COLLEGE OF NATURAL SCIENCES AND MATHEMATICS

UNIVERSITY OF CENTRAL ARKANSAS

APRIL 24TH, 2009

2:00 p.m. – 4:00 p.m.

McCASTLAIN HALL BALLROOM

Cloning by Yeast Gap Repair to Determine the Different Functions of the Homologous Proteins Mdv1 and Caf4.

Justin Allen and Elizabeth Huett
Faculty Mentor: Kari Naylor

Mitochondria are double-membrane organelles responsible for production of ATP- a cell's energy source. Mitochondrial function is dependent upon a specialized structure; mitochondria are tubular and highly branched, quite unlike the jellybean structure shown in textbooks. This specialized structure is maintained by two classes of membrane events, known as fusion and fission. If these events are not balanced, the structure will be compromised, possibly leading to mitochondrial diseases, such as blindness or muscular weakness. In *Saccharomyces cerevisiae*, our model system, there are three proteins required for mitochondrial fission: Dnm1, Fis1, and Mdv1. A newly identified protein, Caf4, a homolog to Mdv1, has also been suggested to play a role in fission; however, little is known about its function. The purpose of these experiments is to determine the role of Caf4 in mitochondrial fission by determining the differences between Caf4 and Mdv1. Crude domain swapping between three domains of Caf4 and their corresponding domains of Mdv1 will be achieved using a yeast gap repair cloning method. Presented here is the technique of gap cloning in yeast. Results from this work will give us insight into the mechanism of mitochondrial fission and further understanding of the relationship between mitochondrial dynamics, structure, function and disease.

Determination of FtsZ Dynamics in Dictyostelium discoideum to understand the evolutionary link between mitochondria and eukaryotes.

LaRhonda Apata and Dean Turbeville
Faculty Mentor: Kari Naylor

Dictyostelium discoideum has emerged as an important model organism in the study of cytokinesis and other membrane scission events. D. discoideum's optical clarity, high capacity for gene-marker tagging, and the simplicity of its life cycle make it a prime candidate model discoideum

Characte

Will Gibberelli

marked divergence of grotto sculpin from surface populations of banded sculpin. We found a substantial degree of dynamic population genetic structure within Perry County, suggesting gene flow may be restricted between certain sites, but fluid among others.

Examining the Potential Apoptosis-Inducing Effects of dppeNiCysEt on MCF-7 Human Breast Cancer Cells

Zachary Byars and Kandice Strickland
Faculty Mentors: Steven Runge, Patrick Desrochers

Ni(II) bis-(phosphine) complexes may interact very specifically with proteins that trigger or participate in apoptosis and are promising new compounds for anticancer potential in clinics. Previous experiments have involved using a compound, dppeNiIICYSEt+Cl⁻, that was developed in the laboratory of Dr. Patrick Desrochers in the Chemistry Department at the University of Central Arkansas. This compound induces cell death in MCF-7 human breast cancer cells at concentrations at or above 5 !M. Unfortunately this concentration is at the upper threshold of what is considered practical for treatment in humans. In a follow-up experiment designed to mimic the tumor environment, MCF-7 cells were cultured in normoxic (normal oxygen), hypoxic (low oxygen), low pH, and a combination of low oxygen and low pH environments. The cells that were adapted to the hypoxic and low pH environments were unaffected by the addition of the dppeNiIICYSEt+Cl⁻. In an attempt to increase efficacy, a modified compound is being assessed. The cysteine amino acid form is being used directly and the ester is now a free carboxylate making the compound neutral overall and hydrophobic molecule as opposed to the hydrophilic dppeNiIICYSEt+Cl⁻. The modified compound, dppeNiCys, may more easily cross the cell membrane and we predict that this new complex will induce apoptosis at lower concentrations, thus showing more efficiency at cell killing than the parent compound. This study will first try to expand on the previous experiments in comparing the activity of the dppeNiCys with the apoptosis-inducing activity of dppeNiIICYSEt+Cl⁻ under normal physiological conditions. By finding a lower effective concentration, the potential usefulness for this compound as a chemotherapeutic drug increases tremendously. Future studies will involve making the compound more effective at entering cells in the unique tumor microenvironments. The outcomes of this study will determine which chemical modifications should be further investigated.

Analysis of B-cell Antibody Gene Segment Use in response to Mercury Treatment

Heather J. Clarke
Faculty Mentor: Ben Rowley

A.SW congenic strain mice have been used for three decades as a model of chemically-induced autoimmunity. When introduced with mercuric chloride (HgCl₂), a defined autoimmune response results in these mice, characterized by antinucleolar antibodies (ANoA600rfecf IgG1 (a)Tj ET Q q 0.0600000

isotypes. Although many studies have been conducted utilizing this mouse model, none have examined specific antibody heavy-chain gene segments of mature, circulating B-cell receptors (BCRs) which are selected in response to mercury treatment. Using nested polymerase chain reaction (PCR), individually sorted B-cells from treated and sham-treated were examined for heavy-chain material which could be amplified. This method was then followed by sequence analyses of gel-purified products in order to identify individual V(D)J gene segments used by B lymphocytes from treated and non-treated mice.

Contaminant Concentration Analysis of Cave Streams Utilized by Grotto Sculpin (*Cottus carolinae*) in Perry County, Missouri.

J. Tyler Fox
Faculty Mentors: Ginny Adams and Karen Steelman

Recent studies have employed polar organic chemical integrative samplers (POCIS) and semipermeable membrane devices (SPMDs) to assess contaminant levels in aquatic ecosystems. The current study is among the first to use these sensitive, *in-situ* samplers to monitor water quality of subterranean streams. These two types of passive samplers rely on either a solid phase sorbent mixture (POCIS) or synthetic lipid (SPMD) to sample bioavailable dissolved aqueous-phase contaminants. Streams chosen for contaminant assessment represent the only known habitat for the Grotto Sculpin (*Cottus sp., sp., nov.*), a rare hypogean fish allocated to the Banded Sculpin (*Cottus carolinae*) complex, and a species of high conservation concern. Of particular interest to this project is the widespread use of sinkholes in Perry County, Missouri for disposal of various agricultural, industrial and domestic wastes. Intensive agriculture, petroleum products manufacturing and wood curing operations are also suspected sources of contaminants. Thin or unconsolidated soil layers underlying many Perry County sinkholes allow contaminant-laden rainwater to flow directly into caves without adequate filtration and remediation. As a consequence, water quality can quickly and severely decline with rapid transmission of pollution from the surface into caves and conduits of the karst aquifer. In order to assess contaminant levels, perforated stainless steel canisters containing three POCIS and three SPMDs were deployed in five cave streams for a period of 30 days during May 2008 and again during June 2008. Upon collection, accumulated chemicals were extracted and purified in preparation for qualitative and quantitative analysis by gas chromatography (GC) – mass spectrometry (MS), and GC – electron capture detection (ECD). Concentrations of individual contaminants present in the samplers will be used to calculate and compare time-weighted average concentrations of contaminants present in each cave stream. Data will also be used by researchersm private landowners, and resource managers to develop conservation measures and best management practices for the Grotto Sculpin and its habitat.

Distribution and function of girdling by caterpillars of prominent moths (Lepidoptera: Notodontidae)

Carissa Ganong
Faculty Mentor: David Dussourd

Many insect species encircle stems or leaf petioles with a ring of cuts or stylet punctures, often before ovipositing beyond the girdle. Few studies have examined girdling by caterpillars. We determined the distribution of girdling in notodontid caterpillars by sleeving larvae in the field. Girdling occurred in two major branches of the Notodontidae, suggesting that the behavior evolved early in notodontid evolution or independently at least twice. Prominent girdlers included members of *Schizura, Heterocampa, Hyperaeschra*, and *Nadata*. The caterpillars typically girdled in the ultimate or penultimate instar. Girdles were produced in members of five tree families, including in oaks, hickory, elm, birch, and cherry. The frequency of girdling in our studies varied between seasons, years, and host plant species, but was not affected by switching larval food plants partway through larval development. Five-hour observations of *Schizura leptinoides* on pecan documented that feeding usually, but not always, occurs distal to girdles. Histology of girdle cross-

Acetylcholine and Endothelin-1 Mediated Arterial Constriction are Mediated by Different Calcium Sources

Ross Gray, Audra Finley, Bonnie Schlicker, and Whitney Philamlee
Faculty Mentor: Brent Hill

Endothein-1 (ET-1) and acetylcholine (ACH) are agonist peptides associated with vasospasms of coronary arteries. Vasospams are triggered by excessive calcium influx from outside the cell and/or calcium release from internal organelle(s). We evaluated the contribution of each of these calcium sources to the ET-1 and ACH mediated contraction using a physiological saline solution (PSS) containing 0 mM and 2 mM calcium. Right coronary arteries were obtained from female pig hearts, sectioned into 3 mm rings, and suspended into organ baths containing PSS (0 or 2 mM calcium). Compared to rings exposed to the 2 mM calcium PSS, the absence of extracellular calcium significantly reduced the ET-1-induced contraction, but had little effect on the ACH contraction. Next, the arterial rings were exposed to 10 µM estrogen and its metabolites, 2-methoxyestradiol and 2-hydroxyestradiol for 60 minutes before the application of ACH or ET-1. In the presence of 2 mM calcium PSS, estrogen and its metabolites decreased the ET-1 and ACH contraction. The inhibition of extracellular calcium influx by estrogen and its metabolites was confirmed using the selective calcium channel agonist, BayK8644. Our data suggests that ET-1 mediates its contractile effect from external and internal calcium sources. In contrast, ACH induces its contraction from internal calcium stores. Estrogen and its metabolites inhibit the ET-1 contraction by inhibiting the influx of calcium into the arterial smooth muscle cell.

Geography and phylogeny of sexual and apomictic *Erigeron tenuis* (Asteraceae)

Dulcinea V. Groff
Faculty Mentor: Richard Noyes

The geographical and evolutionary relationship between sexual populations of *Erigeron tenuis* and *E. strigosus* is explored. *Erigeron tenuis* is the presumed sister species to *E. strigosus* and previous chromosome counts suggest that it comprises diploid and polyploid populations. Analyses of pollen grains from 530 herbarium specimens were used to estimate the distribution of diploid and polyploid populations. The analyses reveal that diploids are restricted to Eastern Texas while polyploids are widely distributed. This pattern is consistent with distributions in other apomictic complexes. Chromosome counts confirm $2n = 18$ for plants collected from a sexual population while counts for polyploids from two populations reveal $2n = 27$. Ovule development of sexual diploid *E. tenuis* is tetrasporic and diplosporous for polyploids. To explore the relationship between diploid *E. tenuis* and diploid *E. strigosus*, the ITS and ETS spacer regions of nuclear ribosomal DNA were used to construct a phylogeny. The phylogenetic analysis nests *E. tenuis* within *E. strigosus*, which implies that *E. strigosus* is paraphyletic. This result has implications for our understanding of apomixis in the group.

trafficked to the cell membrane. We will expose MCF-7 human breast cancer cells to differing levels of hypoxic and acidic stress and observe temporal changes in whole cell and membrane protein expression for three NHE isoforms.

Cells will be subjected to both stresses (hypoxia and acidification), solely to hypoxia, or solely to acidification to determine the factor(s) leading to modulation of NHE isoforms. Harvesting will take place after 6 hours or 2 days of exposure to hypoxia and/or acidification to measure acute and adaptive responses, respectively. Samples of whole cell expression and cell membrane expression will be analyzed to determine if NHE trafficking, protein synthesis, or both are involved in the adaptive response.

develop from a trichome. This project aims to identify genes involved in very early stages of prickle development. Stage one prickles are defined as!a mass of proliferating cells emerging from the stem epidermis usually growing to a size less than 22 μm in diameter. We hypothesize that trichome initiation genes identified in *Arabidopsis* have similar functions in *Rubus* and may possibly be involved in stage one of prickle development. We have several potential gene candidates, including: *GL1*, *GIS*, *ETC1*, *SIM*, *GL3*, *GL2*, *TRY*, *CPC*, and *EL2*, all of which are involved in the molecular pathway of *Arabidopsis* trichome development. We will subject our gene candidates to functional analysis including *in situ* hybridization, whole mount *in situ* hybridization and RT-PCR to determine their function in *Rubus.*

Examination of *Alligator mississippiensis* Populations in Arkansas for Multiple Paternity

Nicole E. Knox
Faculty Mentor: J.D. Swanson

American alligators may increase the genetic variability of their offspring through a reproductive

development. The gene products PAL 1 and PAL 2 are known to play a role in the lignification pathway, and have been targeted for functional analysis in this study due to their potential role as stop signals in prickle development. These genes have been subjected to functional analysis using *in-situ* hybridization and real-time PCR. These functional analysis studies suggest that *PAL 1*, but not *PAL* 2, plays an important role in initiating prickle lignification. Furthermore the way that prickle lignifications takes place between blackberry and raspberry also differ. This suggests that the study of *PAL 1* in genus *Rubus* could lead to viable information in the process of cell

SERCA expression in coronary arteries, thus giving the cells the capacity to limit intracellular Ca^{2+} levels to protect against the development of coronary artery disease in women. The aims of this study were to investigate: (1) the effect of E2 on PKA, PKG, CaMKII expression, (2) if the kinases influence SERCA expression, and (3) if the known E2-induced increase in SERCA expression is dependent on the E2 receptor. The distal portion of right coronary arteries obtained from female porcine hearts were cut into longitudinal strips and incubated for 24 hours in 1 nM E2, 1 pM E2, and the EtOH solvent for E2. When appropriate, the specific inhibitors for PKA, PKG, and the E2 receptor were added during the incubation period. Antibodies reactive to SERCA2b, PKA, PKG, and CaMKII were used to determine their immunoreactivity in homogenized tissue after the 24 hours of treatment. Our results suggest that E2, independently, increases SERCA2b, PKA, PKG and CaMKII expression. It appears that the E2-induced increase in SERCA2b happens via the E2 receptor and is due to the elevated expression of PKG.

The Development of Genomic Resources in *Rubus*

Madeline Richmond
Faculty Mentor: J.D. Swanson

The genus *Rubus,* which contains raspberry and blackberry plays an integral role in a multi-million dollar produce industry, which is linked to health benefits. The berries from these plants produce ripe, vibrant fruits that contain antioxidants that are thought to improve health by eliminating the body's free radicals. Breeders of these crops face hardships including poor berry quality, pathogens, and climate tolerance. Despite their importance, the genus *Rubus* has few genomic resources available. Our lab at UCA is working to increase these genomic resources. To this end, we have implemented molecular markers for patent infringement, investigated individual gene expression using cDNA libraries, and have recently developed a genomic library in red raspberry, the first in the United States. Each genomic resource aids in developing a more complete understanding of the genetics and genes behind important traits in *Rubus* that could lead to healthcare breakthroughs in the future.

RAPD Markers for Evaluating Paternity in Plants

Aaron Roberds
Faculty Mentor: Richard Noyes

In experimental crosses using hermaphroditic organisms such as plants, unintended progeny may be produced that are the result of self- rather than cross-fertilization. Fortunately, DNA markers can be used to differentiate the two classes of progeny. In this experiment RAPD markers were used to identify the origin of diploid progeny that were produced in a complex sexual diploid and apomictic triploid cross. Eight RAPD markers were used to screen thirty-eight diploid individuals. The presence of parental bands in 15 plants (39%) indicates they are of hybrid origin. The absence of paternal bands in 23 (61%) indicates that they probably resulted from self-fertilization.

Behavioral and Function Analysis of Caf4 in *Saccharomyces cerevisiae.*

Jacob Seiter and Annette Wilkins
Faculty Mentor: Kari Naylor

Mitochondria are organelles that provide the cell with chemical energy in the form of ATP. Mitochondria have a dynamic, branching tubular structure which is maintained by constant fission and fusion. Any imbalance of the fission and fusion processes can alter the mitochondrial structure and result in mitochondrial deficiencies which can lead to diseases such as blindness. Mitochondrial fission requires three proteins: Dnm1, Fis1, and Mdv1. Mdv1 functions as a molecular adapter connecting Fis1 and Dnm1 to form the fission complex. Fis1 is the transmembrane protein that targets the entire complex to the mitochondrial membrane, and Dnm1 ultimately mediates the fission event. A fourth recently identified protein, Caf4, an Mdv1

homolog, also serves as an adapter between Dnm1 and Fis1. Caf4 is not necessary for fission to take place; over-expression of Caf4 blocks fission suggesting that Caf4 is a negative regulator. We hypothesize that Caf4 and Mdv1 switch places in the fission complex depending on if the cell needs to carry out fission to maintain proper mitochondrial structure. Using confocal microscopy we aim to better understand the role Caf4 plays in fission, by observing when Caf4 is on the membrane, and specifically at what point during fission this occurs. For example, if Caf4 is present before the fission event and absent during fission, it will support our hypothesis that Caf4 is a negative regulator of mitochondrial fission.

Exploration of the Role of Gingko Biloba Extract in the Prevention of Prostate Cancer in an Animal Model

Jantzen Slater, Rose Willett, Alexandra Kaelin, Megan Millican, Austin Plumlee, and Emily Simon
Faculty Mentor: Wen Wang and Steven Runge

Introduction
Prostate cancer affects one in every six men in the United States. Our goal is to discover dietary supplements that can prevent prostate cancer. Ginkgo, a commonly used dietary supplement, possesses potent anti-oxidative and anti-inflammatory properties. While these properties could be utilized for reducing the risk of prostate cancer, Ginkgo's role is still unknown. Using a prostate cancer cell model, we have discovered that Ginkgo can selectively inhibit the growth of human prostate cancer. Our goal for this pilot study was to assess the anticancer efficacy of Ginkgo against early stage human prostate cancer cells in an animal model.

Methods
The animal model was established by injecting the early stage human prostate cancer cells, LnCap, to the back of male athymic nude mice. The animals were randomized into three experimental groups including control, pre-treatment, and post-treatment groups. Ginkgo (100mg/kg animal weight) was administrated by intravenous injection two-weeks prior to LnCap injection (pre-treatment group) or two-weeks after LnCap injection (post-treatment group). The

Conclusion
Our preliminary findings demonstrated that Ginkgo post-treatment promoted cancer growth in the LnCap prostate cancer animal model, while Ginkgo pre-treatment shown some level of inhibitory effect on the prostate cancer cell growth. Our results may suggest a significant clinical impact in that consuming Ginkgo may promote cancer growth in patients diagnosed with prostate cancer. These current findings warrant further pre-clinical studies and the clinical investigation on the impact of Gingko consumption and prostate cancer development and progression.

Aspects of the Reproductive Biology of Shortnose (*Lepisosteus platostomus)* and Spotted (*Lepisosteus oculatus)* Gar in the Fourche LaFave River

Evan Soper, Robert Wade, and Tommy Inebnit
Faculty Mentor: Reid Adams

Historically, gars were often thought of as worthless and destructive predators, making them less popular for biological study. As such, gar life history and reproductive biology are less understood relative to other fishes, and data comparing the biology of different gar species from the same drainage are lacking. We collected reproductive data on two similar-sized gar species for comparative purposes and to gather information on the understudied shortnose gar. Shortnose and spotted gar were collected from the Fourche LaFave River between February and July of 2007. Each gar was dissected and had its gonads removed and preserved in 10% formalin. Each ovary was weighed and a subsample of 15% of that mass was removed. From that subsample, each egg was counted and the total fecundity was extrapolated. Thirty shortnose gar (53-69 cm total length) and thirty-four spotted gar (54-79 cm total length) were examined, and we found that total fecundity ranged from 3,773 to 19,613 eggs and 1,387 to 21,827 eggs, respectively. We found strong asymmetry in mass and egg count in ovaries of both species, where the left ovary was larger and had more eggs. For both species, there was a positive correlation between total length and total fecundity. Preliminary analyses indicate these two sympatric gar species have a similar pattern of total fecundity/body size relationship. Further, total fecundity estimates of our Arkansas population of shortnose gar are comparable to shortnose gar studied in Illinois. We are continuing to analyze other reproductive data (e.g., GSI, spawning season, and egg diameter).

Coevolutionary Patterns of a Threatened, Troglomorphic Fish and its Acanthocephalan Parasites

Sarah Vestal
Faculty Mentor: David E. Starkey

Phylogeographic analyses of parasites are extremely limited in number and scope, though their usefulness has shown great potential. Comparative studies of parasites and hosts can be useful for illuminating underlying mechanisms of speciation, dispersal, gene flow, effective population size, and evolutionary patterns that might otherwise remain obscure. Grotto sculpin are unique populations of banded sculpin (*Cottus carolinae*) endemic to cave systems underlying Perry County, Missouri. These troglomorphic (cave-adapted) fish are state-threatened and a Federal Endangered Species Candidate. Burr et al. (2001) examined fish from all caves grotto sculpin inhabit and found significant morphological differences between epigean (surface) and hypogean (cave) populations, including smaller eyes, reduced number of pelvic fin rays, reduced pigmentation, and enlarged cephalic lateralis pores. Prior genetic work was unable to fully resolve the evolutionary relationships among sculpin inhabiting cave, spring branch, and surface streams, suggesting that data from a co-evolved species could be beneficial. For this study, we are investigating the population ecology, divergence, and structure in the Acanthocephalan parasites of grotto sculpin in an effort to elucidate otherwise cryptic dispersal patterns. To examine the frequency of Acanthocephalan parasitism, digestive tracts were removed from preserved sculpin. Worms were extracted and enumerated by sampling locality. For our genetic study, we are employing a multi

important food resources of spotted gar were fish (74%), crayfish (26%), aquatic insects (11%), and terrestrial insects (9%). Similarly, fish (59%) was the most commonly occurring food item in shortnose gar, but they consumed aquatic (24%) and terrestrial (35%) insects more frequently than spotted gar. Additionally, shortnose gar utilized amphibians (17%) as prey. Our analyses

given access to manually crushed leaves of *Heliotropium indicum*, a boraginaceous plant known to contain the pyrrolizidine alkaloid lycopsamine. The four egg categories will be presented to the parasitoid wasp *Trichogramma pretiosum* and two egg predators, the adult lady beetle *Coleomegilla maculata* and the larvae of the green lacewing *Chrysoperla rufilabris*. A field test will also be conducted with each of the four egg categories placed on native milkweed in the Conway, Arkansas area during the spring migration of monarchs. Though several studies have demonstrated chemical defense in insect eggs, this study is unique in its potential for showing a synergistic chemical defense system.

CHEMISTRY

! K"

! M

! J

COMPUTER SCIENCE

Volatile Data Predictive Analysis with Interval Methods

Guanchen Chen
Faculty Mentor: Chenyi Hu

Massive data filled in our world usually do not provide us meaningful information explicitly. The objective of this study is to investigate and develop interval computing methods that analyze volatile dataset, extract useful knowledge, and make quality predication.

In this study, we develop interval computing approaches that improve the quality of predictions, especially for volatile datasets. Specifically, we investigate dataset interval representation, spectrum analysis for interval time series, window size selection and radius adjustment in rolling interval least squares (RILS). Applying them in predicting annual stock market with real world macroeconomic data from 1930-2004, we justified the strategy and results published recently. Our integrated interval forecast algorithm can be useful in predictive analysis for other real world volatile datasets.

Intelligent traffic lighting system

Matthew Johnson and Thomas Winters
Faculty Mentor: Vamsi Paruchuri

The traffic lighting systems used to regulate today's trafficking system, although an integral part of the system, are inefficient by today's standards. This inefficiency contributes to the increased cost of transportation while also contributing to the levels of pollution emitted as a result of human transportation needs. In addition to these detriments, this inefficiency also wastes the traveler's time. In this project, we propose and study a new method for the regulation of traffic using intelligent traffic lighting system. This method involves the development of communication protocols for sharing information between individual traffic lights and the development of an algorithm for the intelligent operation of the lights as a result of the data being shared. Variables such as traffic flow changes correlated with time of day will be analyzed to develop this new algorithm in an attempt to reduce the amount of time any given traveler spends in transit.

Protein Local 3D Structure Prediction by Super Granule Support Vector Machines (SGSVMs)

Matthew Johnson
Faculty Mentor: Bernard Chen

Understanding the sequence-to-structure relationship is a central task in Bioinformatics research. Adequate knowledge about this relationship can potentially improve accuracy for local protein structure prediction. One of approaches for protein local structure prediction uses the conventional clustering algorithms to capture the sequence-to-structure relationship. The cluster membership function defined by conventional clustering algorithms may not reveal he complex nonlinear relationship adequately. Compared with the conventional clustering algorithms, Support Vector Machine (SVM) can capture the nonlinear sequence-to-structure relationship by mapping the input space into another higher dimensional feature space. However, SVM is not favorable for huge datasets including millions of samples. Therefore, we propose a novel computational model called Super Granule Support Vector Machines (SGSVMs). Taking advantage of both theory of granular computing and advanced statistical learning methodology, SGSVMs are built specifically for each information granule partitioned intelligently by the clustering algorithm. This feature makes learning tasks for each SGSVM more specific and simpler. SGSVMs modeled for each granule can be easily parallelized so that SGSVMs can be used to handle complex classification problems for huge datasets. The prediction accuracy for local protein 3D structure is over 70%, which indicates that the generalization power for SGSVMs is strong enough to recognize the complicated pattern of sequence-to-structure relationships.

P3HR: Privacy-aware Portable Personal Health Records using Smart Cards

Pavan Roy Marupally
Faculty Mentor: Vamsi Paruchuri

Personal health records (PHRs) offer significant potential to stimulate transformational changes in health care delivery and self-care by patients. There is a gap between today's personal health records (PHRs) and what patients say they want and need from this electronic tool for managing their health information. Current barriers to PHR adoption among patients include cost, concerns that information is not protected or private, inconvenience, design shortcomings, and the inability to share information across hospitals/organizations. We propose a novel architecture to bridge the gap based on Privacy Preserving Portable Health Record (P3HR), a device that incorporates a smart card into a USB flash drive which provides encrypted flash memory for secure mobile data storage. The salient features of the proposed Privacy Preserving Portable Health Record (P3HR) include: strong multifactor authentication using biometrics, public key infrastructure to verify the credentials of the applicants, SSL based authentication protocol suite for authorization and secure online updates, local backup to store patient data which ensures that

the patient will have access to data in case of P3HR theft, lost device, hardware failure, software failure or a Computer virus.

A New Rate-Complexity Model for H.264/AVC Video Rate Control

Xin Yin, Ling Tian

reflective of their contribution to the project while at the same time avoiding the significant managerial overhead such an undertaking generally requires. Dr. Coppit proposes one solution to the challenge: the adaptation of the web-based task management system Issue-Tracker for managing and evaluating a semester-long project involving the entire software engineering class. In this paper we attempt to evaluate the effectiveness and fairness of Issue-Tracker in assessing the individual performance of students participating in such a software engineering group project.

MATHEMATICS

fluid dynamics simulations tools to a web-based interface. Students can then use these tools within formal educational settings such as high school science classes and for informal educational settings such as science museums and high school science fair projects. Three distinct tools were developed – the parameter input interface, the computational solver and the visualization interface. The parameter input interface gave the investigator the ability to choose the test case and the physical parameters, such as the Mach number and the angle of attack. The computational solver solved the governing equations via standard mathematical algorithms – in particular, the inviscid compressible Euler equations. The visualization interface showed the variables as they evolved through the solution process within the two-dimensional domain. These tools were developed via JAVA and Windows-based executables and are available online at

PHYSICS
AND
ASTRONOMY

Verification of Rutherford Scattering (atomic number, energy and angular dependence)

Saroj Adhikari and Caroline Davis
Faculty Mentors: Rahul Mehta and Stephen R. Addison

Rutherford scattering is the elastic coulomb scattering of the incident beam when a target nucleus is bombarded by a beam of charged particles. Early experiments on the scattering of "-particles led to the discovery of the nuclear structure. To verify the dependence of the scattering rate on the atomic number, energy, and scattering angle of the incident particle beam in the Rutherford formula, we bombarded singly ionized Helium ($_2He^+$) beams at various targets, and measured the scattering energies and rates. First, we investigate the linearity of the scattering rate with the square of the atomic numbers to verify the atomic number dependence as predicted by the Rutherford formula. For this, we used $_2He^+$ beams with incident energy of 1.5 MeV at $_{22}Ti$, $_{26}Fe$, $_{29}Cu$, $_{47}Ag$, and $_{79}Au$ targets. We also investigate the inverse square dependence of the scattering rate on the kinetic energies of the incident He

Since the Troposphere is considered to contain mostly idea gases, use of the idea gas law, heat capacities, and the knowledge that our atmosphere is approximately adiabatic gives a dry adiabatic lapse rate similar to our temperature verses altitude results. For our pressure verses altitude results we assumed that temperature is independent of altitude and that our atmosphere was an ideal gas to compare our results to the barometric equation. In the future other sensors will be sent up to gather more data with the Loggerpro system. Payload information and flight data will be presented.

Bessel's Flames of Glory

Shane McNew
Faculty Mentor: William V. Slaton

The Ruben's Tube is a popular physics demonstration that dramatically illustrates one-dimensional standing waves. The demo consists of a long tube closed on one end and the other driven with speaker. The tube is filled with natural gas that exits through small evenly spaced holes along the top of the tube. The gas exiting the holes is lit and the heights and color of the flames are an indication of the speaker-driven standing wave that appears in the tube. Regions where the standing wave acoustic velocity is large are illustrated by tall yellow flames, whereas regions with low acoustic velocity have short bright blue flames. This variation in flame height is due to the Bernoulli effect. This research project explored the theoretical and experimental design, construction and testing of two-dimensional flame pans: square and circular. The square geometry should support standing waves similar to the Ruben's tube in both directions and so the flame patterns will be lines of yellow flames in a grid pattern. The circular geometry should support standing waves that have a radial and polar dependence with corresponding flame patterns. Theoretical predictions of the resonance modes in the two-dimensional flame pans will be compared to photographs of the flame pans in operation.

Electro-dynamic Loudspeaker Parameter Measurements

Eric Sellers
Faculty Mentor: William V. Slaton

The electro-dynamic parameters of loudspeakers are a set of defining characteristics that show how a speaker will perform under a variety of settings and placements. The parameters are best used as quality control for a production facility and possibly for future placement of the speaker. A loudspeaker can be model as a driven damped mass-spring system with an appropriate ordinary differential equation. However, to find out the exact spring constant, moving mass, damping factors, and other properties of the system we would have to destroy the speaker. Since destroying the speaker isn't an option, we need a non-destructive way to find out the basic properties of the speaker; therefore, we can run other tests to obtain the parameters that we need. These parameters were found for a 3 inch and 10 inch speaker. The set of parameters for each speaker were found using different methods so that all the parameters could be found.

theoretical cross sections were calculated for each target, which depends on the atomic numbers of the source & targets, and on the scattering angle. The experimental thicknesses of the targets were then calculated. The thickness of the gold target was found to be 14×10^{17} µg/cm^2.

Lori Isom[!M[!8

Luis R. Suazo[M!

Madeline Richmond[7J

Maggie Block[!K

Marcus Swope[K7

Martin Sharum[!8

Matthew Johnson[!Q[KL

Megan Millican[70

Meghan Thompson[7!

Melissa Kelley[!K[!8[!0

Michael C. Kitchens[KP[ML

Nancy J. Rusch[7!

Nate Jones[7K

Nathan Walsh[KQ

Nicole E. Knox[7K

Nolan Carter[!M[!8

Olabode Sule[M!

Patrick Carmack[K8

Patrick Desrochers[0[!K[!J

Patrick Kells[KQ

Paul Young[K!

Pavan Roy Marupally[KL[K!

Rahul Mehta[KP[ML[M!

Ram Pandey[7M

Reid Adams[7P[7Q

Richard Noyes[7L[7J

Richard Tarkka[!K

Richard Walker[7Q

Robert Wade[7P

Rose Willett[70

Ross Gray[7L

Sarah Stoeckel[!8

Sarah Vestal[7Q

Saroj Adhikari[KP

Shane McNew[M7

Shawn Brummett[J

Sinan Kockara[K!

Stacy Baldwin[8

Stephen R. Addison[KP[KQ[ML[M!

Steven Runge[0[77[70

Susan Lantz[8

Syed Ali[8

Tara Havens[77

Tatum J. Branaman[J

Terri Teague-Ross[8

Thomas Winters[!Q

Tommie Reddick[8

Tommy Inebnit[7P[7Q

Tramaine Shepard[7M

Tyler Staten[!0

Vamsi Paruchuri[!Q[KL

Vincent Yip[K!

Weijiu Liu[K8

Wen Wang[70