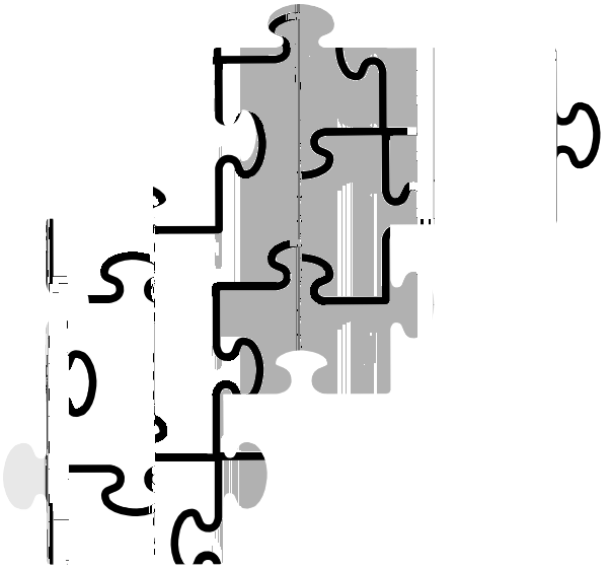
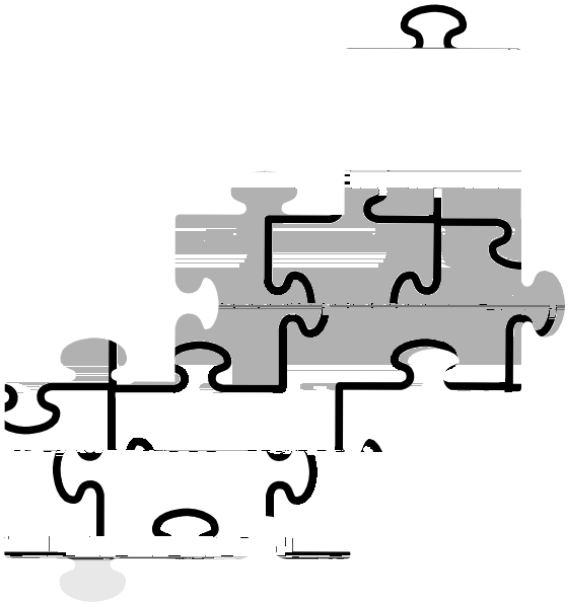
Table of Contents

Department of Biology	7
Department of Chemistry	23
Department of Computer Science	33
Department of Geography	39
Department of Mathematics	43
Department of Physics & Astronomy	47



Department of Biology



Determinants of Dispersal Patterns in the Stream Salamander, Desmognathus brimleyorum

Amber L. Anderson
Faculty Mentor: Matthew E. Gifford

Dispersal is a fundamental ecological and evolutionary process. An individual's propensity to disperse is dependent on a variety of both extrinsic and intrinsic factors. Variation in local population density can have profound effects

Stonedam Creek Water Quality Survey: Site-Specifc Chemical Analyses of Urban Conway Stormwater Runoff

David Black
Faculty Mentor: Sally Entrekin

Water quality monitoring is essential for analyzing, predicting, and rectifying the adverse effects of human activities within watersheds. Watersheds are often exposed to runoff containing both point and nonpoint source pollutants that alter chemical and biological conditions of the receiving streams. This exposure is intensiýed by urbanization and other human modiýcations to natural areas, resulting in widespread occurrences of phenomena such as eutrophication and acidiýcation. Within this context, earlier studies of the Stonedam Creek tributary of Lake Conway have indicated that Stonedam Creek is likely experiencing water quality problems, but there is a need for additional data, particularly site-speciýc analyses of the chemical composition of local runoff. Building on this need, this study quantiýed common analytes found in stormwater runoff from three urbanized areas connected to Stonedam. The three sampling sites consisted of a section of Stonedam that þows through the UCA campus, an apartment complex downstream of UCA, and a downtown Conway urban drainage basin that connects to Stonedam. Runoff

OCT4 and NANOG Expression in Human Fibroblast with Short Telomeres

Ethan M Clement
Faculty Mentor: Calin Marian

Cellular senescence denotes the biological aging of the cell due in part to the shortening of telomeres. In somatic cells, during normal chromosomal replication, the lagging DNA strand is not continuously replicated like the leading strand. This phenomenon, known as the end replication problem, leads to gradual telomere shortening after each cell division. In some normal actively proliferating tissues (such as skin, gut lining, hair follicle, etc.) as well as majority of cancer cells the end replication problem is solved by telomerase, a specialized enzyme that has the capacity to add telomere repeats to the end of chromosomes. Telomerase has two components, the RNA template (hTR) and the reverse transcriptase (hTERT). The re-activation of telomerase has been widely regarded as playing a vital role in the immortality of cancerous cells. Recently, telomerase inhibitor drugs have been shown to induce critical telomere shortening in various cancer types. Our major interest is to investigate the impact of these critically short telomeres on cancer cell and human ýbroblast functions, speciýcally on self-renewal pathways mediated by OCT4 and NANOG transcription factors.

Adaptive Differentiation in Morphology after Colonization of Novel Environments

Ian T. Clifton, and Jeremy D. Chamberlain
Faculty Mentor: Matthew E. Gifford

When a species colonizes a new environment there are likely to be phenotypic changes associated with the colonization. These phenotypic changes are driven by novel environmental pressures unique to the newly inhabited areas. We studied the response of diamond-backed watersnake (Nerodia rhombifer) to colonization of novel environments with different prey regimes than the ñancestralò environments. Feeding morphology is likely to be inþuenced by prey size, especially in gape-limited predators where selection is limited in its ability to act. While N. rhombifer typically occupy natural areas such as rivers, sloughs, and oxbows, they have also colonized man-made ýsh farms. These farms tend to specialize in the types of ýsh they produce with some farms raising large-bodied ýsh and others raising small-bodied ýsh. Our study suggests, counter to expectations, that while differences exist between populations prey size has no predictable inþuence on relative size of feeding structures. We provide three potential explanations for the absence of a predictable pattern among populations.

OVX-Induced Reduction of Mechanical Strength in the Tibias of Young Mice

Charles Deckard
Faculty Mentor: Brent Hill

Osteoporosis is characterized by reduced bone strength and is often associated with postmenopausal women and age-related estrogen deýciencies. However, there are conditions when women experience depleted estrogen levels prior to menopause, for example, it is common for women to undergo ovariectomy (OVX) surgeries as a treatment or preventative measure against ovarian cancers and diseases; also, individuals born with aromatase deýciencies lack the ability to produce adequate levels of estrogen. Previous data suggests estrogen deýciencies in pre-menopausal women are linked to reduced bone volume and mineral density, but little research

The Effects of Two Gray of Radiation on Mice Aorta

Quinton Kaufman
Faculty Mentor: Brent Hill

In todays era one of the leading causes of death is cardio vascular disease. There has been an association with radiation making a person more at risk for heart disease via high blood pressure, yet the cause at this point has been undetermined. We suspect this is due to radiation interfering with various calcium transporters inside of the cell. In this study rats were obtained that had been exposed to 2 Gray of radiation, which was meant to mimic space radiation, but is similar to the radiation that is absorbed during medical procedures such as an abdominal CT scan. A western blot analysis was performed on the smooth muscle cells of the aorta in order to determine the effects of the radiation. Western blot is a procedure which measures the levels of protein in a sample. The protein chosen for the focus of the research is SERCA (Sarco/endoplasmic reticulum calcium ATPase). This protein is one of the main proteins that removes calcium from the cytosol of the cell and stores it in the sarcoplasmic reticulum where it is held to prevent its accumulation in the cytosol. If left unchecked, accumulation in the cytosol would cause an increase in blood pressure.

E-cadherin Expression in Prostate Cancer Cells is Modulated by Adhesion Status

John A. Martindale
Faculty Mentor: Calin O. Marian

Imetelstat is currently being evaluated in clinical trials as a treatment against some of the most lethal forms of cancer. Imetelstat displays a two-pronged attack on cancer cells. It acts as a competitive inhibitor of telomerase, a cornerstone enzyme in cancer cells; telomerase inhibition leads to progressive telomere shortening and ultimately apoptotic death. A secondary attribute of imetelstat is the morphological affects it has on cells rendering them incapable of adhesion to a substrate. This lack of adhesion has been hypothesized to prevent the transition of cancerous cells from benign to metastatic. Though the telomerase inhibitor function of imetelstat was well studied, the signiýcance of adhesion loss is largely unknown. This process must be fully understood before imetelstat can be approved as an anti-cancer drug.

Some studies have been conducted on the loss of adhesion phenomenon to establish a relationship between imetelstat and speciýc cytoskeleton components. A recent study suggested a link between the loss of adhesion and E-cadherin, a transmembrane glycoprotein that plays an important role in cell to cell adhesion. This study determined that treatment with imetelstat correlated with a down-regulation of E-cadherin. However, E-cadherin expression may change as a result of lack of attachment to the substrate. Through our testing we hope to determine whether the down-regulation of E-cadherin is a direct result of the drug or simply a secondary response to growth in suspension. By performing tests which analyze E-cadherin levels in three prostate cancer cell lines grown in suspension we hope of establishing a mechanism by which lack of adhesion takes place.

Role of Cadherin 18

Scotty McKay
Faculty Mentor: Calin O. Marian

Cadherins are calcium dependent cell adhesion proteins that are generally located on the cell membrane. Type 1 Cadherins, which are much more well-known than type 2, play a large role in cell-cell adhesion. Type 2 Cadherins, however, lack the HAV coding region present in type 1 Cadherins which plays a critical role in the cells adhesion functions. Prior research has suggested that type 2 Cadherins may play major roles in cancer development as well as early morphogenesis, however this has yet to be conýrmed. By learning more about the roles that these different type 2 cadherins play in the body, we could bring about very important discoveries involving bodily processes and disease development. The protein that we are speciýcally interested in is a type 2 cadherin known as cadherin 18. We will begin this project by looking at the cellular distribution of cadherin 18 in human embryonic kidney cells. These cells were engineered to over-express this protein as well as GFP tag. We will then examine how these proteins interact with other proteins using techniques such as immunocytochemistry, immunoprecipitation, and mass spectroscopy.

A Novel Approach to Quantifying Melanism in the Red-Eared Slider Turtle (Trachemys scripta elegans)

Lori H. Monday, Alex Ano
Faculty Mentor: W.B. Cash

A common technique used for scoring melanism in freshwater turtles uses a subjective quantiýcation scale based on 0 (no

The Effects of Glucose on the Lifespan of Long-lived Caenorhabditis elegans under Dietary Restriction

Melina Norris and Caitlyn Barthol
Faculty Mentor: Mindy Farris

Diets that are high in glucose have been associated with obesity, type 2 diabetes and cardiovascular diseases, among the leading causes of death in the US. Dietary restriction (DR), on the other hand, has been shown to extend lifespan in diverse organisms,

Changes in Land Use and Fish Assemblages in Four Ozark Highland Streams over Four Decades

Heather A. Saco

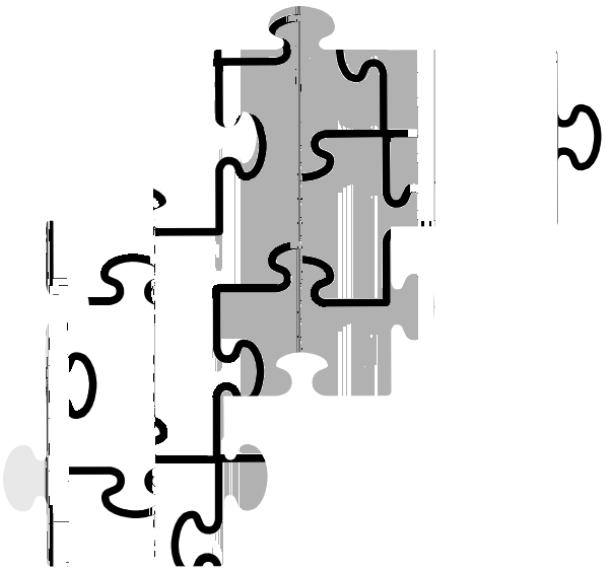
Faculty Mentors: Ginny L. Adams and S. Reid Adams

Long-term studies evaluating land use and ýsh assemblage structure are often lacking but necessary to further understanding of anthropogenic inþuence on local ýsh assemblages. Land use is known to inþuence aquatic ecosystems and the aquatic biota. Sylamore, Piney, Janeôs and Big creeks are in the White River drainage in north central Arkansas. During summers 2014 and 2015, we sampled ýshes at 39 sites across the four drainages. Sites, dates, and sampling methodology were consistent with

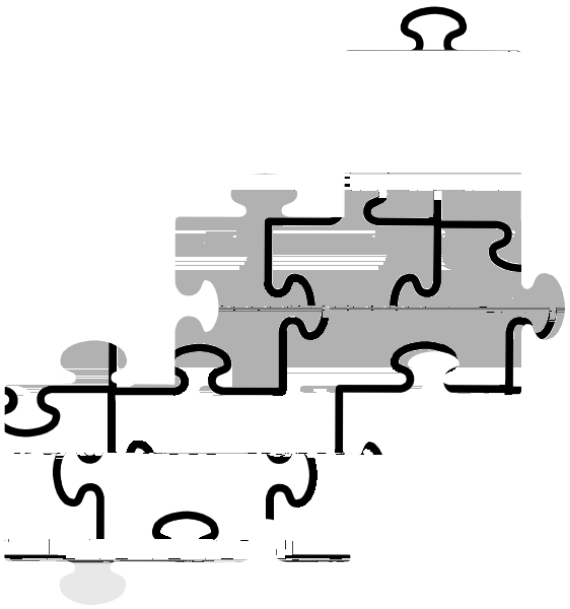
Using Genomics Approaches to Study Formation of

Assessing Misconceptions of Evolution Among Students Enrolled in Freshman Biology Courses at the University of Central Arkansas

Shonqualla West
Faculty Mentor: Mark Bland



Department of Chemistry



Iron Heteroscorpionate Complexes

Kat Demaree
Faculty Mentor: Patrick Desrochers

Scorpionates are aggressive tridentate chelates with broad applications encompassing nearly every metal ion on the periodic table. Heteroscorpionates (where one of the three nitrogen donor groups is varied) introduce interesting asymmetry in the complexes prepared. The heteroscorpionate Tp' (Inorg. Chem. 2011, p. 1931) was developed in our lab following a simple pyrazole-for-triazole substitution strategy. Tp' represents the scorpionate chelate hydrobenzotriazolyl-bis(3,5-dimethylpyrazolyl)borate, a monoanion. For the present work, new iron complexes, $(Tp')_2Fe^{n+}$, will be described. The iron(II) form (n=0) and iron(III) form (n=1, as its BF_4^- salt) of the ligand were synthesized, both of which have been characterized by paramagnetic ^{11}B NMR as well as through infrared and electronic spectroscopies. The orange iron(II) form has been oxidized chemically to the deep purple iron(III) form, and both have been separated into cis and trans isomers. These reactions demonstrate the utility of this scorpionate with earlier transition metals—presently only late metals have been employed (nickel and copper) with Tp'. Iron and still earlier metal ions introduce interesting redox and magnetic properties.

Synthesis of Amino Acid Radical Precursors

Candice Foscue and Daniel Shrum
Faculty Mentor: K. Nolan Carter

Biomolecules are subject to damage by reactive oxygen species such as hydroxyl radical. This process has been implicated in aging and disease. The reaction of hydroxyl radical with proteins is complex since hydroxyl radical is non-speciýc and can attack many sites within the polypeptide chain. Due to this non-speciýcity, studying the role played by speciýc radical intermediates in protein damage is difýcult. To facilitate the study of this process, we are synthesizing compounds that produce speciýc amino acid radicals upon exposure to UV light. Whereas hydroxyl radical produces numerous radicals from a given amino acid, this approach enables selective generation and study of a single intermediate. The monomeric amino acid radicals produced from these precursor compounds are intended to serve as models for the radicals formed within a protein Studies toward the synthesis of these photolabile precursor compounds will be described.

Microwave-assisted synthesis of KTp* and the corresponding Ni Complex as an Undergraduate Inorganic Chemistry Experiment

Emily Helm
Faculty Mentor: Richard Tarkka

Scorpionate ligands, such as hydrotris(3,5-dimethylpyrazolyle)borate, (Tp*), are very common in the inorganic chemistry literature, but are not usually made or used in undergraduate level inorganic chemistry teaching labs. This is probably because the synthesis of KTp* from KBH_4 and 3,5-dimethylpyrazole is prohibitively time consuming. We have developed a simple procedure for synthesizing a KTp* using a microwave technique. The simplicity of the technique allows for the synthesis KTp*, along with the preparation of the two ligand product, $(Tp^*)_2Ni$, in about one hour forty minutes. In a typical three-hour teaching lab block, this allows the complex to be characterized by ^{11}B NMR spectroscopy or other techniques, such as UV-Vis spectroscopy. This technique can be incorporated into current curricula to further the knowledge of scorpionate ligands.

Surface Enhanced RAMAN Spectroscopy on Optimized AgAu Nanoparticles

Taylor Huntington
Faculty Mentor(s): Donald Perry and Jingyi Chen

This laboratory is investigating surface chemistry of hollow nanoparticles constructed from Ag and Au. The goal of this investigation is to develop optimal AgAu nanoparticles for 633 nm surface-enhanced RAMAN and IR spectroscopy (SERS/SEIRA). The formation of the hollow nanoparticles is through the galvanic replacement reaction. The changes of localized surface plasmon resonance from solid to hollow nanoparticles are monitored by UV-vis spectroscopy. Different amounts of Au exhibited different wavelengths in the UV-vis. The hollow nanoparticles are subjected to one of two methods. The initial reaction between the hollow AgAu nanoparticles and rhodamine in acetone is investigated through SERS mentioned above, and multiple layers of rhodamine solution on the substrate are monitored using SEIRA.

University of Central Arkansas ACS student chapter: Integral component of our department

Synthesis and Characterization of Novel Fluoro-bridged Copper(II) Complexes

Bryce Johnson
Faculty Mentor: Lei Yang

The þuorinated organic compounds are very attractive in pharmaceutical and agrochemical disciplines due to their unique thermal stability, solubility and reactivity, but the insertion of þuorine atoms remains as a great challenge. Recently, þuorination of organic substrates mediated by copper catalysts received considerable attention because of the regioselectivity, less harsh reaction conditions and better efýciency. Research results have indicated the high-valent copper-þuoride intermediates could be involved in the catalytic process. In our effort to better understand the possible catalytic mechanism, we used Cu(II) and Cu(I) complexes supported by a simple diamine ligand to react with þuorine reagents. Interesting þuoro-bridged copper clusters were isolated and characterized by X-ray crystallography, UV-vis, EPR and FT-IR. The reactivity of these clusters and possible intermediates of the reactions are currently under investigation.

Comparison of Experimental Aerosol Optical Properties to Mie Scattering Theory of Multi-component Aerosols

Justin Land, Amanda Jarman, and Haley Kay
Faculty Mentor: Kristin S. Dooley

Accurate measurements of the optical properties of aerosols are needed in order to quantify the effects that aerosols have on climate change. While Mie scattering theory is capable of accurately modeling the interaction of light with spherical, single-component, non-absorbing aerosols, various methods must be used to correct the calculation when multi-component, absorbing aerosols are modeled. Cavity Ring-Down Spectroscopy (CRDS) is an optical absorption technique that is ideal for measuring extinction coefýcients as well as scattering and absorption parameters for atmospheric aerosols. After characterization of the pulsed CRDS system at λ = 532 nm with various sizes of polystyrene spheres, optical data from laboratory generated multi-component aerosols are compared with predicted Mie scattering modeling of aerosols. Various correction techniques are applied to the calculation to determine ways to more accurately model multi-component aerosols. Because most atmospheric aerosols are multi-component, a better understanding of how to theoretically treat them will lead to more accurate models of real-world aerosol interaction with light.

3DUWQHU 3(3

Impact Analysis from the Incorporation of a Placement Exam Toward Student Success in Freshman-level Chemistry Courses

Jordan Moore, Jaimi Franklin, Haylee Barnes
Faculty Mentor: Faith Yarberry

In 2012, it was reported that there was a direct correlation between student success rates in freshman-level college chemistry

The Effect of Retinoid Receptor Agonists on K562 Cellular Adhesion, Proliferation, and α5β1 Integrin Cell Surface Expression

Raynin Phomakay and Madison Lee
Faculty Mentor: Melissa Kelley

Establishment and maintenance of proper immunity requires a precise balance between cellular adhesion and proliferation. A disruption in either event culminates in a variety of pathologies encompassing immunosuppression, auto immunity, and cancer. Retinoids, profoundly affect immune function by mediating cellular adhesion and proliferation in certain leukocytes. Retinoids, by binding to retinoid receptors (RARs or RXRs), modify the expression of a variety of signaling proteins involved in immune cell proliferation and adhesion including, integrins. Integrins are a family of transmembrane heterodimeric receptors consisting of non-covalently linked Ŭ and ɓ subunits that are considered to be the principle receptors involved in attachment to the extracellular matrix and provide adhesive interactions that control cellular proliferation. Currently, the contributions by retinoids in immune cell adhesion and proliferation have been independently examined; however, in retinoid responsive immune cell lines there appears to be a potential synergism between cellular adhesion and proliferation, which may be mediated through integrins, speciýcally the Ŭ5ɓ1 subset. In this study, the l ɣ m M ʌ ɜ M N ˬ ˬ f ɕ m ʊ Į m ʊ ɹ ʌ ʊ ɕ S N ˬ ˬ ɕ l D

Calmodulin Induced Conformational Changes in Intrinsically Disordered Protein Regions

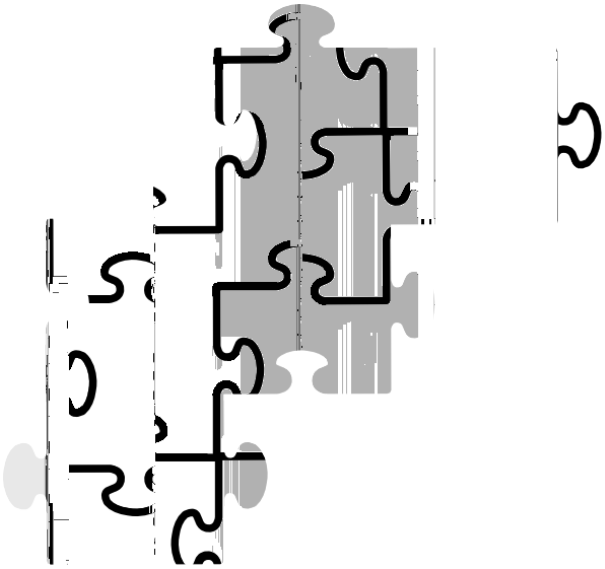
Amber D. Rolland
Faculty Mentor: Tori Dunlap

Calmodulin (CaM) is a calcium-sensing protein that plays a critical role in many signaling pathways, regulating enzyme activity according to calcium concentration þuctuations. It has approximately 300 known ligands and is involved in many critical processes, such as smooth muscle contraction, intracellular movement, memory, and metabolism. Alterations in CaM regulation contribute to multiple disease states, such as Alzheimer's disease, Parkinson's disease, and Long QT syndrome. CaM can bind up to four calcium ions, inducing a conformational change that exposes hydrophobic regions which can then bind to a variety of targets. CaM can also bind to regions known as IQ motifs in the absence of calcium. Often the CaM binding region of a protein is disordered and becomes Ŭ-helical upon CaM binding. Calcineurin (CaN) is a ser/thr phosphatase that is activated by calmodulin, and its CaM binding region undergoes a disorder to Ŭ-helix transition upon CaM binding. Previously published data have shown that disordered residues in the regulatory domain of CaN, outside of the CaM binding region, also gain Ŭ-helical structure upon binding CaM and help to remove CaN's autoinhibitory domain, thus activating the phosphatase. It is unknown if CaM also induces order outside of its direct binding region with other ligands. As preliminary work we utilize limited protease digestion and

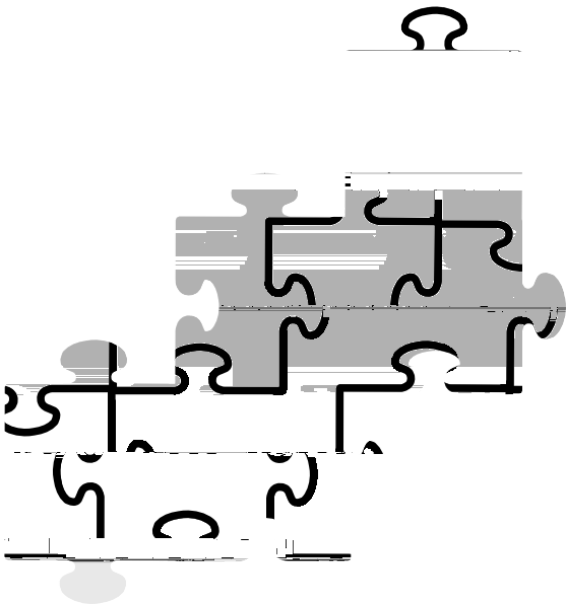
Differences in Water Types in Wells and Springs of the Ozark Plateaus in Northern Arkansas

Samantha R. Wacaster, Kristen E. Barré
Faculty Mentors: Kristin S. Dooley, Matthew H. Connolly
Katherine J. Knierim, U.S. Geological Survey, Lower Mississippi-Gulf Water Science Center, Little Rock, Arkansas

Physical (pH, temperature, conductance) and geochemical (major ions) characteristics of groundwater are used to deýne water types for aquifers within varying geologic regions. Water type can provide hydrogeologic information, such as differences in



Department of Computer Science



Rate Control for H.265/HEVC Video Compression

Joe Hilton, Reese Childers
Faculty Mentor: Yu Sun

The rapid increasing demand of HDTV and next generation Ultra-HDVT has stimulate the development of a new video coding standard, called ñHigh Efýciency Video Coding (HEVC)/H.265ò. However, while the compression methods have improved, the current rate control strategies are developed based its predecessor for H.264/AVC. In this research, we conduct rate control research for HEVC/H.265. Our objective is to develop a new rate controller that will efýciently control the encoding bitrate to meet the channel bandwidth, while obtaining the best available encoding quality. Our proposed rate controller uses an approach that calculates the target bitrate without using a buffer. This is accomplished by calculating the target bitrate through an improved initial target bit estimation, then using a Proportional-Integral-Derivative (PID) bit controller to adjust encoding bitrates. These improvements allow us to remove the buffer, which has been used in traditional rate control algorithms. Removing the buffer will effectively reduce encoding delay and thus improve real time response. To demonstrate the performance of our algorithm, we will compare it to the rate control algorithm adopted by HEVC/H.265.

Complex Event Processing with Esper on Taxi Trajectory Data

Jayalakshmi Kari
Faculty Mentor: Victor S. Sheng

Complex Event Processing (CEP) is being used in business organizations, government organization worldwide. Now a days CEP is mainly used for commercial purpose. There are lot of technologies in place which gives clear idea of what is happening in their business now. But CEP does analyses past data and gives results which would be helpful to improve one's business on large scale. In this Paper, I focus my learning on analyzing Taxi Trajectory data to draw conclusions such as 1)What is the Peak time 2) Which place does have more visits 3)What is the critical time? In this context Critical Time means when taxis are idle for more time. To work on this paper, I have chosen ESPER open source CEP tool. Implementation language is Java 1.7. Operating System used for this project is Linux.

Using Machine Learning to Catch Unexpected Situations in Complex Event Processing

Sertan Kaya
Faculty Mentor: Victor S. Sheng

The data from multiple sources are gathered which are interpreted more complex circumstances. This creates event pools which does not refer any meaning by themselves. Each event can be independent from each other or it can have a relationship with another event. Each event includes relevant and irrelevant actors. In addition, each event consists of action and reaction as well. Event is supposed to have a starting point and an ending point. The deýnition of an event can be expanded by the following example.

For instance, a customer books an airline ticket. When the customer gets in the airport which is an event, a security welcomes him where the security is an irrelevant actor, whereas relevant actor is the customer. When the customer checks in, the ofýcer becomes irrelevant other, whereas the customer is relevant actor. All these are called actions, but the reaction does not exist to respond these actions. During the security checking, there is a starting point and ending point. Thus, this is called an event. Check in process is also considered as an event. In case of the cancel of a þight, customers get frustrated. Thus, customers respond this cancellation by their reaction. This is an example of unexpected situation where the reaction arises.

In this CEP project, our goal is to identify events by deýning particular rules, and then catch unexpected situations during the complex event processing. Furthermore, by using deýned rules, train the machine learning system and expect the system predict and catch unexpected situations.

Educational Robot: LEGO Mindstorm EV3

Min Ji Kim, Yusei Harada
Faculty Mentor: Yu Sun

Nowadays robots for kids are one of the most popular products on the market. Robots with high-end technical features such as app controlling, visual sensors, and voice command will entertain, engage, and inspire kids to learn science and engineering. In this project, we investigate the educational robot –LEGO Mindstorms EV3 by shaping it to different models and building the program using its own sensors and motors. Within this project, our goal is to introduce and demonstrate the LEGO Mindstorms EV3 robot to young students and awaken their learning interest in logic and programming. So far, we have built our robot to Gripper shape in addition to the previous shape Ev3rstorm. We have discovered mobile app control on an EV3 robot of different shapes and developed various programs including beacon-object engagement and object avoidance using an infrared sensor. Currently we working on investigating an easy and simple programming project for young students to learn and play. During our out-reach activities, such as science nights, we found the effectiveness of EV3 as an educational robot. Many of young students were entertained and showed interest about learning and playing with the EV3 robot.

Weighted Ensemble Ground Truth Inference Algorithms

Yaying Li
Faculty Mentor: Victor S. Sheng

In order to increasing the accuracy by one single Ground Truth Inference Algorithm (GTIA), we are ýnding one way which is Ensemble Learning which is a supervised learning algorithm. In statistics and machine learning, ensemble methods use multiple learning algorithms to obtain better predictive performance than could be obtained from any of the constituent learning algorithms. And it tends to yield better results when there is a signiýcant diversity among the models.

Five Ground Truth Inference Algorithms (GTIAs) we used are Majority Voting (MV), DS, KOS, Zencrowd and RY. MV is the simplest inference algorithm. If multiple classes have the same number of members, the class of the integrated label will be randomly chosen from them. DS models annotators by using confusion matrices in multi-class medical diagnoses. One confusion matrix presents one annotator. KOS was motivated by the reality of differences in labeling quality among different labelers. Zencrowd only uses a binary parameter {good, bad} to model the reliability of an annotator, and it is a little more complex than MV, but simpler than other methods likes DS and RY. RY uses a Bayesian approach to estimate the prior probabilities of the parameters and the positive class. And it models sensitivity (bias towards positive class) and speciýcity (bias towards negative class) of an annotator.

Multi Target Regression

Sravani Marreddy
Faculty Mentor: Victor S. Sheng

Multi-target regression is concerned with the simultaneous prediction of multiple continuous target variables based on same set of input/predictive variables. When the prediction target variables are binary they are called multi-label classiýcation, while when the target variables are real valued or continuous the task is called as Multi-target regression. In both tasks, target variables often exhibit statistical dependencies and exploiting them in order to improve predictive accuracy. In this paper, a brief introduction of Regression tress and Multi-target regression trees is explained and general regression process using WEKA tool and OLS Regression is explained.

Application of NEAT: Improving an Implementation of NEAT on Super Mario Bros

James Stamps, Winston Biggs
Faculty Mentor: Victor S. Sheng

Combining both neural networks and genetic algorithms have shown great potential to solving complex reinforcement learning problems. In fact neuroevolution, NE, has been shown to be more effective at solving the problems are single pole balancing and robot arm control than Adaptive Heuristic Critic and Q-Learning. One method of NE developed by Kenneth O. Stanley and Risto Miikkulainen, called Neural Networks through Augmenting Topologies (NEAT), is one such method of NE. Unlike other versions of NE, NEAT doesnôt just focus on using genetic evolution to solve for the weights but in fact uses genetic methods to ýnd both the weights and the structure of the network.

One application of NEAT would be to build networks that can play video games. A semi-famous YouTube star by the name of SethBling did just that. He designed an implementation of the NEAT algorithm to play Super Mario Bros (NES) and Super Mario World (SNES). This implementation did prove quiet effective at playing the game and beating levels but it did suffer at almost being too simple. When building he only gave the network the vision to see only the most basic version of the screen. It could only determine the difference between enemy and neutral blocks. This proved to be quite effective at beating levels but it seemed almost impossible to beat multiple levels with only one network.

We will change this implementation to allow just one network to beat multiple levels at a time. One possible expansion of his method would be to allow the network to determine the difference between enemy types and to build a layered approach to the network. This combined with redeýning the ýtness function of the method should result in a better-rounded model that behave more human like.

Gentleness Simulator, Surgical Dexterity Evaluation with Haptic Interfaces

Alexander Yu, Seth Baer, Jake Farmer, Aditya Dendukuri
Faculty Mentors: Tansel Halic

In the evaluation of technical surgical skills, there is a ceiling effect. It is difýcult for many of the current evaluation platforms to discriminate the level of skills of potential surgeons after 3 to 4 years. In our study, we built a simulator with a pair of Phantom Omni haptic devices that will assess the dexterity of the trainee. The simulator consists of two tasks. The ýrst is hitt "

Complex Event Processing

Alexander Yu, Ariadni Levering
Faculty Mentor: Victor S. Sheng

Traditional Complex Event Processing systems (CEP) did not consider the computation requirements of continuous dynamics

Eff cient Use of Space: Mixed-Use Planning through the Eyes of Conway's Top Restaurants

Will Dane
Faculty Mentor: Jeff Allender

Chick-Fil-A and Cracker Barrel are top two ranked restaurants in Conway based on proýt. It would come as no surprise that these two are both located in highly segregated commercial sectors of town. It may be surprising, however, to ýnd that the smaller restaurants often found in mixed use environments regularly outperform both restaurants after accounting for their size. Since acreage is considered one of the most valuable commodities of a developing city, it is not unreasonable to measure not in standard commercial proýt, but in the tax awarded to the city per acre.

Spatial data can be analyzed using parcel data courtesy of the County Assessor Mapping Program and tax rates and proýt statistics are available courtesy of The Pulse of Conway online newsletter. Acreage of each site is then calculated using GIS techniques in ArcMap 10.2.2. Finally, the raw data is organized in a spreadsheet and analyzed for both property and sales tax revenue awarded back to the city.

The analysis conýrmed that all four of the smaller, more efýcient restaurants located in mixed, dense parts of town proved themselves more valuable to the city based on a per acre measurement scale. Mikeôs Place proved exceptionally efýcient, earning an astounding 25 times more than Cracker Barrel for its acreage. Clearly total proýt is not the only factor at play here. From the perspective of the local government, a small business in a mixed use environment is far more valuable, producing revenue for the city in both property tax and sales tax while keeping wasted space to a minimum. It is imperative that acreage be given more credit, as it is truly the most inþuential commodity in determining city revenue. Moving into the future, cities will have to acknowledge the lost income caused by segregated low density planning.

Predicting the Next Move of the Florida Panther

Margo Jordan
Faculty Mentor: Mary Sue Passe-Smith

The Florida panther's (Puma concolor) ancient range was all across North America and even into parts of South America; so extensive, in fact, that there were several subspecies as well. Now, however, the panthers are down to one species, the Puma concolor coryi, and that one is quickly depleting. Poaching, disease, a small genetic pool and car accidents have depleted the population even more in recent years and its making it hard for the panther populations to bounce back. Thanks to dedicated organizations like the National Wildlife Federation and the Big Cat Rescue, the populations are starting to make small comebacks. If these comebacks continue to be successful, then it is likely that the panthers will leave the wildlife areas where they are currently located and expand to new territories. According to Defenders.org, some male panthers have already begun to move to central and northeast Florida, central Georgia, and near the Alabama border. If ideal panther habitat is deýned using raster GIS methods, utilizing distances from roads and major cities; selecting correct mean temperatures; identifying and extracting their preferred land cover, then we should be able to predict where the Florida Panther will most likely move next, and plan for protecting and preserving larger areas to shelter this magniýcent animal.

Predictive Habitat Mapping of Asimina triloba (Common Pawpaw) in Pennsylvania, USA

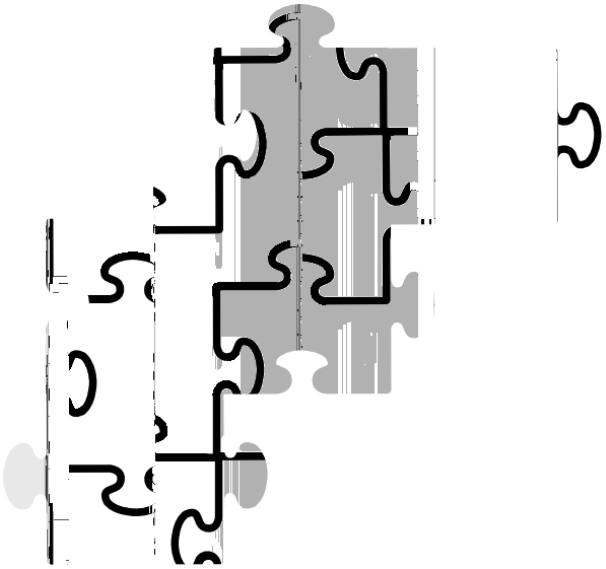
Nate Weston
Faculty Mentor: Mary Sue Passe-Smith

Asimina triloba, or the common pawpaw, is a member of the Anonnaceae family of plants. A. triloba fruit is large, the largest edible fruit indigenous to North America and was highly prized by Native Americans. A. triloba fruit is ecologically valuable in forest landscapes, as many animals depend on its bounty. Many conservationists desire propagating A. triloba for ecological restorations, education, landscaping, or as a native food source. However, A. trilobaôs life history causes it to occur in only select sites, which this project seeks to map across a suit of environmental factors in Pennsylvania, a considerably-diverse region. Selection criteria consisted of: deciduous or mixed forests, moderate or well-drained alýsols, inceptisols or ultisols, and north-aspect topography. The objective was to accurately predict habitat in a location reporting broad distributions, to assist conservation efforts in discovering healthy A. triloba stands. We predict mesic sites within hardwood forests to express the greatest habitat suitability for A. triloba.

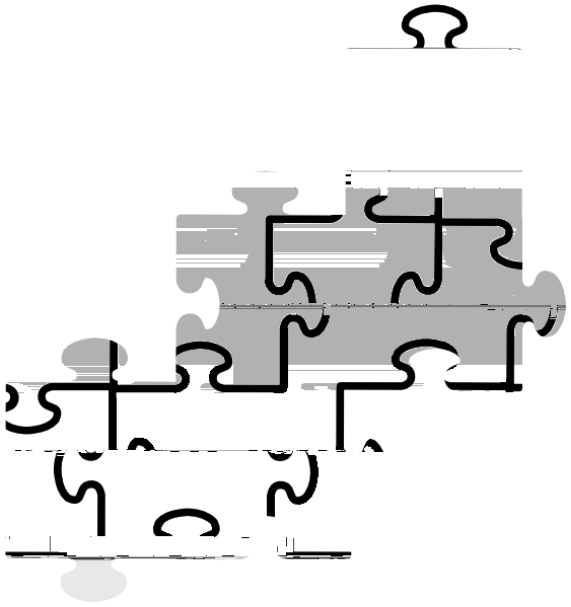
City Redlining: Little Rock and The Bronx

Isaac Sims
Faculty Mentor: Jeff Allender

This essay is a comparison of redlining in the downtown Little Rock area in the 1950's to the 1970's and the Bronx in the 1960ôs and 1970ôs. Redlining is deýned as withholding amenities, goods or services from a minority ethnic group. It is fueled by prejudice and in most cases the practice is directly tied to where these minorities live. As a small southern city, Little Rock experienced singular effects of redlining from its centralized city planning commission and a biased base of white leaders. The results were an unjust redevelopment of an excellent and envied area of downtown Little Rock which, not coincidentally, happened to be the heart of the negro community. In New York City, low-income and racially segregated areas of the Bronx were subject to a militant mindset from New York City's Research and Development Corporation (RAND). This resulted in a removal of certain services from poor neighborhoods. The primary motivation for this study is to examine the unique characteristics of the two cities, how city planning efforts in both locations factored into redlining, and the primary results and conclusions that can be drawn from each case. The poster will include spatial representations showing in detail the areas that were selected for redlining for Little Rock and the Bronx.



Department of Mathematics



Nonclassical Symmetries of a Nonlinear Diffusion/Wave Equation and System Equivalents

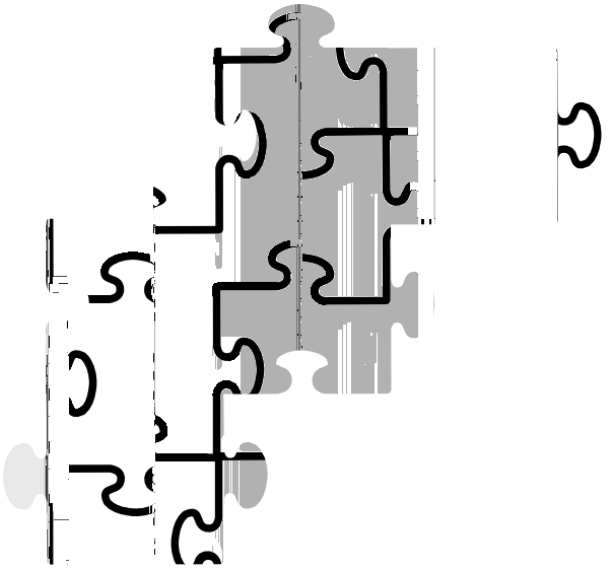
Brandon Ashley, Seth Bloomberg and Thomas Deatherage
Faculty Mentor: Danny Arrigo

It is generally known that classical point and potential Lie symmetries of differential equations (the latter calculated as point symmetries of an equivalent system) can be different. We question whether this is true when the symmetries are extended to nonclassical symmetries. In this poster we consider two classes of nonlinear partial differential equations, the ýrst a diffusion equation, the second a wave equation. We will show that in the general case, the nonclassical point symmetries are inclusive to the nonclassical potential symmetries. We also highlight special cases when the opposite is true.

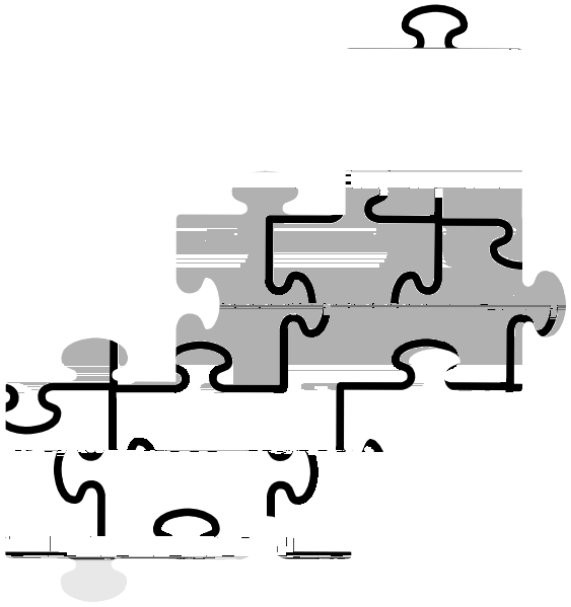
Asymptotic Tracking and Disturbance Rejection of the Blood Glucose Regulation System

Brandon P. Ashley
Faculty Mentor: Weijiu Liu

For people with type 1 diabetes, the pancreas does not correctly secrete the amount of insulin to keep the concentration of glucose in the bloodstream within the desired range. To correct this, external insulin pumps have been designed to control the blood glucose system. Mathematically, we can represent these systems as a control model with multiple feedback controllers.



Department of Physics & Astronomy



Using the H-β Emission Line as a Means of Mass Determination for Spiral Galaxy AGNs

Jacob Cameron and Lucus Ratz
Faculty Mentor: Debra L. Burris

This study focuses on the AGN of spiral galaxies in hopes to use the H-ϐ line to determine the mass of the central black hole. We are replicating the method of Vestergaard and Peterson by extinction correcting emission spectra from these black holes, both for cosmic redshift and for FeII emissions using IRAF. From there we can accurately measure the full width half max of the H-beta line in these spectrum as well as the lumosity and these paired with the OIII lines give us an estimate on the mass of the black hole. The purpose of this is to compare it to the values to pitch angle measurements and to explore the Mass-Pitch Angle relation as outlined by J. Kenneýck from the University of Arkansas.

La and Eu Abundances in Metal-poor Halo Stars

Harrison Cardillo
Faculty Mentor: Debra Burris

Elements with atomic number greater than Z=26 (the Iron Peak) cannot be formed through fusion in a star’s core; the majority of these elements are produced through one of two neutron-capture processes. Early in the history of the Galaxy, the rapid

X-Ray Fluorescence and Moseley's Law

Brandon Miller, Jacob Cameron, Clint Costello
Faculty Mentors: Rahul Mehta and Azida Walker

Modeling Lightning Formations in a Numerical Thunderstorm Model

Kayla Waters
Faculty Mentor: Debra L. Burris

Understanding the formation of lightning is useful for a complete picture of how the electrical charging of a thunderstorm evolves with time. A simple model of dielectric breakdown can be used to simulate lightning formation in a computer model of a thunderstorm. Varying parameters in the model will obviously effect the formation and frequency of lightning strikes in this model. By seeing how these variations effect the model a better understanding of the evolution of the storm is obtained. This leads to more effective measures of protecting lives and also preventing damage to property

Circuit Analogies in Loudspeaker Design

Micheal Wilson
Faculty Mentors: Carl Frederickson, William Slaton

An RE SX 18ò subwoofer mounted in a 4th-order bandpass enclosure is considered as a lumped acoustic impedance model to ýnd the pressure inside the vented chamber. Resistors act as dissipation and loss of acoustic pressure through radiation resistance, viscous, and thermal effects of the propagation of the sound wave through the element. Air chambers were modelled as capacitors, and the un-þanged, rectangular duct (port) was modeled as an inductor. The equivalent circuit is then analyzed with Kirchoffôs Laws to ýnd the current (particle velocity) in the front chamber, and the subsequent voltage (acoustic pressure) as a function of frequency. The subwoofer is also modelled as an equivalent circuit. Then, by utilizing a TermLAB SPL microphone placed inside the front chamber, and applying a constant drive amplitude to the subwoofer, the measured SPL is obtained and compared to the theoretical result to establish the model validity.

Alpha Particle Energy Loss through Matter

Micheal Wilson, Sarah Spellmann, Caleb Webb
Faculty Mentors: Rahul Mehta, Azida Walker

Student Author Index

A

Amber L. Anderson 8
Alex Ano 16
Brandon P. Ashley 44

B

Seth Baer 37
Lucy Baker 8
omas N. Banh 32
Jordan Barajas 48
Haylee Barnes 29
Kristen E. Barré 32
Caitlyn Barthol 17
Lawrence M. Benzmiller 54
Charles Bertram 48
Winston Biggs 37
David Black 9
Jordan Blackstone 9
Seth Bloomberg 44
Bakarie S. Branch 32
Michael Byram 10

C

Jacob Cameron 49, 52
Harr