersen / Computer Science
Peter / 12:40

With the increasing use of the Internet and networked services, the ability to make such services perform better, specifically in terms of increasing throughputs and, by extension, the number of requests that can be handled, is more important than ever. Despite many interface and architecture improvements, such services are constrained by the maintenance of the process abstraction (i.e. the isolation of tasks from each other and the inner workings of the operating system), which imposes a great cost on every network transaction. Slick tackles this problem by providing a convenient interface for providing these services in the kernel. In this work we explore the creation of this framework and the performance implications of its use.

Structure Identification Using Laser Scanner Device
Ian Gillis / Computer Science
Advisor(s): Daniel Huber / Robotics Institute
Kirr Commons / 1st Floor, Window side / 12-2:30

Here, we develop algorithms to identify linear, planar, and blob-like structures of building interiors. Input consists of an unordered 3D point cloud, and output is a color-coded 3-dimensional image that can be seen from different angles. We augmented previous research using certain graph algorithms and heuristics. Our results were comparable to previous attempts to solve this problem.

Towards Efficient Multi-viewpoint Graphics
Jakub Poznanski / Computer Science
Advisor(s): Adrien Treuille / Computer Science
Wean Commons / 1st Floor, Connan side / 3-5

Despite rapid advances in graphics processing architectures, computer graphics is still far from modeling the vast complexity of the world. Combined simulation and rendering of high dimensional phenomena such as fluids requires exponentially more computation than is currently available to any single user. Our system, PLASM, is an architecture for multi-viewpoint computer graphics designed for future large-scale computer systems. By amortizing the cost of expensive computations, several users can share the results of a high quality physics and graphics simulation which will exceed in quality what has been previously been possible in real-time.

Using Pex For C# In Teaching CO
Nathaniel Snyder / Computer Science
Advisor(s): Frank Pfenning / Computer Science
Wright / 3-5

C0 is subset of C with additional features that allow programmers to specify conditions in the program that should hold at runtime (such as preconditions to a function) and have these be checked dynamically. It is being used to teach an introductory course on imperative programming, with the goal of getting students to think logically and carefully about their programs instead of just

hacking until it seems right. Another avenue for furthering this goal is showing students the use of automated program analysis tools. A particular tool of interest is Pex, which was developed by Microsoft to automatically generate interesting test cases for C# code. My independent study project this semester is to compile C0 code to equivalent C# code that can be analyzed by Pex, and investigate possible uses of this for helping students correct and understand their programs.

Walk on Interfaces
Shilpa Ramamurthy / Computer Science
Advisor(s): Scott Hudson / Human Computer Interaction Inst.
Wean Commons / 1st Floor, Connan side / 3-5

We are exploring the use of 3D cameras to create a more intuitive, "user-friendly" office space by examining different forms of detection/interaction opened up by the use of a depth camera as opposed to a regular 2D camera. In this particular project we explore using the feet/floor to input data to create an interface for someone's office door.

Writing code to grade code
Alexandra Johnson / Computer Science
Advisor(s): Leigh Ann Sudol / Computer Science
Wright / 3-5

This project examines the difference between 3 different methods of grading code that has been handwritten for an AP computer science test. 1) Automatically graded by JUnit tests 2) Automatically graded by a combination of JUnit tests and a Janino tree walker 3) hand graded by a human with years of experience in grading similar questions. Collegeboard (the administrator of the AP CS test) aims for a 93% concurrence rate between 2 humans grading the same question. This project examines whether or not automatic grading can reach similar results between an experienced human and a grader.

HUMAN COMPUTER INTERACTION INST.

Evaluation of National Electronic Disease Surveillance System in county Public Health Department
Shruti Kataria / Human Computer Interaction Inst.
Advisor(s): Anind Dey / Human Computer Interaction Inst.
Rangos 1 & 2 / Sigma Xi Group 8 / 11:15

The National Electronic Disease Surveillance System(NEDSS) is the central bio-surveillance software tool used by Public Health Departments to report to the Center for Disease Control(CDC), which monitors incidents of reportable diseases. This poster presentation presentation examines one phase of the collaborative project, Center for Advanced Study of Informatics in Public(CASIPH), between University of Pittsburgh and Carnegie Mellon University. The focus of this project is to improve the ability to detect and characterize disease outbreaks, with an emphasis on successful translation of information between various data points (i.e. labs, nurses, epidemiologists etc.). In this phase, researchers observed a county public health department and the interaction of the health department staff with NEDSS. The data modeled during this phase is a comprehensive

work-flow analysis that will inform the latter parts of the five-year CASIPH project and the design prototypes created will guide the evaluation of future surveillance technology. The objective of CASIPH is to determine and implement an advanced surveillance technology to move the state-of-the-practice forward, and improve the work-flow process at every level of data entry.

Using the Crowd to Estimate Home Energy Use
Young Jae Park / Human Computer Interaction Inst.
Advisor(s): Jennifer Mankoff / Human Computer Interaction Inst.
Wright / 12-2:30

If people knew how much energy different homes and apartments were expected to use, they might be able to make better decisions about what to rent, whether there was a problem at home, or how they could save money and energy. Unfortunately, most landlords do not make this sort of data public. While there are surveys that can provide rough averages for general housing, it is difficult to help people make appropriate queries across that data, even if we could provide a user interface to it. Our solution is to support questions about energy data through a representation that is tied to actual homes and apartments. The benefits of this approach are that:
1.People can easily identify places similar to their own to compare to by filtering based on properties of a home such as size and location
2.For prospective renters, this interface can integrate directly into their apartment search process
3.We can hybridize where we get information by combining data from DOE surveys with reports by individuals about energy use of specific
homes or units, as well as footprint data collected from a popular public footprint calculator.

A Study on Students' Change of Majors, What They Choose and Why
Oliver Lam / Psychology, Michael Len / Computer Science, Go Okumura / Mechanical Engineering, Dunyang Wang / Materials Science Engineering, Wentian Zhu / Science and Humanities Scholars
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

Selecting a major is an important decision for an undergraduate. What a student chooses to study often determines their future career by providing them with a knowledge base that will enable them to succeed in that field. At Carnegie Mellon University (CMU), students are allowed to change majors as they wish in accordance to certain influences in their life, including but not limited to perceived academic success, future job prospects, personal interests, and social pressures. This study aims to determine the retention rates of each major at CMU, which majors are most popular to switch to, and the prevailing factors that influence a students decision to change or not to change their major. Our results lend insight to what CMU departments can do to affect the popularity and retention rates of their majors by identifying what influences an undergraduate's decision on changing majors the most.

Accuracy of Pittsburgh Bus Timetables Used by CMU Students
Matthew Belenky / Economics, Timothy Higgins / Economics & Science and Humanities Scholars, John Sperger / Social & Decision Sciences, Chao Wang / Electrical & Computer Engineering, Tian Wu / Business Administration
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

Many students and Professors at Carnegie Mellon rely on the public transit system to get to work, however students frequently complain about the PAT bus system. The most common complaints are late buses, inaccurate schedules, and the frustration that occurs after waiting for a bus only to have multiple buses of the same route arrive at the same time1. Waiting wastes time, causes frustration, and in the long run could lead commuters to choose to find a way to travel that doesn't involve public transportation. To aim of this study is to first measure the degree to which these complaints are accurate, and if buses are systematically late develop a model for predicting expected arrival time. This study will be build on a strong general literature base on public transportation and investigate the accuracy of bus time tables for the Forbes and Morewood intersection which is the most commonly used bus stop for commuters at Carnegie Mellon University. Bus departure times will be observed and compared to posted bus schedules. A number of potential factors that influence bus punctuality will also be measured including the weather, the time of day, and the level of light. Using these factors and the information collected on bus arrival times, a model will be created to predict when a bus will arrive given the scheduled arrival time.

An Assessment of 33% RPS in California and Projection of its position and CO2 Emissions from the Electricity Sector in 2020

Ya Qi Niu / Economics & Science and Humanities Scholars Karen Yu / Civil and Environmental Engineering
Advisor(s): Ines Azevedo / Engineering and Public Policy
Wean Commons / 1st Floor, Connan side / 3-5

The CPUC and the California Energy Commission are responsible for implementing the state's Renewables Portfolio Standard Program. They have established a 33% renewable goal to help California meet its climate change targets established in AB 32, which requires that California's statewide GHG emissions to be reduced to the 1990 level by 2020 (a reduction of about 25%). The objective of our research is to determine the feasibility for California to achieve the aims of AB 32. In addition, we aim to extrapolate, given current data of carbon dioxide emissions, the extent of emission reductions in 2020 and to predict if the quota of 33% RPS could be attained from current policies and effort by the Californian legislation.

Analysis of APC2 Phosphorylation on Actin Furrow Formation in the Drosophila Syncytial Embryo

Kelly Shibuya / Biological Sciences & Science and Humanities Scholars
Advisor(s): Brooke McCartney Biological / SciencesRangos
Rangos 1 & 2 / Sigma Xi Group 2 / 10:00

The colon cancer tumor suppressor, Adenomatous polyposis coli (APC), is a multifunctional protein that is not only involved in Wnt signaling, which has been extensively studied, but also in the organization of the cytoskeleton. We are investigating the role of APC proteins on the actin cytoskeleton in order to further discover links between APC and tumor development. Like humans, Drosophila have two APC isoforms that are highly conserved. The Drosophila syncytial embryo provides a great model system to study dynamic cytoskeletal events. During this time of development, embryos undergo synchronous nuclear divisions without cytokinesis, and actin-based pseudocleavage furrows act as physical barriers between neighboring cells to provide the mitotic fidelity. Previously, it has been shown that APC2 localizes to these actin furrows, and loss of APC2 activity (APC2 null) leads to furrow extension defects. Our lab also showed that APC2 can form a complex with the actin nucleator Diaphanous (Dia) during furrow formation, possibly regulating its activity. Additionally, APC proteins are highly phosphorylated, a mechanism commonly used to regulate protein functions. In this study, we are investigating the role of phosphorylation of APC2s 20 amino acid repeats (20Rs) on furrow formation. Based on the mammalian studies mutant versions of the protein that are nonphosphorylatable (Ser to Ala) or phospho-mimetic (Ser to Asp) were generated. Drosophila APC2 has five 20Rs with 20R3-R5 having the highest homology to the human APC. Thus, we generated two versions of the phosphorylation mutants, one mutating the relevant residues in 20R1-R5, and one mutating only 20R3-R5. We are testing the ability of these mutants to rescue the furrow defects in APC2 null background. This study will provide a better understanding on the importance of phosphorylation of APC2 on regulating the actin cytoskeleton.

Contact Development to AlGaN/GaN HEMT Chemical Sensors
Jane Herriman / Chemistry & Science and Humanities Scholars
Advisor(s): Lisa Porter / Materials Science Engineering
Hoch Commons / 2nd Floor, Window side / 12-2:30

AlxGa(1-x)N is a wide band gap semiconducting alloy that is employed in UV-light emitting diodes (UV-LEDs) for military uses, sensors, and biomedical devices. It has been found that the 2D electron gas localized at AlGaN/GaN interfaces shows changes in conductivity in the presence of hydrogen. This has enabled the Porter research group at Carnegie Mellon to begin novel work on AlGaN/GaN HEMT hydrogen sensors, which have possible applications in microwave communications and gas sensors. This project focuses on understanding the conditions and device parameters necessary to better the performance of these chemical sensors. Specifically, the primary goal of this project is to heighten device performance through the development of virtually zero resistance (ohmic) contacts to these AlGaN-based sensors.

Degradation of naphthalene using FeIII-TAML catalysts
Medini Annavajhala / Biological Sciences & Science and Humanities Scholars
Advisor(s): Terrence Collins / Chemistry
Kirr Commons / 1st Floor, Window side / 12-2:30

Naphthalene, named a possible carcinogen for humans and animals by the International Agency for Research on Cancer (IARC) and linked to other health effects related to blood poisoning, has a stable structure consisting of two fused benzene rings. With the emergence of naphthalene as a toxin of current interest, especially due to natural gas extraction methods in Pennsylvania, concern is growing regarding the possibility of the compound being found in groundwater systems. Due to the stability of naphthalene, it was previously regarded as a difficult molecule to degrade, including through oxidation methods. However, our project has shown through both high-performance liquid chromatography (HPLC) and nuclear magnetic resonance spectroscopy (NMR) analyses that the patented Fe-TAML catalysts have the ability to activate hydrogen peroxide and lead to significant degradation of naphthalene. One of the products of this reaction has been identified as formate, indicating a deep oxidation of the original compound. Optimizing these reaction conditions will potentially lead to the degradation of naphthalene to nondetection and a better understanding of the reaction mechanism, giving hope to the use of Fe-TAML catalysts in this application.

Dominant mutations in myosin II heavy chain genes 6, 7, and 11 and their affect on myosin protein dimerization
Danielle Devine / Biological Sciences & Science and Humanities Scholars
Advisor(s): Peter Berget / Biological Sciences
Hoch Commons / 2nd Floor, Rangos side / 3-5

Dominant mutations in the myosin II heavy chain genes 6, 7, and 11 are known to cause a number of cardiac diseases. This project is designed to begin to investigate the molecular mechanisms behind these disorders by analyzing the ability of the mutant myosin II proteins to dimerize. Dimerization of myosin proteins is necessary for the formation of a functional motor protein molecule. Currently it is unclear if the mutant myosin heavy chains are able to dimerize with the wild type heavy chain proteins or if only mutant homodimers and wildtype homodimers are able to form in living cells. This project began by creating dominant mutations known to cause heart

disease through overlap polymerase chain reactions (PCR) methods in wild type myosin genes and introducing these new mutant heavy chain sequences into cloning plasmids. The success of the mutagenesis process was confirmed via commercial sequencing, and the confirmed mutations introduced into protein expression vectors. The success of the insertion of the mutated fragment into these expression vectors has been tested with restriction digests and the presence of the mutation confirmed again through commercial sequencing for several of the desired mutations. The mutated genes have been expressed in Escherichia coli (E. coli), and the resulting protein collected and purified. This knowledge could be the first step in understanding how cardiac diseases result from the mutations.

Dynamic Monte Carlo Renormalization Group
Maxwell Hutchinson / Physics, Robert Lee / Physics, Karpur Shukla / Statistics & Science and Humanities Scholars

Advisor(s): Robert Swendsen / Physics
Hoch Commons / 2nd Floor, Window side / 3-5

Monte Carlo methods and renormalization group (RG) analysis are often used in statistical physics to study properties of phase transitions. We explore extending the RG analysis to study the dynamic correlations of a simulated 2D Ising system evolving in time. The simulation software is optimized for performance by using CUDA GPGPU technology and by updating the Ising spins using the Swendsen-Wang cluster algorithm.

Effect of Intralipid on Iron Oxide Particle Labeling of Immune Cells during Organ Rejection
Devin Prior / Biological Sciences & Science and Humanities Scholars

Advisor(s): Chien Ho / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 10:00

Cellular MRI is a powerful technique for studying a range of diseases and treatments. The Ho laboratory is developing a new approach to use cellular MRI to monitor organ rejection by imaging infiltration of macrophages into a rejecting heart. This method is based on labeling immune cells with iron-oxide particles, particularly macrophages which will internalize the particles, thus allowing the cells to be detected in vivo by MRI. Iron oxide particles can have very short blood half-lives because they are quickly taken up by Kupffer cells of the liver. My previous studies have shown that iron-oxide blood clearance can be delayed by using intralipid, a clinically approved fat supplement, which is uptaken by the Kupffer cells thus inhibiting their ability to uptake iron-oxide particles. If more macrophages take up the iron-oxide particles, the sensitivity for detecting macrophage infiltration into the rejecting grafts will be improved. In this project, I investigated the effect of intralipid on micron sized iron oxide particle (MPIO) cellular labeling of macrophages by using flow cytometry and mass spectroscopy. I determined that not only does intralipid cause an increased number of cells to uptake MPIO but also causes each individual cell to uptake an increased number of particles which may drastically increase the sensitivity of detecting organ rejection in vivo with MRI.

Exploring Learning Rates: Do Students Learn at Different Rates?
Emily Boncek / Science and Humanities Scholars, Yinglu Yao / Statistics, Xiaoyu Zhu / Economics and Statistics
Advisor(s): Rebecca Nugent / Statistics
Kirr Commons / 1st Floor, Window side / 12-2:30

As emerging curiosity and excitement in learning behavior gives rise to educational data mining, learning scientists are exploring how people learn. The Pittsburgh Science of Learning Center (PSLC) maintains an open data repository, the DataShop (https://pslcdatashop.web.cmu.edu/), of learning data coming primarily from an interactive tutoring system. Our primary goal is to model differences in student learning rate so that PSLC could potentially design programs to improve learning in the future. To achieve this goal, we are using a Geometric Area dataset collected from 1996 to 1997, where students were prompted to solve various problems related to geometric area step by step. We will develop an algorithm to compare students' learning rates using this data set, and apply the method to other data sets from PSLC.

Faculties Attitude toward Plus/Minus Grading System
Hye Jung Cho / Economics and Statistics, Erica Choi / Science and Humanities Scholars, Aiena Garg / Economics and Statistics, Dong Seob Kim / Chemistry, John Shoup / Statistics
Advisor(s): Brian Junker / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

In Carnegie Mellon University, students work very hard to get high GPAs. Students are concerned about GPAs since they have high impact on chances of getting a job or admissions to graduate schools. Carnegie Mellon University currently implements grading system without plus or minus letter grades. Students' opinions on the current grading system vary. Previous research from Carnegie Mellon students from "Sampling, Survey and Society" in 2008, surveyed 341 students' opinion regarding implementation of plus/minus grading in CMU. In this study, 18 percent of the respondents supported the implementation of plus/minus system, 68 percent were against it and 14 percent were undecided. Our research analyzes faculties' attitude toward the implementation of plus/minus grading system. We distributed on-line surveys to randomly selected 578 faculties. The survey questions constitute several demographic questions as well as view on current grading system in CMU and implementation of plus/minus grading system. After carrying out an exploratory data analysis, we ran analysis of variance on our data. Then, we compared our result to the previous research done in 2008. Our result suggests that faculties from different departments have varying opinions regarding the implementation of plus/minus system.

Further Exploration of Non-Skeletogenic Mesoderm of the Sea Urchin Embryo
Stephanie Guerra / Biological Sciences & Science and Humanities Scholars
Advisor(s): Charles Ettensohn / Biological Sciences
Pake / 12:00

The non-skeletogenic mesoderm (NSM) of the sea urchin embryo gives rise to four cell subpopulations including the pigment, blastocoelar, coelomic pouch, and circumesophageal muscle cells. At the hatched blastula stage, the NSM cells are present in a ring at the vegetal plate that surrounds the presumptive primary mesenchyme cells (PMCs). The PMCs are a critical cell subpopulation in the sea urchin embryo because they give rise to the embryonic skeleton. Without

functional PMCs or PMC-like cells, the embryo of the sea urchin does not develop normally. When PMCs are removed from the embryo at the mesenchyme blastula stage, the embryo is still able to develop normally due to transfating. Transfating is when one cell population takes on the function of another. It has been shown that this transfating population is part of the NSM (Ettensohn 2007). Research in the Ettensohn laboratory has identified the blastocoelar cells of the NSM as the transfating candidate. This project aims to further explore the possible connections between the gene regulatory networks of PMCs and the blastocoelar cells to learn more about the specification of the blastocoelar cells and their potential transfating properties. In addition, examination of the blastocoelar cells in comparison to pigment cells will be conducted to identify keys to the specification process.

Investigation of the results from the Content Focusing Coaching study and evaluating alternative Hierarchical Models

Brittanie Boone / Economics and Statistics, Erica Choi / Science and Humanities Scholars, Thomas Todd / Statistics

Advisor(s): Rebecca Nugent / Statistics

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

One of the current problems facing low income districts is high teacher mobility in classrooms. This may be affecting students' reading comprehension development since many teachers have different methods of teaching. One possible solution is Content-Focused Coaching, a program that pairs trained coaches with classroom teachers for the purpose of improving reading comprehension instruction. Previous research from Marsh et al. (2008) found coaching has positive effects on reading achievement for students. The most current research from Matsumura et al. (2010) found that the CFC program had a positive effect for students who were English language learners. Our research analyzes data from the Matsumura et al. (2010) longitudinal randomized field trial, conducted between 2006 and 2009 to determine the effectiveness of a Content-Focused Coaching program on districts with high teacher mobility. The data came from an urban school district in Texas where fifteen schools were randomly assigned to have the CFC program and 14 schools were randomly assigned to be the control group. Due to ethical issues, control schools were also allowed to have literacy coaches. We used this data to verify the model Matsumura found and investigate more efficient models for the data. Due to the already embedded level structure of the data, schools within a district and teachers within the school, we used hierarchical level model analyses. After running Markov Chain Monte Carlo methods with schools as our level and testing multiple random intercept and random slope hierarchical models, we found no isolated positive effect for the CFC program. We then investigated non-linear models to show the effect of CFC on students in the data and found similar results. It appears that the CFC program does not have a positive direct effect on students' test scores without the interaction with other student variables. This suggests that other programs may be needed in order to improve the test scores for all students.

Israeli Assistance and Biafran Resistance: A Special Relationship, 1967-1970

Caulder Tempel / Science and Humanities Scholars

Advisor(s): Laurie Eisenberg / History

Peter / 4:00

During the Nigerian Civil War of 1967-1970 the secessionist state of Biafra endured assaults from the federal government for three years with the assistance of nation states sympathetic to Biafran sovereignty. There is a lack of academic documentation and analysis on these relationships, in particular the ties between Biafra and Israel. Israel ranked among Biafra's top allies and provided necessary support to the new born nation. Even after Biafra was absorbed into the Federal Republic of Nigeria, the memory of Israeli aide endured in the minds of the Igbo population of Biafra. This essay is an effort to trace this Israeli-Biafran relationship in its diverse manifestations, which range from effective material aide and political commitments to symbolic ethnic solidarity.

Object-based Attention is Modulated by Object Exposure Duration
Elizabeth Cutrone / Science and Humanities Scholars
Advisor(s): Marlene Behrmann / Psychology
Hoch Commons-2nd Floor, Rangos side / 12-2:30

Previous studies have shown a behavioral advantage for locations on perceptual objects to which attention is directed (versus locations on other objects). This effect is known as the Same-Object Advantage and has been shown to decrease with perturbation of the object-related information (for example, the placement of an occluding object over a portion of the attended one). While Shomstein and Behrmann (2008) have shown that attention may be affected by object-related information with a preview time (the time between the onset of the object display and the beginning of the task) as short as 200ms, most other studies have used longer preview times (around 1000ms), presumably allowing for the accumulation of more object-related information in order to maximize the Same-Object Advantage. We further investigate the effect of preview time, using a range of values between 100ms and 1000ms and find that the behavioral Same-Object Advantage is consistent in magnitude within this range, with the exception of 400ms, where it is significantly larger.

Quantifying Grain Boundary Character Distribution of Nickel using High Energy Diffraction Microscopy and Forward Modeling Techniques
Benjamin Ellison / Physics & Science and Humanities Scholars
Advisor(s): Shiu Li / Physics
Rangos 1 & 2 / Sigma Xi Group 6 / 10:30

the grain boundary character distribution (GBCD) is a five parameter classification of the grain boundary network that composes polycrystalline microstructures. As a method of describing both the lattice mismatch across grains and the crystallographic planes that compose the grain interfaces, the GBCD can quantify the evolution of a microstructure as it responds to certain external stimuli. Using synchrotron based high energy x-ray diffraction microscopy (HEDM), a small volume of high purity nickel microstructure was measured after a sequence of grain growth anneals. Analyzing this data with the forward modeling software package, orientation maps can be produced and extended to three dimensions. The properties of the GBCD in each of these anneal states will be quantified and interpreted.

Rooms of Their Own: Autonomous Feminist Squats of the 1980s
Kelly Bescherer / English & Science and Humanities Scholars
Advisor(s): Donna Harsch / History
Dowd / 4:20

Experimentation in the realm of daily life had already been a major battle ground for New Left German groups of the 1960s. This paper traces the post-1968 expansion of the idea of autonomy, as it developed through the countercultures of the women's and the squatter's movements. Both movements defined themselves with the term "autonomous," an idea which for them implied a desire to take control of their own lives by throwing off all forces which threatened their ability for self-rule. I will focus especially on these two movements' point of intersection: the many all-female squats which simultaneously sought autonomy from men, the state and hegemonic culture, at the same time as they sought to create a physical space in which this autonomy would be possible.

Structural Analysis of Crystal Violet Binding Single Gene Variable Fragments by NMR
Sarah Zuerndorfer / Biological Sciences & Science and Humanities Scholars
Advisor(s): Gordon Rule / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 10:45

Current common techniques for the detection and localization of cellular organelles, proteins and other macromolecules utilize tagging with radioactive isotopes and large fluorescent proteins like Green Fluorescent Protein (GFP). These methods are generally successful, but have distinct disadvantages, such as the inability to view two different proteins at once with radioactive isotopes (as they show up indistinctly in X-ray film), the potential disruption in protein function due to the attachment of GFP, and the decay of GFP fluorescence over time. However, these faults can be eliminated by using dyes that can be activated and refreshed as needed by the experimenter. In order to improve upon localization technology, we aim to produce a system that utilizes a single chain variable fragment (scFv) that can localize to the experimenter's choice of protein and fluoresce with the addition of an organic dye. The benefit of this protein it is twofold. First, the scFv does not need to be added at the level of DNA, so less disruption of function would occur, secondly, the dye could be re-applied and varied in color with a different version of the scFv to allow multiple proteins to be viewed simultaneously with no loss of fluorescence. In order to attain these benefits we created a scFv designed to attach to an epitope sequence in the cellular component of interest. The scFv also has a domain that contains a binding site for an organic dye (for my portion of the experiment the dye is crystal violet) which will fluoresce when bound. This allows for the experimenter to essentially turn on detection during a specific time in the cell's cycle. The dye could also be re-applied, thus diminishing the effect of photobleaching and cellular breakdown of the dyes, which would be essential for experiments tracking protein production and localization in the cell over its lifetime. We plan to create this scFv by starting with several plasmid DNAs each encoding one version of the scFv created by the Armitage lab. We will be using several versions of a similar scFv in order to choose one that works best under normal cellular conditions. The DNAs are encoded in a pAK400 vector which we will then subclone into the pET22+ vector. This construct will then be transformed into E. coli strain C3103 cells for optimum antibody expression. The scFv protein will be isolated from the E. coli cells and purified using a cobalt affinity chromatography column before its structure will be determined via NMR. The NMR experiments will be performed on both dye-bound (using crystal violet dye) and unbound states to analyze the structures of both complexes. The resulting NMR structure will give an idea as to how the protein binds its epitope and its general structure, so that these features can be documented and presented to others looking to use this system as a method for protein detection in their own experiments. The protein, once analyzed properly, should be effective in use for many future biological experiments.

Structural Analysis of Activation Induced Cytidine Deaminase via X-Ray Crystallography
Katherine Bonnington / Science and Humanities Scholars
Advisor(s): Gordon Rule / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 4 / 10:30

Activation-induced cytidine deaminase (AID) assists in the production of more diverse and effective antibodies by directly mutating the DNA of B-cells through a process called somatic hypermutation. Additionally, AID allows for B-cell class switch recombination, a change of the antibody's constant region which alters the body's response upon encounter with the antibody's specified antigen. However, the mechanisms, regulation, and extent of AID's activity in the cell are not well known. To gain more insight on the enzymatic mechanism, the ability to produce large quantities of AID to perform biochemical and biophysical assays in vitro would be extremely valuable. In order to accomplish this, I have explored methods of expressing AID in E. coli. Due to previous insolubility issues, a shortened version of AID, containing only the deaminase domain (ddAID, 180aa) is being examined. I have attached a ddAID to a His-tagged GST at the C terminal of AID with a HRV protease cleavage site between the two proteins. Having already expressed and purified the soluble protein product, I am now looking to test the enzyme's deaminase activity. When proper deaminase function has been confirmed, I can begin the process of crystallization. Once crystallized, this enzyme can be used for structural studies via X-ray crystallography in order to shed light on questions about the protein's structure, specificity, and mechanism of deamination.

Survey of Carnegie Mellon Faculty Regarding Attendance Policy and Student Performance
Emily Boncek / Science and Humanities Scholars, Christopher Chang / Statistics, Kelly Chang / Electrical & Computer Engineering, Stephanie Sindler / Economics
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 3-5

We are conducting a survey of members of the Carnegie Mellon faculty community in order to determine if there is a relationship between whether or not a class has mandatory attendance and students' performance in the class. This topic is interesting because there is a large disparity in the way classes are structured across various departments of the university, and thus it is possible for two students of different majors to have entirely opposite classroom experiences. This survey is interested in determining if requiring attendance has an effect on or can improve students' performance in classes. We are distributing a self-administered online survey to Carnegie Mellon faculty who taught undergraduate courses in the Fall 2010 semester. Data collected about each course includes department, class size, attendance policy information, and distribution of final grades. We will compare the distribution of final grades for attendance mandatory versus attendance optional courses to determine the effect of attendance policy on student performance. Although we are still in the data collection process, we expect to find that attendance mandatory courses will have better student performance. While we will definitely be able to make conclusions within academic departments, we also hope to generalize these comparisons within and across colleges.

The Ultra-High-Energy Cosmic Ray -- Active Galactic Nucleus Connection
Kewei Zhang / Science and Humanities Scholars
Advisor(s): Peter Freeman / Statistics
Kirr Commons / 1st Floor, Window side / 3-5

Cosmic rays are energetic charged subatomic particles that stream through the universe at close to speed of light. The most powerful cosmic rays are 100 million times more energetic than the particles produced in the world's most powerful particle accelerator. The question is: how are the most energetic cosmic rays formed? As an side, we know that supernova remnants and other areas where there are shock fronts can accelerate cosmic rays to high energy, but they cannot account for the highest energy cosmic rays, the ones we are looking at. In this project, we investigate the hypothesis that Active galactic Nuclei(AGN), powered by supermassive black holes, might be linked to the origin of ultra-high energy cosmic rays. We compare data both from the Pierre Augar Observatory and from stimulations of uniformly distributed cosmic rays to the observed distribution of nearby AGN, and reject the null hypothesis that the observed data arise from a uniform distribution at the [insert 100 times the minimum p-value here] percent level. We concluded that the observed ultra-high energy cosmic rays are at least associated with the large-scale structures of the nearby universe that the AGN trace out, if not the AGN themselves.

The Zen Mozart: Effect of Mindfulness Meditation and Classical Music on Visuospatial Skills
Cynthia Peng / Psychology

Advisor(s): Lori Holt / Psychology
Rangos 1 & 2 / Sigma Xi Group 8 / 11:45

Performance on visuospatial tasks can be enhanced via different mechanisms. Here, we study how classical music and mindfulness meditation can differentially affect visuospatial skills. Participants completed two markers of visuospatial skill - the Paper Folding and Cutting (PF&C) task and the Mental Rotations Task (MRT) - in order to assess the respective effects of music and meditation on these tasks. Participants served as their own baseline controls in order to compare pre-exposure to post-exposure scores. Behavioral results showed that music led to enhanced performance the PF&C more so than the MRT, assessed by an increase in accuracy. Conversely, meditation led to enhanced performance on the MRT but a decrease on the PF&C. This is perhaps due to the inherent nature of the two conditions, in which the music of Mozart is upbeat and fast, leading to an arousal in mood, while the meditation is calming and slow, leading to relaxation. Thus, it is shown that although both can lead to a temporary boost on visuospatial skills at large, they selectively affect different types. These findings have many implications and applications for education, intelligence testing, cognitive control, and mental health.

The Use of English in Japanese Advertising
Douglas Goldstein / Modern Languages & Science and Humanities Scholars

Advisor(s): Yasufumi Iwasaki / Modern Languages
Wean Commons / 1st Floor, Connan side / 12-2:30

The incredible prevalence of English in Japan – both in written and spoken form – is at first baffling to a native English speaker. Phrases that seem to make no sense (i.e. "Drink Concert") are nevertheless seen everywhere: on t-shirts, as part of television advertisements, and in the Japanese language itself, in the form of loan words. In this paper I intend to focus on television and print advertisements that feature the use of English and try to understand why English is used rather than other forms of communication, and then in what ways it is used and in what ways it is perceived by Japanese people.

Tracking Semiconductor Inventors in Silicon Valley and Beyond
Sebastian Wai / Science and Humanities Scholars

Advisor(s): Steven Klepper / Social & Decision Sciences
Pake / 4:00

This project is a methodical, in-depth study on the origins of inventors in the semiconductor industry. Inventors are identified through patent data, then tracked using both patents and biographical sources. Data collected on inventors is then used to profile the hiring patterns of a variety of semiconductor firms across the country and across the history of the industry. The analysis focuses on geography, education, and employment history, as well as a defining feature of the industry: interplay between parent and spinoff firms.

Understanding Hypertension and Health Literacy in Pittsburgh neighborhoods
Eda Akyar / Science and Humanities Scholars & Devleen Baksi / Biological Sciences
Advisor(s): Caroline Acker / History
Hoch Commons / 2nd Floor, Rangos side / 3-5

High blood pressure is often an unnoticed and undiagnosed health condition that affects many Americans. In 2006, nearly one third of all Americans had hypertension (American Heart Association). Hypertension is a precursor to many other medical aliments, such as diabetes, heart disease and stroke. Therefore, considering the health issues that revolve around hypertension, we would like to conduct a research project in the South Side Flats neighborhood of Pittsburgh to understand health literacy concerning hypertension. We want to understand what community members know about hypertension, its causes, effects and treatment options. We also want to learn where community members get important health information. Finally, through the blood pressure screenings, we would like to determine the correlation of community members who may be identified as “at-risk” for hypertension with their understanding of medical knowledge about hypertension.

Understanding Conformational Changes in Opioid Receptors upon Ligand Binding
Maneesha Sakhuja / Science and Humanities Scholars
Advisor(s): Manojkumar Puthenveed / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 3 / 12:00

Many addictive and abused drugs target the opioid receptor in cells and have very similar signaling pathways. However their physiological affects, including their addictivity, are different. Morphine, an analgesic opioid, and endorphins, an endogenous opioid, have very similar signaling pathways, but morphine is an addictive drug, while endorphins are not. The molecular basis for these physiological differences lie in the differences in the regulatory pathway and is a result of the intrinsic differences in the opioid receptors that are present when bound to different drugs. These receptors adopt different conformations depending on the ligand (drug) that is bound to the receptor. We will use intermolecular Fluorescence resonance energy transfer (FRET) to look for a change in conformation of the receptor. Site specific labeling will allow us to look for FRET changes at a single molecule level. This will allow us to determine whether there are consistent conformational changes that are dependent on the drug to which it is bound. These conformational changes may be responsible for the addictive differences between certain drugs. Analyzing these changes will allow for development of methods that may be able to change the addictive pathways of certain drugs.

Undergraduate Prospects After Graduation
JeWoo Sun / Statistics & Science and Humanities Scholars, Erika Tang / Economics, Zhiyi Tang / Statistics, David Zimmerman / Statistics & Science and Humanitites Scolars
Advisor(s): Brian Junker / Statistics
Rangos 1 & 2 / Sigma Xi Group 8 / 12:00

Given the recent scandal revealing the over optimistic prospects for graduating law school students, the statistics produced by universities and published in the US News and World Report are being brought into question. These misleading statistics encourage hopeful JD seekers to pursue startling loans with the expectation that their debts will be paid off with relative ease upon graduation thanks to the supposed 84% job placement ratings. While the production of undergraduate college rankings has often been criticized for its accuracy in measuring the actual quality of education, Carnegie Mellon University and other universities have long bolstered their reputations for producing intelligent, motivated, and successful students with the use of these faulty lists. However, this raises the question of how measurably successful Carnegie Mellon University undergraduate alumni are. Where do alumni relocate? What occupations do they practice? What graduate programs do they choose to pursue? And, according to the common man's perception of comparative success, how do Carnegie Mellon University undergraduate alumni stack up when compared to graduates of other universities? This study analyzes the data collected and evaluated by the Carnegie Mellon University Career Center (http://www.studentaffairs.cmu.edu/career/students_alumni/post-grad-survey/index.html) in order to answer such questions as: Are alumni—successful by Carnegie Mellon standards—well received by employers and graduate programs? Do alumni display a tendency to remain near to Pittsburgh or to relocate elsewhere? Do alumni successfully attain employment relevant to their subject(s) of study? How accurately do national and international rankings systems gauge the value of a Carnegie Mellon Undergraduate degree? The data collected from the Carnegie Mellon University Career Center is will also be used to test the effectiveness of various survey methods. The Career Center has nearly perfected its collection data collection methods as response rates generally run somewhere in the 90th percentile (with the exception of College of Fine Arts classes where response rates are as low as the 70th percentile). This has yielded results near to that of census data. As such, this study assesses the effectiveness of certain types of sampling schemes (stratified and clustered sampling) to produce results representative of the target population so that future statistical researchers can visually apprehend the significance of various survey designs. Few have had the data provided or the opportunity to conduct a study on accurate census data in order to optimize survey results to population parameters.

Wnt signaling is required for endomesoderm development in the sea star, Patiria miniata
Eda Akyar / Science and Humanities Scholars
Advisor(s): Veronica Hinman / Biological Sciences
Rangos 1 & 2 / Sigma Xi Group 2 / 11:30

Wnt signaling has many different functions during metazoan development. It has well-characterized roles in vertebrate axial patterning and in boundary formation in Drosophila and vertebrates. Wnt signaling is also required for endomesoderm specification in C. elegans and sea urchins; its function during this process is particularly well understood in these organisms. However, the role

of Wnt signaling in sea star development has not been characterized. We have identified five wnt genes that are expressed in embryos of the sea star, Patiria (Asterina) miniata. Temporal profiling indicates that these genes are activated during early cleavage and blastula formation. Spatially, wnt genes are expressed in nested domains at the vegetal pole of the blastula. This nested expression pattern is also observed at the gastrula stages. The endomesodermal wnt expression domains suggest that Wnt signaling may be involved in vegetal development of the sea star. -catenin was previously shown to be nuclearized in vegetal blastomeres in the sea star, further suggesting a role for Wnt signaling in the development of these cells. To test this, we blocked Wnt signaling in two ways. Knockdown of wnt8, the wnt gene expressed earliest, resulted in downregulation of many, but not all, transcription factors (TFs) required for endomesoderm development. To attenuate all canonical Wnt signaling, which may be mediated by Wnts other than Wnt8, we overexpressed mRNA encoding a membrane-tethered cytosolic cadherin domain (-cadherin). This resulted in a similar decrease in expression of regulatory genes required for endomesoderm development. Thus, the nuclearization of -catenin and signaling by Wnt8 are both required for sea star endomesoderm development, suggesting that Wnt8 may be the main driver of -catenin nuclearization in blastulae.

BUSINESS ADMINISTRATION

TEPPER SCHOOL OF BUSINESS

Accuracy of Pittsburgh Bus Timetables Used by CMU Students
Matthew Belenky / Economics, Timothy Higgins / Economicsm, John Sperger / Social & Decision Sciences, Chao Wang / Electrical & Computer Engineering, Tian Wu / Business Administration
Advisor(s): Brian Junker / Statistics
Wean Commons / 1st Floor, Connan side / 12-2:30

Many students and Professors at Carnegie Mellon rely on the public transit system to get to work, however students frequently complain about the PAT bus system. The most common complaints are late buses, inaccurate schedules, and the frustration that occurs after waiting for a bus only to have multiple buses of the same route arrive at the same time1. Waiting wastes time, causes frustration, and in the long run could lead commuters to choose to find a way to travel that doesn't involve public transportation. To aim of this study is to first measure the degree to which these complaints are accurate, and if buses are systematically late develop a model for predicting expected arrival time. This study will be build on a strong general literature base on public transportation and investigate the accuracy of bus time tables for the Forbes and Morewood intersection which is the most commonly used bus stop for commuters at Carnegie Mellon University. Bus departure times will be observed and compared to posted bus schedules. A number of potential factors that influence bus punctuality will also be measured including the weather, the time of day, and the level of light. Using these factors and the information collected on bus arrival times, a model will be created to predict when a bus will arrive given the scheduled arrival time.

ECONOMICS

Student Consumption of Caffeine On Campus

Prerna Agarwal / Economics, Yong-Gyun Choi / Economics and Statistics, Abigail Daughtrey / English, Christopher Loncke / Mathematics, Bassem Mikhael / Economics

Advisor(s): Brian Junker / Statistics

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

Numerous health studies have demonstrated the damaging effects of excessive caffeine consumption on cardiac wellbeing in addition to psychological and mental health. There is significant concern that students today consume large amounts of caffeine to keep up with their academic workload or enance their performance in soprts activiites. We have surveyed the Carnegie Mellon University undergradate population in order to determine types and amounts of students' caffeine consumption. Further, we measured students' perception of acceptable caffeine usage.

SPECIAL COMPETITIONS

The Allen Newell Award for Excellence in Undergraduate Research

Open only to students in SCS. This endowed award, established in 1993, is presented annually by the School of Computer Science. Allen Newell had a long, rich and distinguished scientific career that contributed to multiple subdisciplines in computer science. Still, each individual endeavor was pursued with a characteristic style that his colleagues, students, and friends recognized as essential to Allen. Owing to the breadth and scope of Allen's contributions, this award recognizes extraordinary undergraduate research in his scientific style rather than computer science research in a particular area. The criteria by which a research project is judged is predicated, foremost, on the belief that a good idea is not enough. The qualities that transform a good idea into good science can be captured in three maxims attributable to Allen:

1) Good science responds to real phenomena or real problems.
2) Good science is in the details.
3) Good science makes a difference.

Alumni Award for Undergraduate Excellence in Computer Science

Open only to students in SCS. The Alumni Award for Undergraduate Excellence in Computer Science, established in 2003, is granted on behalf of Carnegie Mellon School of Computer Science alumni. The Award recognizes technical excellence in research and development. The Award is also intended to promote awareness within the undergraduate community that graduation represents both the end of an important phase of life and the beginning of a new phase within the vibrant Carnegie Mellon University School of Computer Science community as an alumnus. The Alumni Award recognizes such factors as contribution to the state of the art; technical excellence; potential societal impact; accessibility; quality of the written, oral, and poster presentations; and generated excitement among the alumni community participating in the process.

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
Paul Eiss, Associate Professor, History
Tim Haggerty, Director, Humanities Scholars Program
Yona Harvey, Director of Creative Writing, English
John Mackey, Assistant Department Head, Mathematical Sciences
Marge Myers, Associate Director, Studio for Creative Inquiry
Terese Tardio, Associate Teaching Professor, Spanish

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.

Shengjun Huang
Mychal Kamara
Diana Pressley
Dexter Rietman
Rodney Wheeler

CIT Honors Poster Competition

All students conducting research through the Carnegie Institute of Technology Honors Program participate in the CIT Poster Competition.
Faculty:
Burcu, Akinci, Civil and Environmental Engineering
Michael Bockstaller, Material Science Engineering
Kaushik Dayal, Civil and Environmental Engineering
Chris Hendrickson, Civil and Environmental Engineering
James Hoe, Electrical and Computer Engineering
Mohammed Islam, Material Science Engineering
Michael Lancet, Electrical and Computer Engineering
Michael McHenry, Material Science Engineering
Benoit Morel, Electrical and Computer Engineering
Irving Oppenheim, Civil and Environmental Engineering
Tom Sullivan, Electrical and Computer Engineering
John Wesner, Institute for Complex Engineered Systems/ME
Alumni Judges:
Bob Unetich

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.
Herm Anand
Billie Godlewski
Mark Sherman
Jiwu Tao

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.
Carolina Ladyga, Project Manager, Global Recruiting Operations

Michael Reilly, IT Director, COMM R&D Marketing Apps
Vic Rios, IT Vice President, GS Commercial & RD
Nina Vishwanath, IT Lead Master, Data Governance

Lockheed Martin ECE Undergraduate Project Awards Sponsored by Lockheed Martin, Organized by Eta Kappa Nu, Sigma, PA

The Sigma Chapter of Eta Kappa Nu at Carnegie Mellon is proud to present the Electrical and Computer Engineering (ECE) Project Awards sponsored by Lockheed Martin. This competition is designed to encourage undergraduate ECE students to present their projects, and motivate them to learn from others' work. Eta Kappa Nu (HKN) Sigma Chapter is the Carnegie Mellon chapter of the National Honor Society of Electrical and Computer Engineering. Our goals are to enhance interactions between ECE students, improve student-faculty communication, and develop contacts with industry leaders.
William Nace, Electrical and Computer Engineering
Chris Mensak, Lockheed Martin

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.
Brooke Feeney, Associate Professor, Psychology
Laurie Heller, Associate Teaching Faculty, Psychology
Vicki Helgeson, Professor, Psychology
Charles Kemp, Assistant Professor, Psychology
Ken Kotovsky, Professor, Psychology
David Rakison, 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)
Joseph Devine (H&SS)
Clark Glymour (Philosophy)
Antonio-Javier Lopez (Biology)
Anne Marie Mesco (University Libraries)

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.

V. Emily Stark, Director of Department Operations, Biological Sciences
Catalina Achim, Chemistry
Joseph Ayoob, Biological Sciences
Jill Blankenship, Biological Sciences
Michael Bockstaller, Materials Science Engineering
Marcel Bruchez, Chemistry
Subha Ranjan Das, Chemistry
Jon Dolan, Robotics
Thomas Ferguson, Physics
Mark Fichman, Tepper School of Business
Corey Flynn, Biological Sciences
Kunal Ghosh, Physics
Ilhem-Faiza Hakem, Materials Science Engineering
Robert Heard, Material Science Engineering
Colin Horwitz, Chemistry
Ken Hovis, Biological Sciences
Bistra Iordanova, Biological Sciences
Fred Lanni, Biological Sciences
Sarah Laszlo, Psychology
Alan Levine, Alcoa Incorporated
Greg Lowry, Chemical Engineering
Sara Majetich, Physics
Michael McHenry, Materials Science Engineering
Nicholas Minnici, CMU Alumni
Timothy Mullins,
Linda Peteanu, Chemistry
Lisa Porter, Professor, Materials Science Engineering
Aarti Sahasranaman, Biological Sciences
Russell Schwartz, Biological Sciences
David Squarer, CMU Alumni, Consultant
Shoba Subramanian, Biological Sciences
Cheemeng Tan, Computational Biology
Cheryl Telmer, Biological Sciences
Wenjie Xu, Biological Sciences

SRC-URO Poster Competition

This competition, sponsored by SRC (Semi-Conductor Research Corporation), seeks to recognize significant and creative work supported by the SRC-URO (Semi-Conductor Research Corporation – Undergraduate Research Opportunities) program, and to encourage students to develop and practice visual and oral presentation skills suitable for academic conferences and industrial research venues. Three prizes will be awarded.

Statistics Competition

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.
Howard Seltman, Associate Research Professor
Cosma Shalizi, Assistant Professor

STUDIO for Creative Inquiry Award

This competition rewards a creative project that exemplifies or explores the zone between art, technology, science and society; and impacts the local or global communities. The recipient(s) will be selected by research fellows and staff of the STUDIO for Creative Inquiry.
Krista Campbell, Assistant Director, Foundation Relations
Marge Myers, Associate Director of STUDIO

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, Faculty Director, Steinbrenner Institute for Environmental Education and Research
Michael Griffin, Executive Director, Green Design Institute
Brian Hill, Program Officer, Richard King Mellon Foundation
Kelvin Gregory, Professor, Civil and Environmental Engineering

Yahoo! Undergraduate Research Awards

Yahoo! will be looking for interesting and creative projects in the area of mobile computing/ applications and use of location awareness and Web-accessed local information.
Don McGillen, Ph.D., Senior Manager, Campus Relations

SURG/SURF SELECTION COMMITTEE

Shelley Anna, Associate Professor, Mechanical & Chemical Engineering
Michael Braxton, Major Gift Officer, University Advancement
Mark Fichman, Associate Professor, Organizational Behavior
Bruce Hanington, Associate Professor, Design
Annette Jacobson, Associate Dean of Undergraduate Studies, Chemical Engineering
Linda Kauffman, Teaching Professor, Biological Sciences
Thomas M. Keating, Assistant Teaching Professor, Computer Science
Jennifer Keating-Miller, Assistant Director of Undergraduate Research and National Fellowships
Kenneth Kotovsky, Professor, Psychology
Rebecca Nugent, Assistant Teaching Professor, Statistics
Jessie Ramey, Founding Director and Special Consultant, URO
Noah Smith, Assistant Professor, Machine Learning Department
Mark Stehlik, Assistant Dean, Computer Science Undergraduate Education
Gloriana St. Clair, Dean of University Libraries
Stephanie Wallach, Associate Vice Provost of Undergraduate Education

UNDERGRADUATE RESEARCH OFFICE SPONSORS

The Undergraduate Research Office and Meeting of the Minds Symposium are made possible through the generosity of the Carnegie Mellon University Office of the Provost and:

Endowed Funds

- Anonymous Undergraduate Research Fund
- Bauhinia Foundation Undergraduate Research Fund
- Victor M. Bearg (S'64) Undergraduate Research Fund
- David and Janet Brashear Undergraduate Research Fund
- Professor William E. Brown Memorial Undergraduate Research Fund
- Natale A. Christiano (E'39) Undergraduate Research Fund
- Janice Seiner Colker (A '51) Undergraduate Research Fund
- Wesley Cowan Undergraduate Research Fund
- Loyd (E'59) and Linda Crawley Undergraduate Research Fund
- Arthur Vining Davis Foundations SURG Grants for Humanities Research
- eSite Entrepreneurship Fund
- Dr. J. Paul Fugassi & Linda E. Monteverde Award
- Stacy Rae Gross (A'00) Memorial Undergraduate Research Fund
- James J. Huttner, M.D., Ph.D. (S'74) Undergraduate Research Fund
- Jennings Family Brave Companions Fund
- Richard Kelson Undergraduate Research Fund
- Walter P. Ketterer Undergraduate Research Fund
- Jennifer Kye Hyun Kim Undergraduate Research Fund
- Linda Daley Kosturko Undergraduate Research Fund
- Frederick Kuo Jr. (E'69) Undergraduate Research Fund
- Lathers Local #33 of Western Pennsylvania Undergraduate Research Fund
- Barbara B. Lazarus Undergraduate Research Fund
- Barbara Lazarus Undergraduate Research Fund for the Humanities
- Leisser Art Fund
- Barry B. and Jamet M. Luokkala Undergraduate Research Fund
- Deidre Maloney-Cutler Memorial Undergraduate Research Fund
- McMullen Family Student Undergraduate Research Fund
- Dr. Rodolphe L. Motard Undergraduate Research Fund
- John V. Nelson (S'76) Undergraduate Research Fund
- Marie Colontoni Pechet (S'84, IA'91) Undergraduate Research Fund
- Hugh F. Porter Jr. Undergraduate Research Fund
- Proctor & Gamble Technical Undergraduate Research Endowment
- Sam Soo Pyo Undergraduate Research Fund
- Jessie B. Ramey Alumni Undergraduate Research Fund
- William H. and Frances S. Ryan Undergraduate Research Fund
- Harry M. (E'39, '50) and Lila O. (MM '45) Schadel Jr. Undergraduate Research Fund
- Frederick Osborne Stebbins Undergraduate Research Fund
- H. Guyford and Louise Stever Undergraduate Research Fund
- Donald E. (S '63) and Peggy Stitzenberg Undergraduate Research Fund
- Hideto Tombabechi Undergraduate Research Fund
- William Wallach Undergraduate Research Fund
- Jill Van Wart Hood Undergraduate Research Fund
- Weinsten Family Undergraduate Research Fund
- Everard M. Williams Memorial Undergraduate Research Fund
- Robert K. Zurawin Undergraduate Research Fund

INDIVIDUAL CONTRIBUTORS

Afzaal M. Akhtar (CIT '84, '86) and Sarah J. Bhutta (MCS '89), Rachel A. Batch (HSS '91), Bhargav U. Bhat (CIT '08), Sarah B. (CIT '94) & Joseph W. (MCS '94) Boyles, B. Toloria Braswell M.D. (HSS '75), Del E. Brown (CIT '94), Susan L. Burkett, Pankaj P. Chauhan (CS '01), Gary & Michelle Chin, Cliff I. Davidson (CIT '72), Christa Bower Downey (IM '97), Suzanne & Thomas Ennis, Timothy K. (H&SS '00) and Sarah J. (H&SS '00) Fife, Vianey Garcia-Osorio (CIT '03) & Garth R. Goodson (CIT '98), James H. (CIT '82, '83, '86) & Ruth Ann (CIT '82) Garrett, Jr., Brian Granger (MCS '09), Patricia K. Haller (CIT, '94), Nicole R. Hallinen (CMU '09), Vicki S. Helgeson, David A. Hill, Jenny Houston & Charles Howard, Annette M. (CIT '79, '88) and Donald B. (HSS '79) Jacobson , Jarrod M, Kallberg (MCS '95) & Barbara E. Thompson (MCS '96), Ashley A. Kilp (CMU '10), Benjamin W. Klahr, Erin L, Krupka (HSS '07), Linda Liao (CFA '04), Shih-Duh Liu (MCS '10), Pedro Jose Manautou (CIT '99), Myrna Marshall & Jon Saxe (CIT '57), Santosh A. Mathan (CS '96), Dhruv Mathur (HSS '09), Robert W. Morris (CIT '81), Robb F. Moskowitz (H&SS '99), Amy G. Nasr (HSS '13), Benjamin M. Neenan, Aroon A. Pahwa (CS '07), Glenn L. Radice (MCS '83), Michael J. Rondinelli (CS '01), James A. Rose, Jr. (MCS '70), Naomi R. Schwartz (H&SS '95, MCS '01), Aurora L. Sharrard (CIT '04), Byron C. Sinor (MCS '93), Swati Varshney (CMU '10), Randi L. (CIT '04) & Ryan M. (CIT '04) Voss, Christine Hsiao-Ting Wang, Alexander S. Weiss (Tepper '04), Robert E. White (MCS '65), Annette M. Woods, Jianghong Zhang

CORPORATE & FOUNDATION SPONSORS

Alcoa Incorporated, Boeing Corporation, Chevron Corporation, Cisco Systems Incorporated, Eaton Corporation, Ford Motor Company, International Business Machines (IBM) Corporation, Johnson & Johnson, Lockheed Martin Corporation, Pittsburgh Venture Capital Association, Raytheon Company, SRC Education Alliance, Yahoo! Incorporated

INDEX BY DEPARTMENT

INDEX BY NAME

Undergraduate Research Office
Stephanie Wallach, Associate Vice Provost for Undergraduate Education
Jennifer Keating-Miller, Assistant Director of Undergraduate Research and National Fellowships
Jennifer Weidenhof, Program Coordinator
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213
(412) 268-5702
sw4s@andrew.cmu.edu
www.cmu.edu/uro

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 Initiative to ensure the accuracy or omission of information submitted for publication.