Undergraduate Research Scholars Symposium

Abstract Book

FEBRUARY 22, 2023

Texas A&M University

LAUNCH
UNDERGRADUATE RESEARCH

URS Symposium Schedule

Free & Open to the Public | Bethancourt Ballrooms (MSC 2300 A-E)

AM

9:00 AM-10:00 AM	|	poster & oral presentations in MSC 2300 A-E
10:15 AM-11:15 AM	|	poster & oral presentations in MSC 2300 A-E

PM

1:00 PM-2:00 PM	|	poster & oral presentations in MSC 2300 A-E
2:15 PM-3:15 PM	|	poster & oral presentations in MSC 2300 A-E
3:30 PM-4:30 PM	|	poster & oral presentations in MSC 2300 A-E

Student Voices

"The URS Symposium was such a fantastic opportunity to present and grow as a student and as a part of the research community! The low-pressure environment made presenting less stressful and the support that was given by the active listeners was wonderful. I also enjoyed getting to share my experiences with the students who came to the presentation."

"I liked that it was more laid back but still professional at the same time. I got a chance to explain my research to people who did not have a background in the field, and this was interesting when deciding what to say."

"Low pressure environment. I got great feedback from faculty who've done this before and were very direct about exactly what they liked and what I could have done better."

"I like that the active listeners gave constructive feedback and that they were polite and asking questions. I liked that the Symposium was open to everyone and that it gave a comfortable space to present. For being the first presentation for many of us, it was great that we felt comfortable in our own space."

About the LAUNCH URS Symposium

The LAUNCH Undergraduate Research Scholars (URS) Symposium showcases undergraduate researchers in the Undergraduate Research Scholars thesis program. The URS thesis program provides undergraduates with a graduate student experience by allowing them to participate in research, produce a professional document, and communicate their findings as principal authors to the University's scholarly community. Learn more about the URS thesis program at https://tx.ag/URSthesis.

The URS Symposium is free and open to the public. Faculty, staff, post-doctoral and graduate students, as well as undergraduate students from all disciplines are encouraged to visit the LAUNCH URS Symposium to learn about numerous research projects being conducted on campus by undergraduates and discover ways to get involved in research at Texas A&M University.

Special Recognition

The Academy of Undergraduate Researchers Across Texas (AURA Texas) is a community of elite student researchers at the two flagship universities in the state, and provides these exceptional students with networking opportunities, the chance to hone their professional skills, and a venue to discuss the importance of undergraduate research and the impact it has on their lives and in Texas. Through AURA Texas, LAUNCH: Undergraduate Research at Texas A&M University, College Station, aims to strengthen the visibility of undergraduate research in Texas with our counterparts at The University of Texas at Austin and offices of Government Relations.

The annual meeting of the Academy of Undergraduate Researchers Across Texas (AURA Texas) coincides with the LAUNCH URS Symposium. Members of AURA Texas from both Texas A&M University and The University of Texas at Austin will present research posters in one of the afternoon poster sessions in the MSC Bethancourt Ballroom C. Learn more at https://tx.ag/AURAtexas.

About LAUNCH

LAUNCH is a unit of Undergraduate Studies in the Division of Academic Affairs under the Office of the Provost. We are a collaboration of six teams that work together supporting students, faculty, and staff across Texas A&M University. Our programs are supported through student fees and generous contributions from the Association of Former Students and other contributors. Through community building, high-impact practices, personal and professional development opportunities, and the recognition of excellence, LAUNCH encourages all Aggies to expand their minds, take on challenges, dare to dream, and get involved. LAUNCH also joins the university community in making Texas A&M a welcoming environment for all individuals. We are committed to helping our students understand the experiences that make each of us unique and appreciate the shared values that bring us together. Learn more at https://launch.tamu.edu. Direct questions to ugr@tamu.edu.

Contents

Oral Sessions

Oral Session 1: 9:00 AM-10:00 AM CT

Room: MSC 2300 A

Comparative Analysis of Error Correction in High-Throughput Sequences for the Human Gut Microbiome

Nathan Purwosumarto

Faculty Advisor(s): Dr. Sing-Hoi Sze

With the development of high-throughput sequencing tools over the last few decades, the sequencing of genomic data at a large scale with relatively low costs has drastically revolutionized the field of bioinformatics. However, the one drawback of these tools are that they produce a lot more errors than early sequencing methods. Since these errors are at the core of experimental data and have the potential to confound analysis and results later on within bioinformatics pipelines, many tools have been developed to mitigate this issue. The traditional method is to use clustering & denoising techniques to mitigate the error, but there have been a variety of software that also look at reducing error correction through alternative methods. This project looks at the traditional method of error correction of high throughput sequencing using clustering & denoising vs other non-standard error correction models. As the entire field of high-throughput sequencing is very large, a focus will be placed on the 16S rRNa gene due to its ubiquity and importance in bacterial taxonomic classification. This gene is a highly conserved sequence among most prokaryotes, serving a fundamental role in protein synthesis across bacterial species. Differences within this sequence allow for the analysis of taxonomic composition within bacterial communities, which will be analyzed in the context of the human gut microbiome. Existing sequences that have known taxonomic composition for the human gut microbiome will be used with different error correction methods as part of an in silico pipeline using QIIME2. This project builds off previous research in the field, studying their methodologies and differences to address the problem of errors arising during sequencing.

Identifying Genetic Factors of Nuclear Pore Complex Assembly in Saccharomyces cerevisiae

Ava Perry

Faculty Advisor(s): Dr. Kathryn Ryan

Deep within the cell, the Nuclear Pore Complex (NPC) works as the only transportation route of important genetic and biochemical materials across the nuclear envelope. Composed of multiple copies of about 30 different proteins called nucleoporins, the NPC is organized in a highly complex, radially symmetric, basket-like structure. While NPC structure has been studied extensively, there is still much to learn about the assembly process. The Ryan lab is working to identify key genetic contributions to the assembly process by identifying a previously selected NPC assembly mutant (KRY 141) in Saccharomyces

cerevisiae through complementation testing. At nonpermissive temperatures, KRY141 nucleoporin proteins fail to assemble properly and thus mis-localize within the cell. Since the single point mutation confers both mutated NPC assembly and temperature sensitivity, we can use temperature sensitivity as a proxy for complementation of mutation. Previous work mapped KRY141 to the centromeric side of the MATÎ± locus on chromosome III. Since then, genes within the region have been isolated and cloned one at a time, attempting to rescue the mutant. We have ruled out 3 probable genes- MAK32, PMP1, and YCR024C-B- and are currently working on one of our last suspects- a previously dubious gene. Identification of this gene in the assembly of the NPC would mean understanding NPC assembly related diseases as well as the discovery of a new gene function.

Project Title Pending

Jose Solis
Glasscock Summer Scholar

Faculty Advisor(s):

Abstract Pending

Room: MSC 2300 B

Thermal Conductivity of Single Molecule Magnets

Wells Hero

Faculty Advisor(s): Dr. Rupak Mahapatra

Single molecule magnets often abbreviated as SMMs are materials that demonstrate superparamagnetism below a certain temperature at the molecular scale. While superparamagnetism is (arguably) the defining feature of SMMs they have other important properties as well such as hysteresis (magnetic memory) and magnetic avalanche. Because of these properties in particular magnetic avalanche SMMs have interested physicists since their discovery in 1993. After investigating SMMs, physicists have determined that their unique properties have potential utility in both the search for Dark Matter as a low energy detector, and storing qubits for use in quantum computing. The most studied SMM sometimes referred to as the archetypal SMM is Mn12 acetate, often abbreviated as Mn12, is the SMM that will be investigated in this paper. This paper will utilize a dilution fridge provided by Infrared laboratories inc. that can reach temperatures of 280mK, a temperature sensor, and copper since it is a metal with known thermal conductivity that is often used in thermal conductivity experiments, to investigate the thermal conductivity of Mn12 at low temperatures where magnetic avalanches are possible. The point of this research is to better understand a material that will most likely be important in future technologies so that it can be utilized fully.

Sampling for Artistic Control in Lagrangian Simulations

Samantha Hallam

Faculty Advisor(s): Dr. John Keyser

Fluids such as gases and liquids are often animated through physically based techniques rather than manually. While this method can generate highly detailed fluids without tedious work from an artist, it also diminishes the amount of control an artist has over the end simulation. One proposed solution to this problem is to provide a low-resolution preview to allow an artist to visualize a potential simulation before committing to a final, high-resolution animation. However, increasing the resolution will also result in non-negligible differences between the preview and final versions of a fluid animation. A potential technique to combat this problem is match point sampling. In this scheme, match points are placed in regions of interest and are used as a guideline to force the fluid in that region to conform to how it behaved during its preview stage. This method has shown promising results, but its development has been limited to grid-based Eulerian simulations, which are primarily utilized for gas simulation. This work focuses on adapting the original sampling technique for use in particle-based Lagrangian simulations, which are primarily used for liquid simulations. Specifically, we investigate different methods of distributing and moving match points through three-dimensional space in the absence of a fixed grid and evaluate their efficacy by examining any differences between the preview and final versions of different liquid simulations.

Prediction of Illicit Transactions on the Bitcoin Blockchain using Machine Learning

Jack Sebastian

Faculty Advisor(s): Dr. James Caverlee

With the emergence of cryptocurrencies and blockchain technology, the paradigm of the structure of data storing and distribution has completely changed. And while the central goal of Bitcoin's 2008 whitepaper was to create internet-based peer-to-peer money without a central third party, there are some unforeseen issues that come with having a completely decentralized ledger. Money laundering is possible by moving illicit funds through hundreds of wallets before depositing the funds and cashing out with a crypto exchange. And with these methods of money laundering becoming more advanced over the decades, the advent of cryptocurrency means a new venue for criminals to carry out more malicious schemes. Anti-money laundering techniques have given way to software within the world of technology that is becoming heavily used by financial institutions to analyze and detect suspicious data. The Elliptic Data Set, which maps Bitcoin transactions to real entities categorized as either from a licit or illicit group, is utilized in this study. It is known as the largest data set that is publicly available by any cryptocurrency and is made up of over 200,000 nodes and 230,000 edges. To aid in the fight against money laundering schemes, we discuss and analyze areas of machine learning that can benefit AML in a big way. Visualization of the graph constructed from the data set is examined to show any promising patterns in the location of licit vs illicit nodes. Furthermore, various binary classification models are used on the Elliptic data set in analyzing performance of prediction of illicit nodes within the network. The classification models include Logistic Regression, K-Nearest Neighbours, Decision Trees, Multilayer Perceptron, Random Forest, and Graph Attention Networks. Results from running these models on the data set will ultimately provide insight into how nodes in the blockchain network are structured and innovate new ways that machine learning can be leveraged in the AML industry.

Room: MSC 2300 D

El Señor Hollywood: How a White-Dominated University Impacted the Life of a Mexican American Storyteller

Cesar Loya, Jr.
Aggie Creative Collective

Faculty Advisor(s): Dr. Jason Marc Harris

In recent decades, films and shows that consist of young adults take place in high school or college, with the protagonist being white and them pursuing music or sports. But when a film involves Mexicans or Mexican Americans, Hollywood has stereotyped these characters to be drug dealers, gangsters, or lowlifes. They are painted as individuals who should be looked down on or feared. However, films such as Stand and Deliver (1988) which is about Chicanos taking on higher high school education inspired my screenplay and series El Señor Hollywood. Stand and Deliver (1988) takes place in a high school and ends with the students succeeding after facing struggle, but I have always wondered what their college experience was like. This question is examined in El Señor Hollywood, which is based on my personal experiences as a Mexican American student at Texas A&M University, a school with a predominately white student body. The topics include the effects of exclusion, culture shock, culture and religion clash, and Hispanics in a higher education setting. The screenplay also goes deeper into more personal topics that the average person can relate to like certain mental states and health issues. Examples of this would consist of imposter syndrome and sleep deprivation. As the story progresses there will be a narrator who will be controlling how the story is told, and it is up to the viewer to determine whether they trust him or not. So, how do you represent the Hispanic college experience in the film medium? El Señor Hollywood will be a cinematic series and while certain biopic shows are dramatized, El Señor Hollywood will remain as true and honest as possible to the real experience and events.

Assignment and Trajectory Planning for Two Robots with Sporadic Communication and Risk of Failure

William L. Park

Faculty Advisor(s): Dr. Dylan Shell

In Multi-Robot Task Allocation, resource and environmental constraints can cause robots to resort to sporadic communication, which delays their response to reassign their tasks according to new information. For our scenario, environmental factors could cause some robots to fail, but due to the limited number of calls robots can make, it is uncertain whether a robot's radio silence is due to a conservation of calls or a failure. To address this in a path planning scenario - where two robots are assigned to drive to two destinations to collect some rewards - we propose an approach where, under a synchronized, interval communication method, robots can make use of the delay between calls to proactively plan their paths in anticipation of possible robot failures. The communication method involves a promise for all robots to simultaneously contact each other at fixed points in time to

guarantee an accurate roll call of inactive robots while maintaining synchronous information. At one end of absolute certainty, knowing one robot will definitely fail gives a single direct route and destination for the remaining one. Conversely, when both robots are guaranteed to live, each will take a direct route to its assigned destination. For cases where a robot's failure is a possibility with no way of knowing until later, our plan is neither of those two options - it incorporates an indirect route that is somewhere in between. We give examples where this is the best plan that handles delayed awareness of robot failure because, over multiple trials, it will ultimately travel less while collecting more reward.

Novel Highly Aligned and Porous ECM Patch for Wound Healing

Eric Wang

Faculty Advisor(s): Dr. Feng Zhao

Skin is the largest organ in the human body and the first line of defense against the environment and bodily injures. The skin wound healing process is extremely complex and creates fibrotic tissue, or scarring, which is undesirable both functionally and aesthetically. With the current growing population of the elderly and morbidity, there is a strong demand to fabricate biomaterials that can repair wounds faster, improve functional capabilities of the skin, and reduce scarring. Decellularized extracellular matrix (ECM)-based scaffolds have emerged as one of the most promising biomaterials for skin wound healing. ECM scaffolds have been implemented with success in clinical models, but wide-spread application is hindered by poor mechanical properties. In our study, we fabricated a highly aligned and interwoven decellularized ECM scaffold using a micro-patterned PDMS sheet. We hypothesize that our interwoven micro-patterned PDMS substrate will result in higher alignment of cells and hence, stronger ECM scaffold. We used human dermal fibroblasts (hDF) cells for seeding and examined the structure of the PDMS mold in addition to the alignment of the hDF cells.

Room: MSC 2300 E

Development of A Magnetic Gear Acoustic Optimizer

Thomas Simms

Faculty Advisor(s): Dr. Hamid Toliyat and Dr. Matthew Johnson

Contactless magnetic gearboxes have been identified by NASA and others to be a potential key enabling technology necessary to realize future fully electric aircraft and spacecraft. These gears are significantly more efficient and reliable compared to mechanical gearboxes. Additionally, mechanical gearboxes are louder than magnetic gearboxes; however, the acoustic noise produced by magnetic gears is typically isolated to a few frequencies as opposed to a wide spectrum. Identifying and eliminating the source of this noise would significantly improve the attractiveness of magnetic gears to companies. Furthermore, developing and testing magnetic gears can be very time intensive. This research aims to resolve these issues. This research involves the development of a lightweight, modular data analysis tool designed to analyze the acoustics of magnetic gears. The tool will provide a quick analysis of acoustic data and output design optimization suggestions. Data used for these calculations will be stored within a local database that can be accessed by the user. The analysis tool also includes functionality for generating plots of the data being analyzed. Additionally, several companion automation scripts will be developed to allow for the rapid creation and testing of magnetic gear simulation models. These scripts will assist in generating simple magnetic gear models from user-provided parameters. The automation scripts are designed to run directly in 3D modeling software and provide a significant amount of flexibility in their designs. The resulting gear models can serve as a base for more complex gear designs or as a quick method to determine the feasibility of a design.

When the Alps Met the Andes: German Migration to Chile in the Mid-Nineteenth Century

Katherine Guidry

Faculty Advisor(s): Dr. Maddalena Cerrato, Dr. James Howell, and Dr. Ashley Passmore

This thesis analyzes how the Chilean nation-building politics of the mid-nineteenth century enabled German immigration and sustained its subsequent influence in Chile. It explores the origin of Germans in Chile starting in the mid-nineteenth century, acknowledging how the Chilean government distanced itself from Spanish imperialism in their newfound independence and filled the infrastructural gap with immigrant activity from German-speaking Europe. The analysis of the German settlements in Chile reveals how the Chilean government valued Germans as the 'ideal immigrant' in their growing country. The Chilean state's receptivity toward wealthy German migrants granted Germans societal mobility in Chile. Understanding how the Chilean state supported and welcomed multiple waves of German immigrants illuminates the process of German presence becoming ingrained in Chile, from the geopolitics of the south and relations with the native Mapuche people to the establishment of German institutions and business relations in metropolitan cities. This background provides a possible

explanation regarding how Germans obtained and maintained a privileged position in Chilean society, securing a status that would withstand the onset of world wars and the related stigmas that followed. By tracking the origin of these German migration movements and relating them to the political motives of the Chilean state, this research allows for a better view of how German immigrants were instrumental in the formation of Chile as a nation-state.

Hedonic Damages and Monetary Compensation in Tort Law

Morgan Devenzio

Faculty Advisor(s): Dr. Linda Radzik

The question that I am posing here is why money is used as the compensation for tort law considering the hedonic damages. Tort law is the area of law that focuses on when someone suffers a wrongful loss at the hand of another, and, for these cases, money is used as the compensation for the victim in a case. I am analyzing why exactly money is used for reparation for the plaintiff in tort cases because there is nothing innate about wrongful loss that causes them to equal monetary compensation. I will be looking at certain philosophies of law to provide my own analysis of this such as the corrective justice theory and punitive justice. These theories consider the different ways in which money is justified as a solution for tort cases such as aiming to attempt to make the victim "whole" again and deterring potential wrongdoers from committing harmful actions against potential victims in the future. Furthermore, I am analyzing how exactly this monetary compensation operates with the hedonic damages that are commonplace in tort law cases. Hedonic damages are those that take away from the pleasure of life, and these damages are typically abstract and non-quantifiable. However, in tort cases, the jury is attempting to award something that is a quantity, money, as reimbursement for something that is not able to be measured. My thesis will provide an in-depth analysis of both aspects of the reasoning for monetary restitution and hedonic damages in tort law cases.

Oral Session 2: 10:15 AM-11:15 AM CT

Room: MSC 2300 A

Privacy Preserving Sensor Selection

Rishi Phatak

Faculty Advisor(s): Dr. Dylan Shell

Recently, robots and other automated systems have become ubiquitous in everyday life. They are used in a variety of scenarios where privacy and/or secrecy is of utmost importance. At the same time, they need to be audited to ensure they are performing within the limits of their intended functionality. Given these facts, this paper examines whether it is possible to select sensors accomplishing a dual objective: verification of claimed itineraries that are also privacy preserving. The theoretical framework builds upon previous works in sensor selection naturally leading to higher problem complexity. While the previous research has explored finding a minimum sensor selection to validate a pre disclosed itinerary, this paper investigates whether it is possible to solve the sensor selection problem on multiple itineraries, each of which is possibly present in different types of constraints with others. Fundamentally, we present two types of constraints each of which specify exactly which information the outside system should and should not learn. We present a novel approach to solving this problem and prove that when conflation constraints are added, the problem scales exponentially in the input size. A few case studies are presented to demonstrate the usefulness and scalability of our proposed solution under various optimizations.

Traffic Light Detection in Autonomous Driving Vehicles

Dakshika Srivastava

Faculty Advisor(s): Dr. Dezhen Song

Autonomous driving is an important field of research, especially now since the world is moving away from gas-operated vehicles, and towards electric vehicles. Since the operation of these vehicles heavily depends on the algorithm running behind the scenes, it's imperative to ensure that these algorithms are highly accurate and efficient in detecting obstacles on the roads (pedestrians, construction signs, etc) and making smart driving decisions (stopping, speeding up, turning, etc.). Although there has been prior work in detecting traffic lights, the existing algorithms are either not efficient enough to run in real-time, or require high-power computing capabilities. There also isn't much prior work around detecting flashing lights, especially since their inconsistent frequency makes the problem more challenging. Hence, the goal of this thesis is to create an efficient and accurate real-time detection algorithm for traffic light signal state, and its color and shape. This will be done using Hough transformation and neural networks. The proposed algorithm also aims to determine if the detected traffic light is flashing, using the concept of a state machine. This research explores the domain of autonomous driving and traffic light detection, investigates potential solutions to tackling these challenges, and implements and

tests the most efficient approach. The algorithm resulting from this research will be tested for feasibility with real-time inferences, as well as compatibility with the Robot Operating System (ROS). By testing with various public open-source datasets, as well as images collected from the local Bryan/College Station area, the proposed neural network will be trained and tested against various types of traffic lights.

Automatic Recognition of Reservoir Models Using a Deep Learning Technique

Mahmoud Moussa and Janessa Paderes
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Albertus Retnanto

Well test analysis calls for the human interpretation of pressure derivative plots in order to perform reservoir characterization which allows for the estimation of certain reservoir properties such as permeability and skin factor. However, the presence of noise and outliers sometimes lead to misinterpretation of the plot which emphasizes the dependence on the expertise and experience of the interpreter for this method. In addition to this, with the ever-rising development of data acquisition, big sets of data are required to be interpreted on a timely basis which raises the need for a more efficient approach to analyze well test data. Machine learning techniques have been widely used in several disciplines in the past decades, including this field. Wherein, pressure derivative patterns from select reservoir models are identified through machine learning algorithms. For this paper, we aim to construct a deep learning algorithm with the goal of classifying well test data from 40 reservoir models in total, each having varying reservoir/well and boundary types. Three hundred simulated pressure derivative plots for each model are generated using Ecrin software while the coding is done on MATLAB. Each plot contains 100 pressure signals over a reservoir time duration of 36 hours. Total classification accuracy (TCA) will be the main criterion for identifying the optimum configuration of deep learning parameters for the algorithm. In addition, the resulting algorithm will be applied to real world data to investigate its capability to recognize its class.

Room: MSC 2300 B

Development of Drop Tower Impact Testing Apparatus to Evaluate Novel THA Femoral Broaches

Rebecca Bates

Faculty Advisor(s): Dr. Michael Moreno and Dr. Andrew Robbins

Canine Total Hip Arthroplasty, while used to treat multiple canine hip pathologies, such as dysplasia, dislocation, and fracture, has a complication rate of 9.4-12.5%. During the surgery, the head of the femur and the acetabular cup of the hip are replaced with prosthetics. The stem envelope in the femur is cut by a broach matching the exterior geometry of the stem implant. Sclerotic bone, which is more prone to fracture under the repetitive impact loading due to its higher density, can complicate this procedure. To address this issue, multiple novel tooth designs for broaches have been developed and require evaluation. Previously, these designs have been tested using a quasi-static insertion method. method. This approach however, did not adequately simulate the clinical environment, so an impact testing apparatus is being developed to test broach insertion analogous to the manual strike and force found in the clinical environment. This apparatus uses a weight in guided free-fall to impact the broach until it is fully seated in the femur. Energy required to seat the broach and broach advancement will be analyzed to determine the efficacy of the novel broach designs. Greater efficiency in broach design reduces the cumulative force and amount of impacts required during the procedure and thus the risk of fracture, informing whether novel designs should replace tools currently in use. Beyond this project, the impact testing apparatus will be designed to be readily adaptable for future impact research projects.

Economic Profiling on Oxidative Coupling of Methane and Opportunities for Integration

Faisal M. Ashour

Texas A&M University at Qatar

Faculty Advisor(s): Dr. Patrick Linke and Dr. Ma'moun Al-Rawashdeh

Oxidative coupling of methane (OCM) has been investigated through catalysis, reaction engineering and various processes to achieve the valued economic performance of producing ethylene from natural gas for more than 40 years. Studies on OCM focus on the reactions' performance and catalyst options with the absences of economic analysis. More recent studies on the reaction's performance investigates the economic limitations of the reactions to add value, they are carried out on specific systems in the lack of a systematic analysis approach. These analyzed systems highlight a gap of a basic analysis that presents the economic potential as well as motivate the development of an economic screening method. A method that is quick and applicable by any system of reactions that displays an understanding of the economic performance of the reactions and the required minimum of key performance indicators such as selectivity for profitable potential. This research will present the development of the screening method and its application to OCM reactions in the form of 'value addition/destruction maps'. The

simulation of an integrated process of OCM and a combined cycle power plant was part of the analysis as well motivated by the results of the economic screening. The minimum selectivity found for the OCM standalone system considering material flows was 58%, this selectivity indicates the minimum performance when considering 100% conversion of methane. The minimum represents the point where any lower value means that the system will never generate profit. The results were effective in the use of the developed methodology of screening, it was used to identify the economic weaknesses of OCM through the analysis and create an idea of integrating it with a different process to add value.

Physics Based Interpolation for Animation Using Physics Informed Neural Networks

Carlos Alvarez del Castillo Saleh

Faculty Advisor(s): Dr. Shinjiro Sueda

Keyframe interpolation is a fundamental technique used in computer animation. In this technique, a user specifies keyframes and has a computer program generate the in-betweens by interpolating between them. However, most common forms of interpolation use a non-physics-based path between keyframes to decide where the in-betweens should be drawn. When animating physical behavior, it would be useful to have the ability to interpolate along the path of motion to reduce the number of keyframes that must be specified by the user. Physically Informed Neural Networks (PINNs) are neural networks that are used to solve problems involving partial differential equations by incorporating information about those equations directly into the network. Because prior knowledge of the functions they are trying to model is incorporated into the network, one advantage of PINNs is they require less data to train than neural networks trained using only data points. This project aims to take advantage of this to create a tool that will allow a user to specify the position and/or velocity of the animated object at only a few keyframes, train a PINN to model the trajectory of the object while closely meeting the constraints imposed by the keyframes, and use the results from that model to generate in-between frames along the modelled trajectory. In addition, this project aims to find effective methods of training PINNs for this purpose.

Room: MSC 2300 D

An Automated Mechanism to Rate the Severity of Cleft Lips

Farah Shabbir
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Erchin Serpedin

A cleft lip is a congenital deformity formed due to the malformation of the nasolabial area. The condition is treated by facial reconstructive surgeons and can take several procedures. The project aims to address the problem that there is presently no index that rates the severity of cleft lips for surgeons to measure and track the healing progress of their patients. Measuring and monitoring the process is essential since there are usually many surgical procedures. Therefore, the aim is to create an automated rating mechanism that rates the patient's deformity numerically along their own continuum of normality. To achieve this goal, existing Image Inpainting algorithms will be used to normalize the nasolabial area in cleft images where the anomaly is present. Then the algorithm's results with the best performance will be used to create a rating mechanism using Pixel-wise subtraction. Pixel-wise subtraction will help to measure the variation from normality. This will be done by subtracting a matrix of pixels of the original image from the normalized images. The resulting "difference" pixels from the output will create a heat map. The region with the most difference in pixels will be darker in color as compared to the other areas. This will be converted to numerical values, producing a severity 'rating' based on the significant differences.

The German Radical Right's Rise through Social Media

Alexandra Freytes

Faculty Advisor(s): Dr. Ashley Passmore

The Alternative for Germany (AfD) was founded in 2013 in response to the Euro crisis and reached the electoral threshold to participate in the federal government by 2017. Within the first few years of its creation, the AfD transformed from a single-issue party to a radical right populist party promoting xenophobic, Islamophobic, and nativist beliefs. Scholars discuss the AfD's unique origins and the various factors influencing its growth despite Germany's historical predisposition to reject a radical right-wing party. These factors include the AfD's uniquely Eurosceptic beginning, the convergence of the German political center-right, the timing of various crises, the presence of a European populist movement, and social media. Social media and the other factors influencing the party's rise are often addressed separately which leads to the research question: What is the role of social media platforms such as Twitter and Facebook in the AfD's growth in the past ten years and how does this growth reflect a global trend? This thesis presents how scholars have characterized the rise of the AfD and examines how social media usage has amplified factors contributing to the AfD's growth. The growth of the AfD is the result of the combination of social media's algorithm and other aspects including the populist movement present in local communities within Germany and other European countries. It is necessary to address

the growth of the AfD because much of the party's current ideology is intolerant, xenophobic, and reflects a worrisome growing trend in Europe that presents the possibility of violence to those that nativist populists see as a threat to society.

Room: MSC 2300 E

Neural Via Points for Muscle Wrapping

Kyne Sun

Faculty Advisor(s): Dr. Shinjiro Sueda

Line-based musculoskeletal simulation is important in both computer graphics and biomechanics research. Software such as OpenSim can provide simulations of musculoskeletal dynamics and neural control where it would be difficult to measure with experiments. These tasks are done with the help of OpenSim's various types of muscle paths, including straight muscles and via point muscles. However, there are limitations to these models, specifically when it comes to handling muscle mass. One common method used by these models is to combine the mass of the bones and soft tissues with the mass of the muscle, treating each body segment as a single body. This method has been shown to produce errors in inertia that can be quite large and variable. The main challenge in allowing more accurate muscle mass in musculoskeletal simulation is that the muscle mass points must be differentiable with respect to the joint angles. Adding mass for a simple muscle path represented as a single line is relatively easy. However, when the muscle path must go through multiple 3D "via" points, it becomes computationally more difficult. Furthermore, these via points may be functions of the joint angles, allowing them to become active or inactive based on the current joint configuration. We define these muscles as switch muscles. Our goal, therefore, is to generate a large training set involving many configurations of a switch muscle and to build a differentiable machine-learning model from this dataset. We created three models for a line muscle, via point muscle, and switch muscle where for each we reached a loss within the 1e-6 range. With these results we can use these models to predict muscle mass points for muscle calculations as a function of joint angle.

On-Farm Brackish Groundwater Desalination with Brine Management and Recovery of Value-Added Products

Beena Debnath, Laiba Nadeem, Naseem El-Dehaibi, Noor Ibrahim Hassan, and Vishmi Mandira Singhapura

Texas A&M University at Qatar

Faculty Advisor(s): Dr. Ahmed Abdel-Wahab and Dr. Patrick Linke

Recent history has seen an alarming increase in environmental and economic concerns regarding increasing salinity of groundwater which is mainly utilized for agriculture in arid regions. However, a major challenge with inland desalination of groundwater is brine management. We investigated brackish water from Heenat Salama Farm in Qatar to devise a desalination and brine management process that is both environmentally and economically sustainable. The first step in this process was to evaluate pretreatment processes to decide on the method that is the most efficient at eliminating the use of antiscalants and maximizing water recovery in a reverse osmosis (RO) desalination process. Three pretreatment methods to sequentially first remove calcium hardness, and then magnesium hardness

were performed and analyzed. In the first method we used soda ash and lime, in the second method lime was replaced by sodium hydroxide, and the third used carbon dioxide and sodium hydroxide. Investigation of the residue from the pretreatment for potential value-added products which are magnesium hydroxide and calcium carbonate was carried out. Three different configurations for desalination using brackish water (BW) and sea water (SW) RO membranes were SWRO (one-stage), BWRO+SWRO (two-stage) desalination, and one-stage desalination integrated with nanofiltration. Following that, we explored brine value extraction and management, and integration of renewable energy supply in the system. Our findings suggest that the pretreated water with lowest levels of calcium and magnesium ions was obtained using carbon dioxide and sodium hydroxide method. The most efficient desalination process configuration was RO using BWRO and then SWRO membrane as it resulted in the highest recovery and salt rejection.

Project Title Pending

Jose Solis
Glasscock Summer Scholar

Faculty Advisor(s):

Abstract Pending

Oral Session 3: 1:00 PM-2:00 PM CT

Room: MSC 2300 A

Why eFPGAs are Designed in Such Way?

Saini Ye

Faculty Advisor(s): Dr. Jeyavijayan Rajendran

Field Programmable Gate Arrays (FPGAs) are a type of integrated circuit that offers a higher level of flexibility than Application Specific Integrated Circuits (ASICs), as they can be used for a variety of implementations. Reduced Instruction Set Computer - V (RISC-V) is a free and open instruction set architecture (ISA) that can be implemented in various forms of processors. It is designed to be small, simple, and modular, and can be used for a wide range of devices. When RISC-V and FPGAs are combined, it offers extensive control over the system architecture and its core functions in the instruction set, something that is difficult to achieve with other ISAs or when developing all FPGA logic from scratch. This makes RISC-V based FPGA implementations suitable for applications that require data aggregation, low-latency processing, operations on diverse data streams, and low power consumption in embedded systems. This research aims to uncover structural insights for combinational modules in three different open-sourced RISC-V processors: the Berkeley Out-of-Order Machine (BOOM), the Berkeley in-order core generator Rocket-Chip, and the CORE-V CVA6 CPU designed by OpenHW Group. It will use an internal attack tool to predict the functionality of the core modules of processors, and a script that generates random test benches to query both the predicted circuit and the original design. The output of both circuits will be used to evaluate the attack's performance and the security of the modules. The research aims to understand the theory behind RISC-V processor architecture and find insights for future researchers and designers. It is anticipated that the security level of various modules will vary, as they possess different lengths and complexity of logic.

Dust Emissions From 3D Printing of Concrete

Mohammad Shaaban, Ahmad Hammoud, and Nathan Braganza

Texas A&M University at Qatar

Faculty Advisor(s): Dr. Bing Guo and Dr. Eyad Masad

Air pollution has evolved into a severe global environmental problem [1]. Air pollution has been linked to being the source of numerous respiratory diseases. When inhaled, particulate matter can lead to several respiratory diseases and be the direct cause of premature deaths [2]. The construction sector is one of most countries' most prominent contributors to air pollution. While recent technology of the 3D printing of buildings using various build materials like geopolymers have been researched to reduce setting time and improving strength, the dust emissions and health risk associated from the entire process have been merely addressed in the available research. The conventional concrete production has dust as one of the primary airborne pollutants formed but recently 3D printing of buildings have

been introduced using various build materials. Construction 3D printing using various build materials is actively being researched to achieve higher strength, faster settling time and better layer cohesion of the material. This particular research focuses on three different materials used for 3D printing which includes geopolymer mix composed by TAMUQ team, CyBe material, and another material developed under the collaboration between TAMUQ and DCP. Even though using these materials can potentially improve the concrete properties, it is unknown about the concentrations of dust produced during the different activities of making the structure. Therefore, our research would target to measure the dust concentrations with the particle sizes of PM 10 and PM 2.5 produced during the mixing, printing, curing, and finishing phase of these 3 different materials. Once all the data is collected our goal would be to compare the measurements to the air safety standards set by Health Canada.

Exploring the Impacts of the First Year Eats Program During Sophomore Year

Erin Batta

First Year Eats Program

Faculty Advisor(s): Dr. Alan Dabney and Dr. Sumana Datta

A major issue faced by many college students is food insecurity. Students who lack quality food often have lower grades and poorer mental health than those who have access to the food they need. The First Year Eats (FYE) program at Texas A&M University aims to address this problem by providing freshman students in need with food and cooking lessons. The goal is to help students not only have quality food, but also learn skills that will help them be healthier and more confident in general. In the past three years, this program has been evaluated to determine its effect. A comparison of FYE to non-FYE freshmen showed that FYE students tend to achieve higher grades, be less stressed and have better emotional wellbeing. To continue this research, I have analyzed sophomore students, comparing those who were formerly in FYE to those who were not. I used a student wellbeing survey and two years of sophomore grades to identify differences between these two populations. Results showed that former FYE students still had higher GPAs in the first semester of their sophomore year than non-former-FYE students. This indicates that the impact of the FYE program lasts beyond just the time that students are involved in it. Furthermore, those students who had participated in FYE also reported being more likely to consider health when shopping at the grocery store, compared to students who were not in FYE. Lastly, results indicated that FYE students were less likely to withdraw from the university within their first 4 semesters. In the future, it would be of interest to compare graduation rates between FYE students and non-FYE students. As the program grows and develops, researchers could also investigate which methods are most effective in increasing participation and involvement.

Room: MSC 2300 B

Bringing Grayscale to Ghost Translation

Zachary D. Bottorff

Faculty Advisor(s): Dr. Alexei V. Sokolov

In recent decades, physicists developed ghost imaging, which is an alternative technique to the conventional imaging used everywhere by cameras. Deep learning techniques were then adopted from computer science to create computational ghost imaging, which has situational advantages over conventional imaging. In the past few years, researchers have begun utilizing a type of deep learning network called a Transformer network, resulting in a regime known as ghost translation. This regime appears to be robust to noise and could enable major computational shortcuts when compared to ones that utilize other types of neural networks. However, ghost translation has only been developed to work on simple binary images, which do not resemble most applications found in real-life or laboratory settings. I build upon this recent work, exploring the feasibility of extending this regime from binary images to grayscale ones. I evaluate methods of doing so, comparing how the deep neural network behaves with a binary input with how it behaves with a grayscale input. Grayscale images are found in common imaging applications, and they are the step immediately preceding full-color images that are the hallmark of conventional imaging. Hence, improving this regime to give it compatibility with grayscale images opens the door to useful laboratory applications and promotes the discovery of further uses for computational ghost imaging.

Automated Bug Detection In Source Code Using Machine Learning

Glenn Fitzpatrick

Faculty Advisor(s): Dr. John Hamilton and Dr. Martin Carlisle

Software errors, more commonly known as "bugs", have plagued programmers and computer scientists since the dawn of the digital revolution. Some bugs are detectable at compile-time such as invalid syntax or using a variable of the wrong type and often do not allow the program to be built into an executable. Other bugs are less detectable and are only discovered by dynamically analyzing the program and seeing where unexpected behavior occurs. Most of these bugs seem benign, such as an off-by-one error or assuming data will not be NULL, but the consequences can be severe in regards to the execution and output of the program. As more and more businesses moved to digital platforms, the financial repercussions of these bugs became more relevant, and a larger interest was put into automatically finding these bugs before code was distributed. Newer languages such as Java or Rust partially fix these issues through different means such as bounds checking for memory access issues and stricter error handling and programming requirements, however this does not resolve all the problems. The rise of machine learning in recent years provides new opportunities to automatically detect bugs in software. By treating the source code as a language and breaking it down into a tokenized form, we can apply the advancements made in other fields of machine learning, such as natural language processing, to bug

detection. In this research project, we apply machine learning models such as Random Forest Classifiers, Recurrent Neural Networks, and Convolutional Neural Networks to software source code and demonstrate the validity of this approach for bug detection.

Evaluating the Success of Microfinance in Mexico

Jacqueline Gold

Faculty Advisor(s): Dr. Adel Varghese

Microfinance is a poverty alleviation tool that expands financial markets around the world. Microfinance takes on many forms, with different missions, but broadly focuses on serving determined people living in less developed communities. Most microfinance institutions exist to expand the financial market, increase private credit ownership, elevate small businesses, increase incomes and savings, and fight global poverty and inequity. Understanding the macroeconomic context of a given country allows researchers to figure out which communities microfinance flourishes in. Mexico has a massive market for microfinance. Therefore, studying Mexican microfinance is a good indicator of microfinance outlooks in similar emerging market economies. The commercialization of microfinance institutions is a great controversy amongst experts in microfinance. This thesis argues that Mexico struggles to foster a socially-impactful market for microfinance as a result of its macroeconomic context and its 'mission drift' towards a commercialized approach. This study aims to understand the dynamic relationships between Mexico's economy and its microfinance institutions and discover the ethical and financial issues that surround them.

Room: MSC 2300 D

A Prediction of Moisture-Induced Stresses to Evaluate the Performance of a Low-Cost Texas Seawall

Vicki Chu and Benjamin McKeig

Faculty Advisor(s): Dr. David Allen

This paper proposes to develop a potential low-cost seawall to protect parts of the Texas coastline from hurricanes. A seawall made from a durable, low-cost material with a geologic berm supporting it may be a viable solution in terms of overall strength, cost, and longevity. However, the depth that the seawall must be placed into the ground for the purpose of ensuring that moisture does not compromise the geologic berm during the hurricane event is unknown. This is crucial to minimize the moisture-induced expansion stresses within the berm that could cause a structural failure. A two-part model is under development herein to first predict the distribution of moisture after a hurricane and subsequently utilize the resulting predicted distribution of moisture as an input to model the moisture-induced stresses within the geologic berm as a means of predicting moisture-induced failure of the seawall. The moisture distribution is governed by Fick's Second Law to describe the distribution of moisture in two dimensions with respect to time. The stress analysis is governed by the Theory of Elasticity to model the moisture-induced stresses within the berm. A finite element model based on the above concepts is deployed to model the beach sand, seawall, base material, and berm. Within the model, the seawall was assumed to be impermeable so that the moisture must travel under the seawall to reach the berm. The results from this model are then used to evaluate how deep the seawall must be placed into the base material to prevent failure of the berm due to significant moisture diffusion during a hurricane event. Accordingly, it is hypothesized that the model developed herein could be utilized for the purpose of designing future hurricane-resistant seawalls along the Texas coast.

Trixie Motel: Extending the Art of Drag Beyond the Self

Lora C. Kim

Faculty Advisor(s): Dr. Nathan A. Crick and Dr. David T. Tarvin

In this paper, I analyze how drag queen Trixie Mattel utilizes fantasy themes to push the limits of drag performance based on overlapping performative principles of art, comedy, and popular culture. I analyze the deeper implications within eight-episode docuseries Trixie Motel in relation to how the art of drag can be broadened moving forward. I start by examining Trixie's performance style for the relationships between art, comedy, and popular culture. I asses the creation of the Trixie Motel as a continuation of these relationships and the Trixie fantasy. I then analyze the underlying implications of the project through the lenses of Aristotle, Gorgias, and Aristophanes. I conclude with a discussion on what the Trixie Motel project means for drag at large. Trixie's newest business venture into the motel renovation scene suggests two new ideas: first, she has exemplified a way in which drag can be done without presence of the body, and second, the definition of drag can now include different aspects of

performance. Before now, drag has typically been understood as gendered performance of a persona. The Trixie Motel now broadens that definition to be any performance by any entity that uses fantasy themes to elevate the intersection of art, comedy, and culture.

Muslim Immigration & Assimilation in France: How the Murder of Samuel Paty Exposes France's Failure to Assimilate New Immigrants

Allison Bendersky

Faculty Advisor(s): Dr. Maddalena Cerrato and Dr. Adam Rosenthal

Historically, France has experienced and integrated many periods of immigration, although France observed a shift in the origin of immigrants following World War II, with the majority of new immigrants hailing from former colonies and the Maghreb, a region in North Africa. Being predominantly Muslim, these immigrants represented a stark contradiction between religious identity and the heavy push for Republican secularism from the French government, resulting in isolated immigrant communities and rising tensions between those communities and the French state. This research investigates the implications of the emphasis on secularism and assimilation by the French state on these new Muslim immigrant communities. As seen from the riots in the banlieues of Paris as well as the murder of Samuel Paty, the implications of these tensions are extremely relevant in society today. Using the Paty case as a case study for examining the cultural divide that exists between Muslim immigrants and French society, this thesis portrays the characteristics of France's attempts to assimilate new immigrants as well as discusses the outcomes of those attempts. Beginning with a focus on French immigration policy, this research compares the shifting politics on immigration to the Muslim experience in France to demonstrate the tensions between immigrant communities and French society. This is contrasted by the French opposition to multiculturalism, which is so prevalent in French society that many politicians refuse to discuss it, through l'affaire de foulards.

Room: MSC 2300 E

Nashville to Neural Networks: A Study of Subgenre Recognition in Country Music

Matthew Chang

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

With the growing popularity of music streaming services such as Spotify and Apple Music, music genre recognition has become an increasingly important task. In recent years, music services have gone beyond the basics and have started catering to users with song recommendations and auto-generated playlists. These help to better engage listeners by introducing them to tracks based on genre, mood, or user listening activity. While metadata of a song, such as artist or duration, can be useful to genre classification, the true genre of a song is characterized by the musical features contained in audio. As with other mainstream musical genres, country music is divided into multiple subgenres. Originating in the early twentieth century in the Southern United States, country music has been shaped by many influences and produced many unique subgenres including bluegrass, country rock, traditional country, and country pop. The distinctions, while blurred, remain important to user preference. A quantitative approach to identifying country music subgenres can further improve user engagement when it comes to country music recommendations. In this research, I create a machine learning model that distinguishes between the subgenres of country music given a short audio clip. I use sample audio and genre label data from Spotify to determine the classification boundaries between the subgenres. Then, I evaluate the accuracy of my model and compare its performance using different audio features and processing techniques. Through this process, I identify key distinguishing features within the audio that can be used to quantify listener country music subgenre preference, helping listeners find music they enjoy and driving up engagement with the music industry.

Examining the Consequences of the Neoliberal Theory on Democratic Elements in Chile

Sneha Kumar

Faculty Advisor(s): Dr. Maddalena Cerrato

The involvement of the United States in the military coup and the rise of Augusto Pinochet indicates their subsequent interference in Chile's economic development. Chile served as a laboratory for the United States' neoliberal experiment before introducing similar reforms to their own country. This thesis critically appraises the consequences of the neoliberal model on democracy in Chile since the military coup in 1973. It examines the neoliberal policies implemented under Pinochet's technocratic government. The primary policymakers were a group of Chilean economists studying free-market capitalism at the University of Chicago. The policies build on the economic doctrine of individual freedoms based on a free market with no government interference. To evaluate the relationship between neoliberalism and democracy in Chile, this project considers the implementation of two significant economic measures: privatization and cuts in social spending. The social constraints placed by

these two structural changes expand on neoliberalism's tendencies to marketize the political sphere, institutions, and people. This thesis examines how each economic measure has infringed on the ideals of democracy. It is a meaningful research topic because there is a rising global trend to prioritize economic stakes over all other interests. This movement deteriorates the freedoms and liberties guaranteed to all human beings. This thesis affirms that the introduction and maintenance of neoliberalism in Chile undermine its social and political democracy.

Machinations of the Mazarine: Interpersonal Conflicts of Ambition

Matthew J. Vieyra
Aggie Creative Collective

Faculty Advisor(s): Dr. Jason Harris

My thesis explores the psychological strain of ambition on our interpersonal relationships built as adults. I investigate how the two subjects are correlated and the trap individuals fall in when utilizing a singular motivation. These improvements can better prepare people through kairotic moments of ethics in times of confrontation. Principles in which are created through moral compasses developed since childhood and can be impacted to operating under limited goal-oriented vision. From these understandings our brains are able to move past a lens of ambition and discover liberating alternatives to either-or fallacies. My research aims to analyze these interpersonal concepts wrapped in a compelling psychological thriller piece. The creative artifact presented displays the third option process in action with an excerpt of my novel, Machinations of the Mazarine. A passage which depicts a conversation between two characters poised with business and familial tension. Dawn Lebleu is a prodigy to a fortune 500 airline company that belongs to her father's family. While working as an accountant under the new leadership of her brother-in-law Archer Lennox, Dawn learns his true motives. Lennox inherited the airline's leadership titles solely for a money laundering scheme tied with his other criminal organizations. The piece is a direct confrontation of their conflict while also displays decision making based on separate ethical philosophies.

Oral Session 4: 2:15 PM-3:15 PM CT

Room: MSC 2300 A

Investing Micro-Behaviors in Team Interactions between Engineering Students

Kiara Berry

Faculty Advisor(s): Dr. Theodora Chaspari

This paper examines the interpersonal behaviors between first- and second-year undergraduate students pursuing a STEM field, in a group setting. Dynamics in team settings can contribute to the overall success of a team, mental health of students, and even long-term success of the students' career. Interdisciplinary research has begun to study how technology can improve human interactions to reduce racism, sexism, and hate speech. Many of these technologies have been built by taking textual examples from social media or through retrospective interviews. This paper explores the creation of a dataset of micro-aggressions and micro-affirmations built from listening and running LIWC toolbox on audio and transcript text from group interactions through zoom recordings, where teams of 3 to 4 students (either 2 men 2 women or 3 men 1 women split) work together to solve a set of programming problems. Our dataset can be used to train and create an Artificial Intelligence model that can predict, from a real time interaction, whether a statement is a micro-aggression or micro-affirmation. This can be used to enhance interactions in group settings and improve individuals' communications to reduce micro-aggressions. We expect to find from this dataset that most of the text labelled as a micro-aggression are targeted towards women, who are a minority in STEM, and would result in a decrease of group performance. We expect that micro-affirmations result in the receiver being more communicative in their ideas and even encourage the individual to initiate micro-affirmations of their own. From this dataset, machine learning algorithms were then performed to create a model that can begin to predict on its own micro-aggressions and micro-affirmations.

Sheath Shattered - Using Record Keeping to Build your World

Madeleine Cadungog

Aggie Creative Collective

Faculty Advisor(s): Samuel Woodfin

In my research, I explore using historical examples of non-artistic record keeping as inspiration for worldbuilding in epistolary fiction. For example, in Lewis and Clark's expedition, they discovered new plants and animals and mapped routes to the Pacific Ocean. Their detailed recording of maps and routes, which laid out which areas were great for agriculture and settlement, had a strong impact on American life in expanding west and became the leading force of Manifest Destiny. History is often used as inspiration, while epistolary fiction is apt at creating intimacy between the letter-writer and the reader through the transparency and intimacy of emotion in the idea of writing in the moment. The genre even holds historical ties as the letter novel was considered a popular genre in the 18th century,

many readers enjoying reading the everyday life of the fiction characters. In recent times, the writing style isn't as commonly employed as there are many rules to upkeeping the realism of the style. However, with the introduction of technology, the genre has expanded to various forms such as research reports, newspaper articles, and even emails and texts. This has allowed the style to be less restrictive, while still playing on the strengths of realism. The genre was also associated with the feminine voice as it was considered favored to use as moral instruction to women at that time. Considering the main character of my artifact is female, further research into the topic offers further subversions from epistolary fiction's original intent. To emulate the strong worldbuilding offered by historical recordkeeping, I created Sheath Shattered, a creative artifact in the epistolary fiction genre, which takes a more explorational stance as it introduces a fantasy setting.

Lyapunov Stability of Attractors in Various Artificial Neural Network Architectures

Nicholas X. Siodlarz

Faculty Advisor(s): Dr. Raktim Bhattacharya

Over the last decade, enormous strides have been made in neural network research, leading to their implementation across various platforms. Recommendation algorithms have seen a transformation from being quickly dismissed to having astounding accuracy. Generative deep learning has seen itself thrust into the forefront of public perception with deepfakes, AI-generated artwork, and chatbots spawning questions of ethics and proper practices. However, due to this high exposure, neural networks are subject to a large degree of harmful noise. Thus, it is important to be able to improve and recognize the stability of a neural network, or its ability to settle on a particular set of weights and biases. Often times, the solution involves improving data processing or tweaking key parameters of the network. Although it is recognized that these techniques work to varying degrees of success, the problem often lies in the architecture of the network itself. To combat this, an extensive menagerie of neural network architectures has been proposed for different tasks, with varying degrees of convergence. Directly quantifying the stability of neural networks has proven to be a computationally intensive task, often involving dense, esoteric expressions. Taking the perspective of treating neural networks as discrete dynamical systems, a refreshingly clear insight is offered into their inner workings. This paper aims to identify and visualize the attractors and, through this, the stability, of common neural architectures using dynamical systems theory and Lyapunov stability criteria. Furthermore, algorithms will be proposed that quantify various properties of these attractors, as well as novel neural network architectures that optimize these stability properties.

Room: MSC 2300 B

Creating a Quantum Gate Through Strong Coupling of a Two-Level System in a Nanocavity

Daniel Garraway

Faculty Advisor(s): Dr. Alexey Belyanin

Since the dawn of human observation, we have been studying the interaction between light and the rest of the universe. From the harnessing of fire to the use of telephones, humans have been finding new ways to use light to communicate with one another. Today, our communications have transitioned to a nanolevel, and great strides have been made in the recent past within quantum computing and quantum information systems. These quantum computers are analogous to modern computers in the fact that modern computers compute using bits and logic gates. Still, quantum computers will transfer information using quantum gates created by a coupled two-level system. Manipulating the state of a two-level system can be done in many different ways. In the past, studies would often show that a molecule with two specified energy states can transition between them based on atomic beam pulses. A more effective approach would be to use a classical or semiclassical field to transition between states. We find that quantum gates can be created through a variety of variations of a two-level system. Whether through a quantum dot, a single molecule transitioning between the electronic and vibrational frequency modes, or two molecules coupled by the cavity mode, a quantum gate can be utilized in many different applications. We show that depending on how you set up the initial conditions you can achieve several different types of quantum gates using both one and two-qubit setups. With the increasing interest in the field of quantum computing, the research on how to create, manipulate and control quantum gates is becoming more and more important, which leads to a better understanding of the underlying physics and the development of new technologies.

Multi-Source Breadth First Search in Matrix Notation

Alexandra Goff

Faculty Advisor(s): Dr. Timothy Davis

In this project, I developed a multi-source breadth first search algorithm for LAGraph, a GraphBLAS graph analysis package that analyzes graphs in matrix representation. The algorithm allows a user to get the breadth first search parent and level data of a graph for several source nodes at once instead of having to do each source individually. This is not only easier on the user, but because of the parallelization that the matrix representation allows, it is also more efficient than looping through each of the nodes of interest. While this is valuable to a user in its own right, a multi-source breadth first search also opens the door to other algorithms that could be developed in the future.

Moroccan Livelihood In France: The Role of Ethnic Discrimination in Radicalization

Serena Shabout

Faculty Advisor(s): Dr. Christopher Hemmig and Dr. Maddalena Cerrato

An increase in major European terrorist events over the past decade has shifted the reality for Muslims in Western Europe and not for the better. The 2015 Paris attacks and the 2016 Nice truck attack, both conducted largely by French nationals, have refocused attention on people's origins as a place of blame rather than examining the internal factors that may have contributed to their individual radical actions. Moroccans, one of the largest immigrant populations in Western Europe, are consequently one of the largest Arab populations to have been affected by the policy and attitude changes in response to these events. The French secularist policy has long faced criticism for being prejudiced against Muslim populations. Through new research, I show the presence of a potential connection between ethnic discrimination and radicalization through the application of the reactive ethnicity theory as a theoretical framework. The understanding of collective ethnic identity formations through the lens of psychologists such as Jean Phinney, Ruben Rumbaut, and Henri Tajfel allow for a deeper comprehension of the importance of identity. The pertinence of identity in relation to radicalism is explained by examining the process of radicalization as researched by psychologist Bertjan Doosje, and political scientist Anja Dalgaard-Nielsen. However, these studies were independent of each other and did not attempt to connect the relationship of ethnic identity and radicalism through the lens of reactive ethnic identity. Along with examining reactive ethnicity as a concept, this piece delves into the process of radicalization in Europe by examining the Moroccan immigrant population in discriminatory contexts.

Room: MSC 2300 D

3D Semantic Segmentation with Quasi Solid-State LiDAR

Yifan Sun

Faculty Advisor(s): Dr. Dezhen Song

Current, most 3D semantic segmentation models for autonomous driving are mainly trained on spinning Light Detection And Ranging (LiDAR) data because spinning LiDAR sensors have been one the most popular sensors for autonomous driving vehicles and there is an abundance of spinning LiDAR dataset available to the public. However, spinning LiDAR sensors are costly and requires large amounts of energy to operate. The newly emerged quasi solid-state LiDAR sensors are more cost efficient and require lower amount of energy to operate on autonomous driving vehicles. If we reuse the current models pretrained with spinning LiDAR data on quasi solid-state LiDAR data, its performance is below expectation. Currently there are not enough quasi solid-state LiDAR data to train 3D semantic segmentation deep learning models effectively, and the data pattern for quasi solid-state LiDAR is mostly different from the spinning LiDAR data. This research will study the similarities and differences of the data patterns from spinning and quasi solid-state LiDAR's and develop an algorithm to transform large spinning LiDAR datasets into quasi solid-state LiDAR datasets in order to synthesize enough training data for deep learning models of 3D semantic segmentation. Then a visualization tool will be developed to visualize the training and testing results produced by the deep learning models so that their performances can be evaluated based on comparing the labels of objects in 3D spaces to the truth. After that, part of the newly generated quasi solid-state LiDAR data can be fed into various deep learning models for evaluation, and the best model with high performance and accuracy will be chosen to be trained on the entire dataset.

The Labor and Environmental Dimensions of the Oil And Gas Industry in Qatar

Zaina Aloudeh

Texas A&M University at Qatar

Faculty Advisor(s): Dr. Albertus Retnanto

The aim of this module is to highlight the roles and contributions of these Southeast and South Asian oil and gas professionals. We contacted and interviewed a total of 15 oil and gas employees who come from countries such as Indonesia, India, Pakistan, and the Philippines. Out of those fifteen people, five are female employees and the rest are male. Some of them had worked in their home countries or elsewhere before coming to Qatar. They currently work or have worked in various positions for several oil and gas companies such as QatarEnergy, SLB, Qatar Shell, QAPCO, and TotalEnergies. These interviews were conducted on Zoom over several weeks, and then we transcribed and analyzed these interviews in order to identify recurring themes of discussion. This module highlights several themes that emerged as our interviewees recounted and compared their personal and professional experiences in Qatar to other places they have worked: the personal stories and motivations of these workers to

come to work in Qatar's oil and gas industry, their workplace challenges, their thoughts on Qatarization and their mentorship experience, and their advice for young aspiring engineers. Understanding their roles and contributions would serve at least two things. First, to appreciate the important role they play in the development of Qatar's oil and gas industry and hence to ensure the protection of their rights under Qatari laws. Second, to tell a more complete story of Qatar's oil and gas industry and the development of the country.

Using Multi-instance Regression For Rapid RTL Design Convergence

Pranav Jain and Kunal Gupta

Faculty Advisor(s): Dr. Aakash Tyagi

Chip designs must meet several requirements before they are ready for fabrication. Two of these are total negative slack (TNS) and dynamic power requirements. Meeting these two requirements is a time-consuming task for chip designers in the industry for two reasons. First, the standard approach to calculate these values involves logic synthesis and placement, both of which can take hours or days to run. Second, since the design requirements are rarely met after one design iteration, these processes need to be rerun multiple times to recalculate values during development. To expedite the process of satisfying the design requirements, our research team previously presented a machine learning based approach to calculate TNS and dynamic power values of Verilog chip designs. This technique was orders of magnitude faster than running logic synthesis and placement. In this work, we build on top of the previous approach by employing methods from the field of multi-instance regression (MIR). We also introduce RTL_QoR_Predictor, a tool that enables Verilog chip designers to quickly evaluate the TNS and dynamic power of their designs, and can be run from a command-line interface. The tool also allows researchers to generate feature vectors from their designs, and train and test custom machine learning models for higher accuracy and/or predicting other useful attributes.

Room: MSC 2300 E

Wayward Sword: How Sibling and Family Dynamics Reflect Changes in Culture and Society

Kindy Li
Aggie Creative Collective

Faculty Advisor(s): Dr. Lowell Mick White

Sibling relationships are complex, intimate, and often a very formative part of our lives. Our siblings are often our first friends and first steps into socialization. How we interact with our siblings is often dictated by a set of patterns, such as family situation, culture, or birth order. However, current sibling research often sways in the direction of the elder child, and focuses on sibling interactions within one culture, sibling interactions with disabilities, or sibling incest, but rarely addresses the impact of cultural differences within families and between siblings. Different cultures have different family dynamics, but how exactly does this translate into differences and similarities in how siblings treat each other, and what can we predict about future sibling relationships from what observations we have now? I will be answering this question through the application of research I compiled through the observation of American families at different eras, Confucian principles behind Late Era Chinese dynasties, and research done regarding modern era sibling relationships, by analyzing the main driving points behind each time period then observing how the roles of families and siblings are influenced by and changed as well. My project, Wayward Sword, is an urban fantasy novel that seeks to project a believable, culturally-influenced sibling relationship in a futuristic world that has largely evolved past the use of petroleum and now uses primarily a dangerous pollutive new energy. It follows two siblings, Alys and Rysel Zhou, as they navigate their lives and clash over their different viewpoints of their world through lenses influenced by their respective upbringings and the attitudes their family and society bears towards them.

Mitigating Linguistic Bias in BERT Based Medical Diagnosis Models

Shri Mathavan

Faculty Advisor(s): Dr. James Caverlee

Specialization of masked language models has led to their integration in critical fields such as healthcare. Current machine learning applications have been used for tasks such as patient diagnoses, predicting trial enrollments, consumer health and question answering, and more. However, they've yet to be fully trusted. The issue reveals itself when we recognize that Machine Learning algorithms are subject to bias, a result of the datasets they are trained on, misclassification, and sample sizes. When this bias presents itself in clinical tasks it may exacerbate existing socioeconomic disparities. In this thesis, we propose using prompt-based methods for debiasing clinical-based natural language processing models. No longer focused on traditional debiasing approaches reliant on large domain text corpora. Instead, we aim to utilize prompt design methods and a variant of the beam search method to first generate prompts that

directly invoke the most bias in our models. Once we identify the prompts, we use the Jensen-Shannon divergence to fine-tune the model and lower unfairness. In our preliminary experiments, we found that the prompt design approach reduced both gender and racial bias in language models such as BERT, RoBERTa, and ALBERT, as well as clinical BERT model: SciBERT. Furthermore, this improvement in fairness was not at the detriment of the model's comprehension as showcased in the GLUE benchmark. We hope to further this work by exploring tunable prompts, which would consist of taking our model outputs and back-propagating them into a soft prompt vector. Thus, by the end, instead of a de-biased model, we would have a prompt prefix that would get rid of bias on its own.

Matching and Coarsening in GraphBLAS

Vidith Madhu

Faculty Advisor(s): Dr. Timothy Davis

Recently, there has been a significant desire both within the scientific community and industry to write graph algorithms using linear algebraic operations. This leads to algorithms that can leverage many important algebraic properties of matrix operations, as well as the vast body of research conducted in high performance and parallel linear algebra computations. In addition, such formulations usually lead to densely expressive and short code. To this end, SuiteSparse:GraphBLAS is a framework developed to easily write graph algorithms in the language of linear algebra. LAGraph is a test harness and collection of algorithms written with SuiteSparse; this work will detail the contribution of new algorithms to this collection, which perform maximal matching and coarsening of undirected graphs. A matching is a subset of the edges of a graph such that no two edges in the set share a common vertex. A maximal matching is a matching that cannot be expanded without breaking the matching condition. In this work, we are concerned with maximal matchings of maximum weight. Coarsening refers to reducing the size of a graph in a manner that preserves connectivity information. One way to achieve this is by collapsing edges in a maximal matching. It is known from prior work that matching-based coarsening produces small graphs that can be easily bisected (a process known as multilevel bisection). By projecting the coarsened graph back to its original size, and applying refinements at each stage, multilevel bisection can be recursively used to approximate good k-way partitions, which is known to be an NP-hard problem. We will first explore some mathematical background behind linear algebraic graph algorithms, detail the partitioning and coarsening problems, and present our algorithms.

Oral Session 5: 3:30 PM-4:30 PM CT

Room: MSC 2300 A

Queer Islam: A Lesbian Muslim Experience

Izzah Yousuf
Aggie Creative Collective

Faculty Advisor(s): Dr. Lowell White

This creative work aims at exploring the intersection of identities, specifically that of being both lesbian and Muslim. Islam as a religion has a reputation for being strict and unyielding which, therefore, means associations between the Muslim and queer community is minimal. Muslim-majority countries also have strict laws prohibiting same-sex relationships, punishments for which can be extreme. The societal views of those inhabiting those countries also reflect anti-LGBTQ+ sentiments. While the Western world has seen an increase in support for queer rights and societal views towards queer people have increased as well, Muslims living in Western countries continue to hold prejudice towards queer individuals due to religious beliefs. The emergence of queer Muslims is not unusual and not, in fact, an emergence, but rather a coming out due to societal progress. While facing vehement prejudice and often rejection from the Muslim community, queer Muslims also face hardships from society as a whole for being Muslims and queer, respectively. The overlap of these identities is complicated and intense. My creative artifact explores my experience in this unusual intersection, being a lesbian Muslim, through the medium of poetry. The research reflects on Islamic literature and its view on LGBTQ+ people, also commenting on how other forms of media have previously portrayed queer Muslims.

The Complimentary Gaze: Pain and Pleasure in Jane Austen's Persuasion

Erin Clay

Faculty Advisor(s): Dr. Mary Ann O'Farrell

Contemporary film theorist, Laura Mulvey, conceptualized the "male gaze" as the operation and exaltation of the phallic in cinema and the greater society cinema often reflects. While Mulvey coined the "male gaze" in modernity, such ideas are grounded in the literature and social life of the British Empire's Regency era. The picture of the post-Edenic woman, present in many Regency conduct manuals, catalyzed a phallic fear of immoral women, wanton, and burdened by original sin. In hopes of taming immorality and vice, Regency society correlated external appearances and manners with measures of morality and rightness. Consequently, bodies became signs to be read. In her last complete novel, Persuasion, Jane Austen illustrates the language and power of the gaze to provide both narrative life and death. While previous scholars apply the "male gaze" to the Austenian canon, this research extends such scholarship by introducing an independent authority, the female gaze, and exploring the intersection of both the male and female gaze within the text. Film theory, psychoanalysis, literary criticism, conduct literature, and other secondary scholarship richly contribute to and inform the literary

analysis central to this study. In taking a feminist, historical, and literary theoretical framework, this research argues that although the presence of the gaze proves dually painful and pleasurable in Persuasion, a balanced and complementary relationship between the male and female form provides not only solace in their union but also freedom from the hyper-male gaze rampant in oppressive traditionalism.

Intermediaries

Tami Akerele
Aggie Creative Collective

Faculty Advisor(s): Dr. Lowell Mick White

Daydreaming is an integral part of the life of every individual. A momentary and purposeful withdraw from life to focus on better things. There is, however, a population of people whose daydreams are neither momentary nor purposeful. There is a murky vitreous border between reality and maladaptive daydreamers; They float in a space between real and comfortable. Maladaptive daydreaming is not considered an official disorder to many mental health professionals, but there has been increased exposure about maladaptive daydreaming over social media. There are a multitude of forums and groups on the internet engaged in discourse on maladaptive daydreaming ,and they all seem to revolve around the same three things; how did you start, what do you daydream about ,and how do I stop it ? Intermediaries is a body of work to exploring the intermediaries in our daily lives that we create as a quasi-buffer zone between ourselves and reality, and why people turn to intangible forms of self-expression when unable to deal with the varied experiences that come with life. Specifically, what happens to young women when their intangible forms of self-expression become detrimental to their mental health and overall development? Utilizing the style of the confessional prose and poetry of Sylvia Plath, Intermediaries is a partly fictional poetry and prose collection that will answer the questions surrounding where and why young women go collapse into their minds when they experience collapse externally.

Room: MSC 2300 B

Assessment of Optical Transceiver Compatibility of the Muon Backend System for the CMS Experiment at the LHC

Shachar Gottlieb

Faculty Advisor(s): Dr. Alexei Safonov and Dr. Jason Gilmore

The Large Hadron Collider (LHC), the largest particle accelerator in the world, is planning on upgrading its accelerator in the upcoming High-Luminosity LHC project. This project will increase the flux of incoming particles in the detectors and the rate of data collection, seeking to reveal new elements of physics related to the Standard Model and beyond it. To accomplish this upgrade, the electronics in the LHC detectors must be improved to handle the higher rate of data. The Compact Muon Solenoid (CMS) experiment, one of the four main detectors at the LHC and mainly responsible for the detection of muons, will use new Quad Small Form-Factor Plug (QSFP) optical transceivers as part of this upgrade. These QSFPs will be used to transmit information between the frontend muon detector systems and the backend system. This research study seeks to verify that these optical transceivers will meet the specifications for reliable operation in the CMS experiment by checking their compatibility with the design of the backend system and the multiple interface systems that the backend will interact with. A testing procedure has been created for qualification of the optical transceivers, and involves testing a chosen sample of QSFPs using different frontend systems and determining the sensitivity at which errors start occurring. This testing procedure will allow validation of the design of the backend system and will prove whether or not all QSFP devices satisfy the given specifications.

Injectable Bandage for Treatment of Postpartum Hemorrhage

Elaine Leslie

Faculty Advisor(s): Dr. Akhilesh Gaharwar

Postpartum hemorrhage (PPH), heavy bleeding following childbirth, is a leading cause of maternal morbidity and mortality worldwide. PPH can occur rapidly, within 24 hours of delivery, or as many as twelve weeks later. PPH can result from a variety of conditions, with the most common being uterine atony. PPH can lead to psychological problems such as PTSD and postpartum depression, as well as physical ailments including severe anemia, renal failure, and blood clots throughout the body. There are a variety of current treatments available including manual application of pressure, systemic drugs to combat the underlying cause, and blood transfusions to replace lost blood. While effective, these current treatments require extensive effort by medical providers and invasive intervention. Moreover, they can cause additional trauma to the uterus and systemic adverse effects. Recent efforts to better address PPH focus on developing minimally invasive treatments to stop bleeding and reduce physical trauma to patients. This thesis aims to summarize the currently available treatments for PPH, identify the ideal criteria for novel PPH treatments, and evaluate a misoprostol-loaded hydrogel-based hemostat as a novel PPH treatment. A hydrogel-based hemostat loaded with misoprostol will be characterized for

its material properties and drug-release profile using in vitro models for cytocompatibility, injectability, hemostatic properties, timing of misoprostol release, and stability (shelf-life). Finally, preparations will be made for testing in animal models, as well as preparations for FDA approval. Ultimately, this project aims to develop a novel treatment for PPH that could be used as a stand-alone treatment or in tandem with other current treatments.

Seeds in Sunflowers: Ecocriticism and Identity in a Post-Pandemic World

Damaris Martinez
Aggie Creative Collective

Faculty Advisor(s): Dr. Jason Harris

When it comes to climate change or any environmental rhetoric, so much discourse is met with a distinct divide of urgency and opposition. Many genres in literature often play with the idea of what happens next in the aftermath of an ecological disaster. Seeds in Sunflowers is a thesis with a creative artifact that shows a world where humans were born into the aftermath of ecological and manmade disasters, but can no longer see the consequences of their actions. It then leaves the responsibility to the animals who survived. The artifact centers around a stray tabby cat named Kenny and a bee named Poppy as they navigate the world in order to find some semblance of safety and happiness within their paradigms. The setting of the artifact is modeled around the geographical and architectural structures of the city of Monterrey in Nuevo Leon, Mexico. The methodology used in this thesis is through an ecocritical framework that serves to analyze the implications of a setting that is both industrial and environmental. By using this framework it allows for a more holistic understanding of the implications of environmental concerns left after the first wave of the pandemic in 2020. This explores the dynamics of a post-pandemic world, pulling from narratives that are in a way as a form of escapism and at the same time representative of a culture that is not always put in a positive light in the media.

Room: MSC 2300 D

Constraining the Uncertainty of Climate Change Using Simple Climate Models and Paleoclimate Data

Jeffrey Sachnik

Faculty Advisor(s): Dr. Yangyang Xu

The extent to which the Earth will warm in the coming years due to human-induced global warming is uncertain for several reasons. One such reason is the uncertainty surrounding the heat inertial behavior of the "effective ocean." The effective ocean is the ocean which actively participates in the Earth system. Reducing the uncertainty surrounding how this key climate parameter warms and cools would provide policy makers higher-precision guidance to better mitigate and manage global warming, and ultimately combat climate change. However, innovating novel methods to constrain future temperature projections is difficult, especially considering the limited record of detailed current observations (~1850—Present), a snapshot in climatological time. Paleoclimate data can supplement the current observational record of climate data, allowing further insight into how the ocean behaves at (warmer) conditions unfamiliar to the present-day. These million-year-old records of temperature, carbon dioxide concentrations, and other atmospheric conditions are relatively fundamental compared to the data today. Therefore, climate analyses must be made using "simple" climate models. Simple climate models use only key parameters of Earth's climate system, such as the heat capacity of the effective ocean. This research work analyzes a record of climate data from millions of years ago using a simple climate model to constrain effective ocean behavior. However, due to Intellectual Property rights concerns, any data or results analyzed from this data cannot be disclosed at this time. Instead, an introductory overview will be given, covering how paleo climate data can improve future climate projections, particularly using simple energy-balancing climate models.

The Composition of Quantitative Nutritional Analysis Using Raman Spectroscopy

Axell Rodriguez

Faculty Advisor(s): Dr. Dmitry Kurouski

The main goal of this research journey is to enhance the upcoming, cutting-edge technology that is Raman spectroscopy (RS), known for being non-invasive, non-destructive, and chemical-free. Through this method, we aim to strengthen and test the instrument's potential in its ability to accurately identify and classify different vibrational frequencies to enhance precision nutrition. Through precision nutrition, we can identify important macromolecules such as carbohydrates, proteins, and fats to reach a precise quantification of one's nutrient intake. By analyzing popular international foods such as ramen noodles and bread, we can promote the use of Raman spectroscopy to create a non-destructive and chemical-free method in the production of these foods. In this study we can successfully collect and process the data obtained from these foods to support the claim to enhance our nutrition through Raman Spectroscopy. In addition to this, our goal in using Raman spectroscopy is to analyze a variety of peanut

genotypes, and potentially other biofuels, to assist in the search for an efficient, reliable, and renewable energy source. To further support the data collected using this spectroscopic technique, the data is analyzed using a multi-paradigm programming language. The program in question used to process this data is MATLAB by MathWorks.

The Reconquista Myth and the Rise of Vox in Andalusia

Mahera Muquith

Faculty Advisor(s): Dr. Maddalena Cerrato

Spain has differed from the rest of the European Union for decades due to its lack of far-right party representation in the government. However, that unexpectedly changed when in 2018 the far-right Vox Party infiltrated the regional parliament of Andalusia after a successful election. Despite its recent emergence in 2013, the Vox Party was able to flip the Andalusian parliament after years of social democratic rule. This thesis explores how the Vox Party was able to gain support in the Andalusian region. The Vox Party has invoked the concept of the Reconquista as part of its narrative, a strategy that has been used by far-right entities in Spain since the Franco regime. This thesis argues that the concept of the Reconquista is a historical myth that was created to legitimize Spain through a unified identity. However, it also highlights that constructing a fictional national historiography in order to establish a nation is not unique to Spain. This thesis further argues that the Vox Party instrumentalized the Reconquista, a historical myth, as a narrative that parallels the current conditions of contemporary Spain. By continuing to mold Spain's history, specifically the Reconquista, into a national narrative about how Spain is a Catholic nation united against Islam, Vox was able to garner the support of the people of Andalusia. While this thesis acknowledges that there are other factors that contributed to Vox's success, it adds that the Reconquista is also an important contributor.

Room: MSC 2300 E

Experimental Validation of a Volumetric Receiver Model Which Enhances the Volumetric Effect of Concentrated Solar Power Using Partially Reflective Surfaces

Sayed Afnaan Ahmed
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Konstantinos Kakosimos

The project focuses on experimentally validating a previously designed theoretical model that works to enhance the volumetric effect of concentrated solar power using partially reflective surfaces. The design optimizes a honeycomb-like structure that improves the reflectivity distribution to take advantage of the volumetric effect (Salih, 2021). Throughout the paper, the design, fabrication, testing, and commissioning of the volumetric receiver will be discussed. After ensuring the volumetric receiver is ready for data acquisition, it was placed with the other components in the setup, such as the flow and cooling systems. A solar simulator was used to provide a concentrated heat source to the receiver and the system was tested and commissioned. A flux gauge was also used to measure the flux produced by the solar simulator after which the receiver was placed instead of it to absorb the radiation. The data collected will be analysed according to appropriate data analysis and research methods. The aim is to verify the increased efficiency of the receiver's ability to absorb a greater percentage of solar energy than state-of-the-art receivers available today. The validation of the experiment could result unsuccessful if the data obtained is not significant to solidify the theoretical model, however the main focus of the research will be to collect good quality data regardless of the outcome.

Set Fires to Our Rivers of Hope: Social Identity Theory and Blame Attribution in the International Climate Crisis

Hollie B. Polk

Faculty Advisor(s): Dr. Nehemia Geva and Maisie McCormack

Climate change has become a multifaceted, intersectional issue requiring an international, political, and personal response. It has posed a number of questions, including how intergenerational, geographical, cultural, and theoretical problems converge. To mitigate climate change, immediate actions are necessary, but when international disasters occur, what actions will citizens support? Though there has been previous research on belief in human-caused or naturally-caused climate change over time, this research has rarely focused on the ways in which disastrous events abroad are perceived by Americans. This paper utilizes an experimental approach, looking into how cultural similarities and differences, responsibility for emission levels, and geographical proximity either hinder or create support of action. Data consists of survey results from 600 Gen-Z students at Texas A&M University. The findings show that individuals believe climate change is human-caused, rather than due to natural cycles. Additionally, individuals do not strongly believe that climate change has affected them in the past, but consistently believe that climate change will adversely affect their futures. Contrary to assumptions and previous

findings, individuals broadly support international and domestic action being taken against climate change, regardless of the cultural identity, responsibility, or geographical distance of the victim of a disaster. However, there are differences in the levels of willingness of an individual to personally act and reduce carbon footprint as a result of cultural distinctions, emission responsibility, and geography. Regardless of the identity of a victim, Gen-Z individuals perceive climate change as increasingly dangerous, human-caused, and worthy of combatting.

Evaluating the Impact of Lifestyle-Altering Events on the Usage of Green Transportation Systems

Mohona Ghosh

Faculty Advisor(s): Dr. Tracy Hammond

The advent of and worsening climate change has made the development of green technology increasingly prevalent in today's society. One of the primary focuses of such development is in transportation, as it is widely viewed as one of the largest contributors to global warming. Bike-share systems are at the forefront of this field, being a widely used and relatively inexpensive mode of travel that does not depend on the usage of fuels, non-renewable or otherwise. While many bike-share systems have been established in cities and individual institutions around the world, the reach potential for these systems has not yet been fully realized. One overarching reason for this could be that such systems are unable to adequately satisfy the demands of the population of service or robustly respond to lifestyle-altering events such as the COVID-19 pandemic. This paper aims to demonstrate an evaluation of the effectiveness of a bike-share system by using Texas A&M's VeoRide bike-share system as a model. First, data collected from the system's API before and after the bulk of the COVID-19 pandemic is analyzed to determine if and how usage patterns across campus significantly changed as a result of the pandemic; as part of this analysis, a machine learning algorithm is trained on pre-pandemic data and tested on post-pandemic data. Second, a survey is conducted to better understand the average user's view of the bike-share system's efficacy and pinpoint areas of improvement. Together, these two methods of analysis will facilitate the understanding of how movement patterns change as a result of major lifestyle changes, and how attempts at green transportation systems can more robustly address the needs of their customers over long periods of time.

Poster Sessions

Poster Session 1: 9:00 AM-10:00 AM CT

Room: MSC 2300 C

Poster #1

On a Series Involving Euler's Totient Function

William F. Frendreiss

Faculty Advisor(s): Dr. Matthew P. Young

The goal of this thesis is to provide an in-depth analysis and discussion of an equivalence to the Riemann Hypothesis (RH) proven by Jean-Louis Nicolas. Nicolas' proof relates RH to an inequality of Euler's totient function phi, and establishes a number-theoretic equivalence to RH. If Nicolas' criterion holds for all primorial numbers, then RH is true. If not, then RH is false. This proof is given an original translation into English from the original French and annotated, with small corrections to computations. His work is then extended by relating the equivalence to the convergence of an infinite series which is shown to converge to 1/2. Using this series and the related partial sum, consequences of the truth or falsehood of RH are explored in the context of Nicolas' criterion. We assume both the truth and falsehood of RH, and in doing so underscore the extreme difficulty of this problem as well as the delicacy of the inequalities involved. Also provided are multiple programs which computationally verify expectations regarding the rate of convergence of the aforementioned infinite series. Optimization of these programs are discussed as well as difficulties. The research results were limited by the nature of the problem. None of the analysis on the convergence criterion yielded a contradiction to an established result or conjecture, assuming either RH true or false. However, RH is known to be one of, if not the most difficult problems in modern mathematics, and significant progress was largely outside the scope of this thesis. The hope is that this research renews interest into Nicolas' criterion and arithmetic inequalities equivalent to RH.

Poster #2

Utilizing Wearables to Predict the Onset of Anxiety: Refining Design, Data Collection, and Interpretation

Jacob Kelly

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

For at least the past fourteen years, the net percentage of adults aged eighteen and older who experience symptoms of anxiety has continued to rise. Presently, there is not a widely accessible, low-profile, and accurate device available to indicate when an individual is entering a state of heightened anxiety. Commercially available devices provide low accuracy, while most devices used in research take the form of chest straps, EEGs, or other obtrusive devices. One solution is to develop software that can interface with a common consumer wearable, such as the Apple Watch or Fitbit. This study implements a software to track changes of an individual's physiological readings, such as their heart rate, in order to

predict their anxiety levels in real-time. Through interfacing this software with the Apple Watch, this study serves to demonstrate that this is a valid approach to solving this problem. The accuracy of this study's results have been determined through comparison to studies that utilized EEG or other large-profile devices to obtain readings. The development of a widely available and accessible system to predict and track anxiety will allow users to gain increased control over their situation. With sufficient forewarning, they may be able to take preventative measures to reduce their symptoms of anxiety such that they do not become severe.

Poster #3

Techno-Economic Production, Storage, and Utilization of Green Hydrogen in Qatar

Muhammed Zeeshan Ahmed and Abdul Raheem Tahir
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Dhabia Al-Mohannadi

Techno-economic utilization of green hydrogen is a vital topic since the main goal of this effort is to reduce or eliminate carbon dioxide emissions caused by Qatar's energy production. There are potential gaps in the research and limitations since the research was performed using a computer-based model and the data was based on literature review. It was determined that the overall capital investment cost of the entire system is approximately $6000 per kW. This figure is within a particular economic range. The annual cost of operation and maintenance is thought to be between 4% and 5% of the original cost. Based on collected information, it was determined that a model would be needed to produce 865,642,000 extra kWh per day to transition Qatar from using conventionally fueled vehicles to alternative vehicles and 1,840,000 kg of hydrogen per day to transition Qatar from heavy diesel vehicles to heavy hydrogen vehicles. It was concluded that when the process of natural gas extraction was considered, the carbon dioxide emission by 2 natural gas steam reforming was approximately ten times that of ethanol steam reforming. This analysis did not consider the environmental aspects of hydrogen costs. The investment cost of a fuel cell is expected to decrease as technology advances.

Poster #4

Study for Improving Autograder Feedback

Jacob Enerio

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

Autograders are used throughout computer science classes to grade programming assignments, with experimental versions capable of analyzing "Explain in plain English" by using Natural Language Processing (NLP). However, most of this development has been focused on making autograders for different kinds of programming environments. While there have been attempts to improve feedback of autograders, these attempts do not match the quality feedback of humans. Some of them also require a significant amount of input from the instructor. My proposed solution is to create a program that guides students on how to fix their programs and point out any gaps in the student's conceptual knowledge of

the problem. The system would go through the debugging process with students. It features a debugger along with some other specialized tools. For example, there is an algorithm visualizer to help students trace through the different steps of solving the problem. Students can also make their own test cases and run them through either the debugger or visualizer. The evaluation of the program involves gathering student feedback on the system through surveys after using the autograder system to complete a short programming problem. The system would be able to help students outside of office hours and allow them to get a better understanding of debugging.

Poster #5

Microbial Activity and Response to Temporal and Chemical Gradients in the Gulf of Mexico.

Norely Faz

Faculty Advisor(s): Dr. Emily R. Estes and Dr. Jason B. Sylvan

Seasonal hypoxia in the Gulf of Mexico can create dead zones that have significant economic and ecological impacts. Hypoxia is exacerbated by anthropogenic activities in the Mississippi River watershed which lead to elevated nutrient concentrations in Mississippi River discharge. Previous research has established that hypoxic conditions alter microbial activity and microbial community structure. Here, we study microbial abundance and enzyme activity under different conditions to achieve a holistic view on the metabolic response of heterotrophic microorganisms to varying geochemical parameters. Two cruises were completed during March '21 and August '22 on the R/V Pelican in the northern Gulf of Mexico and Mississippi River. We captured gradients in salinity, temperature, nutrient concentrations, dissolved oxygen, chlorophyll, and CDOM. The cruises resulted in 92 cell count samples and 200 cell count samples respectively. Of these, approximately half were duplicates. The spring dataset showed that enzyme activity rate varied by enzyme and site, with esterase being the most abundant. These values were comparable with previous studies. The new dataset will allow us to extend these correlations to more hypoxic conditions. A final planned cruise in October 2023 will provide samples from after hypoxic conditions have dissipated.

Poster #6

The Impact of Creative Movement on College Students' Mental Health

Callysta Hall and Trinity Pace

Faculty Advisor(s): Alexandra Pooley

Dance science is a rapidly expanding field of study that aims to discover the advancing effects of dance and places an emphasis on maximizing safe participation in it to contribute to the longevity of dancers' careers. Anyone from professional healthcare workers, to dancers, to the everyday person can experience benefits through understanding these concepts. Recent studies have revealed that participation in dance and creative movement can benefit mental health. The goal of this study is to

further expand on the research on this concept by using the college undergraduate student population to test the efficacy of using dance as a way to help treat and prevent specific mental health symptoms. Participants took an hour-long guided improvisational dance class led by the student researchers, Cally Hall and Trinity Pace, once a week for 4 weeks in a row. The participants were encouraged to step out of their comfort zones and try moving their bodies in ways that challenged them both physically and mentally. In order to quantitatively test for improvement in the participants' mental health symptoms, we utilized the Depression, Anxiety, and Stress (DASS) Test, which has been approved for non-clinical research. The participants completed the DASS test prior to the first week and once again after the fourth week of their dance classes, which served as the pre and post-test assessment of their mental health status. Additionally, they completed a free response style survey after the second week to note any changes in their mental state that they experienced through participation in the study leading up to that point. The researchers hypothesized that with the implementation of four weeks of dance classes the DASS scores should decrease, indicating a decrease in negative symptoms.

Poster #7

Affects of Sex Education Perspectives

Tatiana Shojaei

Faculty Advisor(s): Dr. Rachel Smallman and Dr. Sara Dowd

Sex education plays a vital role in many aspects of a person's life, yet, there is a large disparity of knowledge revolving around the topic of sex and sex education. The sensitive nature of sex stems from its political and religious affiliations, which have in some cases become a part of sex education or been the reason for a lack of sex education. The delivery of sex education, if a person receives any, is often geared towards a specific narrative that in turn formulates our perspective and carries on into different aspects of our lives. The current work focuses on three different forms of sex education, Love and Intimacy based sex education, Biology-based sex education, and Abstinence-based sex education, and looks to evaluate their influence on a person's perceptions of sex, virginity, love and intimacy, sexual well-being, and sexual self-efficacy. By evaluating the varying perspectives of sex education, the current work looks to identify the individual influences each form of sex education has to offer, as the best programs will offer a diversity of opinions. Participants were randomly sorted into one of four conditions, the Love and Intimacy based condition, the Biology based condition, the Abstinence based condition, or the control condition. Besides the control group, each group was given a sex education video according to their assigned condition. Evaluating the different sex perspectives collected from the different variations of sex education there is an expectation that the quality of one's sex life and overall views of sex and virginity will be affected. The data collected further delves into the interpretations of the different sex education perspectives and their varying impacts.

Poster #8

Branch History Based Data Prefetching

Scott Shepherd

Faculty Advisor(s): Dr. Paul Gratz

Memory prefetching in computer processors is the practice of predicting memory addresses that will need to be accessed and issuing requests to pull data from those addresses ahead of time. These circuits are crucial to combatting the "memory wall", a bottleneck in processor speed caused by the relatively slower progression of memory access speeds compared to progress in instruction execution speed. This project builds upon the Signature Path Prefetcher (SPP), a prefetcher for the L2C cache developed in Professor Gratz's CAMSIN research group. The SPP decides prefetch addresses based on a delta access history signature. This project explores the possibility of enhancing the SPP by incorporating branch history data (branch decisions & target addresses) into the existing prefetcher structure. The Branch-Directed SPP aims to improve overall performance as measured by IPC speedup, as well as prefetcher accuracy and coverage. Preliminary results show that the design performs similarly to baseline SPP across these metrics, outperforming slightly on some trace sets and underperforming slightly on others.

Poster #9

Parahydrogen Delivery and the Effectiveness of Low-Field Nuclear Magnetic Resonance (NMR) in Detecting Protein-Ligand Binding

Clarice Flores

Faculty Advisor(s): Dr. Christian Hilty

In recent years, researchers have returned to focusing on and developing low-field NMR systems. One of the most commonly used chemical analysis methods, high-field NMR requires superconducting magnets that are both expensive and space-consuming. Currently, low-field NMR is an area of study that has the potential to deliver fast data with a cheaper, benchtop experience compared to typical high-field or super-high-field NMR. Optimizing currently known NMR instrumentation has many different applications from commercial food analysis to magnetic resonance imaging (MRI). Low-field NMR, which does not employ a superconducting magnet, cannot get a strong enough signal to produce timely results or results with a large enough signal-to-noise ratio to be viable. One method of amplifying the signal obtained from low-field NMR is para-hydrogen-induced polarization (PHIP). Low-temperature hydrogen gas in a super-aligned spin state is known as parahydrogen. Parahydrogen delivery to a liquid NMR sample allows for the transfer of the super-aligned spin state to the target molecule increasing the magnitude of the low-field NMR signal. This research addresses how best to deliver parahydrogen to a low-field NMR sample solution non-reactively so that optimal polarization can occur. The accurate introduction of parahydrogen delivery is important to make low-field NMR a competitive method for affordable, benchtop analysis of protein-ligand bonding. Other low-field NMR processes have varying methods of parahydrogen delivery and sample polarization in general. Current low-field NMR processes

are still being optimized and are in the process of being widely used. Particularly, for the scope of this research, drug discovery is a highlighted potential application.

Poster #10

Survey of Dorsal Root Ganglion Neuronal Subtypes That Synaptically Connect With Transplanted Neurons in the Injured Spinal Cord

Jacob Stallman

Faculty Advisor(s): Dr. Jennifer Dulin

Spinal cord injuries are devastating and can lead to many complications including allodynia, hyperalgesia, spasticity, and loss of sensory and motor function. Currently, there are no treatment plans that can successfully repair spinal cord injuries, so primary care providers are forced to resort to treating symptoms. A promising research avenue for the treatment of spinal cord injuries is neural progenitor cell (NPC) transplantation. This form of stem cell therapy has been shown to integrate into the host's nervous system and improve sensory function in mice and primate models, but no one has investigated exactly which subtypes of sensory neurons are forming connections with the neural progenitor cell graft. To do this, we used Rabies helper/Syn1-cre grafts in C4 dorsal column lesions and monosynaptic rabies tracing. By colocalizing rabies positive neurons with other biomarkers visualized through fluorescence imaging and immunohistochemistry we will be able to see which specific subtypes are forming these connections. Additionally, by performing this analysis at every level of the spinal cord, we will be able to visualize the extent of connections these grafts can make. These results will help gain a greater knowledge of how sensory function improves after NPC transplantation and the graft cytoarchitecture from which it originates.

Poster #11

Characterizing Effects of Anterior-Posterior Identity on Neural Progenitor Cell Graft Integration after Spinal Cord Injury

Joseph Hoppe

Faculty Advisor(s): Dr. Jennifer N. Dulin

Transplanting neural progenitor cells (NPCs) into sites of spinal cord injury (SCI) is a promising approach at rebuilding complex neuronal connections and potentially restoring lost neurological function. Studies have shown that the broad regional identity of transplanted NPCs "“ for example, brain versus spinal cord identity "“ has a significant impact on graft integration into SCI sites in rodent models. However, no studies have looked specifically at how NPCs derived from anterior versus posterior embryonic spinal cord regions might differentially integrate into the injured spinal cord. In this study, we aimed to understand whether NPCs of anterior or posterior tissue identity exhibit differences in neurogenesis and gliogenesis, or differences in integration with existing neurons within the injured nervous system. We performed dorsal column lesions at the C5 spinal cord level in adult wild-type mice. NPCs were obtained

from either the anterior or posterior regions of GFP+ embryonic (E12.5) mouse spinal cords and transplanted into the injured adult SCI mouse models. Grafts were given 8 weeks post-transplantation to mature and integrate in vivo, then mice were sacrificed. The spinal cord tissue was then cryo-sectioned transversely, and the sections underwent immunohistochemistry. Image analysis of the graft and surrounding tissue using FIJI software was performed. As predicted, we did not observe any significant differences in graft volume, Sox9+ astrocyte density, neuronal density, or axon outgrowth between the two groups. Currently, quantitative PCR is being performed to further analyze gene expression differences in the anterior and posterior regions of embryonic spinal cords.

Poster #12

Counterfactual Thinking, the ABC Model, and Healthy Eating Intentions

Meagan C. Hodges

Faculty Advisor(s): Dr. Rachel Smallman and Dr. Sherecce Fields

University students tend to engage in unhealthy eating behaviors for a variety of reasons such as convenience, taste preference, and a lack of nutritional knowledge. In an attempt to identify barriers to healthy eating, researchers have discovered that one's state of mind impacts eating behaviors. Counterfactual thinking is a type of cognition involving thinking about an alternative outcome to a past event. Typically, counterfactuals are characterized as "if only¦then¦"? statements. When used as an intervention, functional counterfactuals can change behavioral intentions. Functional counterfactuals have been theorized as needing to correctly identify a causal antecedent that one can perform and understanding how the future behavior could be relevant in the future. However, researchers have not fully explored how to guide participants to generate more functional counterfactuals. The ABC model of therapy involves identifying the antecedent, behavior, and consequence of an event. The present study furthers counterfactual interventions by examining how the ABC model can lead to a more significant change in behavioral intentions and counterfactual generation related to healthy eating intentions. Participants were randomly assigned to one of four conditions: negative event only, negative event with ABC model, negative event with counterfactual intervention, and negative event with counterfactual invention and ABC model. We hypothesized that those in the ABC model condition would generate more counterfactuals/factual statements and more functional counterfactuals. Additionally, it was hypothesized that participants in the counterfactual ABC condition will report the strongest intentions to eat healthy.

Poster #13

Effects of Butyrate on Colonic Organoid Growth and Gene Expression in High vs. Low Glucose Conditions

Jennie P. Kim

Faculty Advisor(s): Dr. Robert S. Chapkin

Organoids are key experimental tools due to their 3-D arrangement which better recapitulate the structures of an organism in vivo. In this study, we utilize adult mouse colonic organoids. The colon contains trillions of microbes that form the gut microbiota, a unique microbial community. Fiber is fermented by gut microbes which produce various metabolites as byproducts, one of which includes short chain fatty acids (SCFA). Butyrate, a 4-carbon SCFA, is an area of high interest and widely studied for its functions in the colon as an energy source for cells and a histone deacetylase (HDAC) inhibitor. Butyrate metabolism involves high oxygen-consuming processes that induce a semi-hypoxic environment that upregulates hypoxia-inducing factors (HIF), transcription factors that influence intestinal homeostasis. In a parallel set of conditions comparing high vs. low glucose, we seek to investigate the dose-dependent effects of butyrate on colonic organoid growth and HDAC activity, HIF expression, and downstream gene activation to better understand butyrate as an epigenetic regulator. We hypothesize that butyrate in low glucose will increase organoid growth. In contrast, at higher concentrations, butyrate will function as an HDAC inhibitor and increase apoptosis, inhibiting organoid growth. In high glucose, butyrate will decrease organoid growth due to the intranuclear accumulation of butyrate. Colonic crypts from Lgr5-GFP high mice will be isolated to prepare single cells for sorting. The cells will be cultured in high or low glucose media with varying concentrations of butyrate. Organoids will be imaged using fluorescence microscopy, and HDAC activity measured using an HDAC activity assay. RNA sequencing will be performed to measure the effects of butyrate on gene expression.

Poster #14

Photostimulating the ER-Chloroplast Junction, but not only the ER, Results in Immediate Cytosolic Calcium Release in Arabidopsis Hypocotyl Cells

Nicholas Chow

Faculty Advisor(s): Dr. Lawrence Griffing

The Arabidopsis thaliana endoplasmic reticulum (ER) forms contact sites around the chloroplast via a membrane structure which results in an ER-chloroplast junction or nexus. By photostimulating the nexus with blue/violet beam an immediate calcium wave is released to the cytosol from the Ca2+ stores in the ER. Similarly, photostimulating the ER with blue/violet beam results in a cytosolic calcium wave. However, FRET (fluorescence resonance energy transfer) analysis of the ER calcium wave demonstrated a delayed and significantly lower Ca2+ release from the ER lumen when compared to the nexus cytosolic calcium wave. Multiple ER photostimulations concentrated around the nexus and multiple ER photostimulations distributed throughout the cell results in a delayed cytosolic calcium wave. Multiple ER photostimulations, despite being photostimulated in different areas, results in similar calcium waves

to a single ER photostimulation. Thus, multiple ER photostimulations couldn't simulate a nexus cytosolic calcium wave indicating that a special structure within the nexus detects blue/violet beam, coupled to the Ca2+ stores in the ER. Using varying levels of blue/violet beam (100/75/50/25% laser power) to photostimulate, the nexus shows a trend of decreasing cytosolic calcium as light intensity lowers. Multiple ER photostimulations demonstrates similar, but increasing, cytosolic calcium waves that are relatively invariate with light intensity. Comparison of ER and nexus photostimulation creates a model that certain levels of photostimulation produces additive responses similar to an action potential in a nerve cell.

Poster #15

Bison Wholesale Price Analysis with Competing Animal Protein Sources in the United States

James H. Johnston

Faculty Advisor(s): Dr. Senarath Dharmasena

Bison are steadily gaining popularity as a protein source in the United States. Restaurants and grocery stores are increasingly offering bison products such as ground bison and bison steaks. Bison were almost driven to extinction in the late 1800s from an estimated 30 million head to just 325. Herd sizes have steadily grown since the beginning of the 20th century to around 500,000 with 80 percent being raised as livestock. With the increase in population and popularity, some cattle ranchers are switching from raising beef cattle to raising bison for slaughter. Animal protein sources are substitute goods for one another, thus a change in the price of bison meat could drastically affect the price of competing meats. However, research has not yet been done on bison meat from a producer price analysis standpoint. Using historical monthly weighted averages of negotiated bison wholesale prices, this study aims to find the effect that bison meat has on the national protein market and to establish where bison meats stand as a product compared to its substitutes. Causal inference is found through machine learning and artificial intelligence implemented through directed acyclic graphs. Findings from this study could yield trends and correlations between bison meat and other protein sources.

Poster #16

Automated System for Benchtop Characterization of RF Coils

Jeanpaul Posso

Faculty Advisor(s): Dr. Mary P. McDougall

Radio frequency (RF) coils play a pivotal role in the quality of magnetic resonance imaging (MRI). RF coils are designed to optimize sensitivity to a range of sample geometries, resulting in a broad range of coil shapes and sizes. Therefore, this requires the ability to characterize often vastly different coil geometries before they are used for imaging. To do this, "benchtop" measurements of the transmit fields (B1+) of the coil are acquired with the use of a field probe and a network analyzer. Data gathered

from this procedure can be visualized as a field map to illustrate the B1+ field with respect to spatial location and to draw conclusions about the behavior of the coil under various conditions and the respective fields produced. While the process of acquiring benchtop measurements can be performed by hand, this option has proven to be time-consuming and to produce inconsistent results. To overcome this issue, commercial systems to automate the procedure have been built, but are costly. In this work, an alternative solution is proposed consisting of a low-cost automated system capable of acquiring consistent and repeatable benchtop data including performing B1+ field measurements of coils of varying sizes for field map visualization. The functionality of this system was evaluated by generating field maps of the magnitude and phase of a birdcage coil. The field maps were successfully generated for a circular cross section with a field of view (FOV) across a 13 cm diameter and 1 cm resolution, showing an overall homogenous B1+ field as expected for the birdcage coil as compared to imaging data.

Poster #17

Differential Partitioning of Per- and Poly-Fluoroalkyl Substances in Alaskan Fish

Brittney Breazeale

Faculty Advisor(s): Dr. Yina Liu

Per- and Polyfluoroalkyl Substances (PFAS) are a classification of human-made chemicals that are resistant to degradation, and thus are persistant in the environment. PFAS widely used in numerous consumer products, such as fire suppressors, foam-blowing agents, and products with oil and water-resistant characteristics. Therefore, PFAS are ubiquitous in the environment and found in many organisms, such as fish. PFAS research among fish typically aims at determining concentrations in the entirety of the fish or a particular organ such as the muscle or liver (Haukas et al.). However, data on systematic, multi-organic distribution of PFAS is relatively scarce. PFAS binds based on a protein's hydrophobic and polar/electrostatic interaction characteristics. Proteins displaying these features are primarily found in organisms' blood, kidney, and liver. This research aims to understand how the chemicals partition within different organs of various high trophic level fish. Concentrations of 35 PFAS compounds were determined in muscle, kidney, liver, gonads, and roe for 3 Alaskan upper trophic level fish species. The most abundant compound in each species was perfluorooctane sulfonic acid (PFOS). The location of the species also dramatically influences the concentration of particular PFAS, where Monsson Lake and Moose Creek have significantly higher concentrations than the species gathered from Cushing Lake, reflecting the levels of PFAS contamination in these regions.

Poster #18

DART Dynamic Affordable Radio Telescope

Andy Cox

Faculty Advisor(s): Dr. Justin Spilker

Substantial discoveries and achievements in space are waiting to be made, but despite increasing public and private investment, many significant advancements require expensive and specialized equipment -- particularly in the electromagnetic spectrum. The Dynamic Affordable Radio Telescope (DART) design is a quick deployment and low-cost radio telescope for single or multi-band applications from parts obtainable at a local hardware store. The impact of DART is providing accessibility to study and interact with the cosmos to the general public. The DART design serves as a complete package featuring: stressed parabolic antenna, motorized mount and programs for both control and construction aid; all of which many amateur radio telescopes do not provide. The DART implemented in this thesis is a single band receiver purpose built for hydrogen line observations and serves as a model for the cost, construction, and design process. Once complete, it will function as an educational tool for Texas A&M University. This research focuses on best considerations, practices, and implementation strategies for creating DARTs. The research methods used are those in theory and experimentation. Theory answers, "what one should do" and is supported by literature and numeric computations. Experimentation answers "what one can do" due to variables and limitations not accounted for in theory. Various graphs, explanations, photographs, and programs are prepared to support both theory and implementation throughout the design process as well as expression of personal design decisions and challenges. Further research can provide better implementation practices considering material specifications, construction techniques, and the use of computer-generated models.

Poster Session 2: 10:15 AM-11:15 AM CT

Room: MSC 2300 C

Poster #1

Volume Measurement and Analysis of Left Ventricular Assist Device (LVAD) Inflow Cannulation in Heart Failure Patients

Ankita Rao

Faculty Advisor(s): Dr. Michael Moreno and Dr. Andrew Robbins

Left Ventricular Assist Devices (LVADs) are used as destination treatment or bridge to transplant in patients with late-stage heart failure. However, LVAD treatment can lead to complications such as stroke and gastrointestinal bleeding. Previous studies have shown that blood pooling around the inflow cannula can lead to clotting, which greatly increases the risk of complications. However, the descriptions of the measurement methods used in these studies are vague and vary from one to another, making repetition of these methods difficult. We propose a well-defined, repeatable method of volume segmentation from CT scans that can assess the stagnant blood volume and the risk of thrombus formation in the left ventricle based on patient-specific geometry.

Poster #2

Regional Variation in Common Dietary Markers (δ13 C and δ15 N) for Wahoo (Acanthocybium solandri) from the Atlantic Ocean

Brendan Gough

Texas A&M University at Galveston

Faculty Advisor(s): Dr. Jay Rooker

Trophic ecology is an integral area of research that provides important insights on the food web structure in marine ecosystems. Stable isotopes **δ**13C and **δ**15N are common dietary markers that accumulate in the muscle tissue of predators and can be used to determine broad trends in dietary sources and trophic position. Using stable isotopes, the aim of this study was to assess regional differences in the trophic ecology of wahoo (Acanthocybium solandri). Wahoo muscle biopsies from four regions were included in our analysis: eastern Gulf of Mexico (n=10), western Gulf of Mexico (n=10), northwest Atlantic Ocean (n=10), and Caribbean Sea (n=10). Carbon and nitrogen stable isotope ratios (**δ**13C and **δ**15N) of wahoo from all regions ranged from -15.8‰ to -18.8‰ and 7.2‰ to 12.8‰, respectively. Regional variation in both dietary markers was present, with the most salient differences observed between individuals collected from the Gulf of Mexico (mean **δ**13C = -17.06‰ **δ1**5N = 11.27‰) relative to the Caribbean Sea (mean **δ**13C =-16.34‰ **δ**15N = 8.44‰). Results indicate that

dietary sources and the trophic position of wahoo vary as a function of their geographic location, which appears to support the premise that this species may feed opportunistically throughout its range.

Poster #3

The Application of Additive Manufacturing in Industry to Replace Subtractive Methods for Manufacturing

Hassan Khan, Mohammed Irfan Shahul Hameed, Ahmed Afzal, and Adnan Ebrik
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Bilal Mansoor

In this project, a mold for a damaged polymer structure within a pump casing will be built. Essentially a mold similar to the casing of a water pump. The part that is being studied upon is the casing of a water pump which is used in industry and has been damaged. The project phase 1 looks at subtractive manufacturing and the effectiveness and properties of the part will be compared with additive manufacturing in phase 2 of the project. The properties of both processes will be analyzed to see which process is best for industry. The CAD design that was produced by the team was improved with the guidance of Engineer Osama Desouky as initially our dimensions exceeded the process parameters for the machines available at Texas A&M at Qatar. Once scaled down by a factor of 40%, the team was able to machine the part but once the G-code for the part was sent to the machine shop an error was encountered by the lab technician which was not visible in the Fusion software. One of the 2 main constraints encountered was a sharp turn in the radius of the part which needed a fillet of 3 mm for the machine shop to be able to produce the part. Sharp turns increase the likelihood of tool damage and can introduce residual stresses within the part. All in all, once the machined part is received a more in-depth analysis will be conducted on the material properties and surfaces quality produced. This will allow the team to get a better idea of the product quality that can be obtained using subtractive manufacturing.

Poster #4

Using Machine Learning for Malware Analysis

Rohan Viswanathan

Faculty Advisor(s): Dr. Christopher I. G. Lanclos and Dr. John A. Hamilton, Jr.

Malware is an extremely prevalent issue in today's society. There are constantly stories on the news about the latest data breaches or ransomware attacks affecting millions of people at a time. There are numerous anti-malware solutions readily available, yet so many systems still become compromised. This illustrates the need for better malware detection and prevention. The current methods involve utilizing signature detection, which works quite well for previously known malware samples. However, new malware is continuously being created and distributed, making this technique obsolete and ineffective. A new proactive technique needs to be developed to detect these new variants before they take effect on live systems. When analyzing malware, it is only practical to assume possession of the final product.

Source code is rarely available for custom-made malware, making any information derived from it ultimately impractical. This research delves into creating a potential feature extraction technique utilizing binary code clones. Code clones are segments of code that appear in multiple samples. Binary code clones are the exact same, but with respect to the binary instructions. Malware can be categorized into numerous families. Each family has a main purpose and a corresponding resolution. Being able to accurately classify malware into these families can allow for it to be properly handled. Some malware families are borderline harmless whereas others could be extremely detrimental if activated. The goal of this research is to propose methods of analyzing malicious binaries and demonstrate that a machine learning model can utilize these methods to accurately classify malware into their respective families.

Poster #5

Glial Cell and GHSR Concentrations in Sensory Processing of Alzheimer's Disease

Thomas Mathew

Faculty Advisor(s): Dr. Yuxiang Sun

The purpose of this project is to determine and expand upon the role that Alzheimer's Disease (AD) has on visual and auditory perception by histological examination of mouse brain tissue, specifically the glial cells of the Lateral Geniculate Nucleus (LGN), the Medial Geniculate Nucleus (MGN), the visual cortex (V1), and the Superior Colliculus (SC), and to determine the effects that microglial growth hormone secretagogue receptor (GHSR) has on Alzheimer's Disease as a whole. Alzheimer's is a devastating form of dementia that severely affects all areas of the brain and unfortunately has no known cure. This project can potentially shed new light and knowledge on the disease and specifically how it interacts with the various structures involved in visual and auditory perception, as well as elucidate the role of GHSR in Alzheimer's. Previous research has shown links between Alzheimer's and visual and auditory deficiencies within humans, and it also suggests that GHSR has implications within Alzheimer's, however these findings are conflictive with one another. Experimentation is still ongoing, however preliminary findings demonstrate that substantial change occurs in glial cells within the sensory processing centers of the brain under Alzheimer's Disease. More specifically, microglial cell concentrations and morphology are markedly different compared to control mouse models. This change could be attributed to the neurological damage that Alzheimer's Disease causes to tissues responsible for sensory processing. This damage could be a promoter of the macrophagic activity of microglia. Further experimentation will be done over the coming weeks to determine the presence and activity of GHSR and astrocytes within a brain afflicted with Alzheimer's Disease.

Poster #6

Artificial Intelligence in Radiology: The Use of Machine Learning Algorithms to Detect Pathologies in Chest X-Rays

Roda Al-Subaie, Oumaima Bouhali, Lolwa Al-Nasr, and Yara Elgazar
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Jim Ji

Radiologists are in charge of detecting and diagnosing diseases by means of x-rays, Magnetic Resonance Imaging (MRI), Computed Tomography (CT) scans, and other medical imaging techniques. Of these imaging techniques, chest x-rays are widely popular, as they can detect various diseases related to the heart and lungs. In Qatar, the majority of diseases detected by x-rays include COVID-19, Pneumonia, Tuberculosis, and lung cancer. While chest x-rays are really helpful in detecting these diseases, one of the biggest problems concerning the field of radiology is that radiologists often have trouble diagnosing the patient, even though they can detect that there is something wrong. As a result, they often have to repeat the x-ray, consult other doctors, or resort to other medical imaging techniques. Consequently, a lot of time is wasted and costs are amounted, meaning there is inefficiency in the system. Furthermore, exposing the patient to repeated scans is risky. An inefficient radiologist can lead to unsatisfied patients and prolonged treatment plans. This can be dangerous, especially when the patient's disease is high risk and requires an immediate response. In recent years, radiologists have begun to adopt Artificial Intelligence (AI) to help them resolve these inefficiencies by aiding them in the diagnosis of diseases. The purpose of this project is to create an AI algorithm that will help the radiologist to diagnose a patient based on a given image of a chest x-ray. The algorithm will be accessed through a graphical user interface (GUI), where the radiologist can input an image and get the diagnosis as an output. There are essentially two subsystems nested into one another: the AI algorithm and the GUI. The entire system shall be called Che-X-Ray.

Poster #7

Legitimizing Hamas: A Rejection of US Ideals on Terrorism

Fariha Sultana

Faculty Advisor(s): Dr. Maddalena Cerrato and Dr. Christopher Hemmig

Hamas has been categorized as a terrorist organization, a sociopolitical organization, and a violent and armed non-state actor resembling a government. However, the "terrorist" label overshadows opposing categorizations. This label disregards Hamas' role as a provider of governance to Palestinian Gazans. This agenda is pushed forward by the United States' official perspective which represents its political objectives in conjunction with Israel. The United States' exclusionary policies towards Hamas make attempts at governance difficult. In lieu of these difficulties, Hamas has turned to a Dual Resistance Strategy which contends with the coexistence of violence and democracy until one becomes a more viable route to their goals. Hamas' balancing act between violence and political participation is made more effective by popular support from its base and its social strategy as a provider of basic goods.

However, Hamas isn't considered a legitimate authority because it lacks international recognition, prevented by the "terrorist" label. Despite the United States' beliefs on the legitimacy of terrorist groups, violent non-state groups are capable of representing a people. Recognition of Hamas' role as a representative of a people may allow non-state actors to govern without a reliance on violence as political participation becomes a more accessible route to addressing their concerns.

Poster #8

Low-cost MRI System for Teaching

Reed Smoot and Jacob Carroll

Faculty Advisor(s): Dr. Steven M. Wright

Magnetic resonance imaging instrumentation is taught at Texas A&M University through the ECEN 463 course and its graduate level equivalents. This class guides students through several labs where they design their own desktop MRI system using various hardware components and LabVIEW. However, the course currently uses expensive NI equipment, which limits student access to the technology. Because of the high cost of the equipment, there are only four lab stations available, while classes typically have fifteen to twenty students. The equipment also contains parts that have become obsolete, limiting one's ability to maintain the system long term. This project will focus on using easily accessible and more affordable equipment for the MRI system. It can also potentially provide opportunities for remote learning, where students could work on assignments off campus. Other projects have aimed to design low-cost MRI systems with an emphasis on clinical applications or which require advanced FPGA programming skills or pre-programmed modules. This project will develop the MRI instrumentation with updated lower-cost, off-the-shelf components. The NI chassis will be replaced with a relatively low-cost Analog Discovery 2 device, transmit and receive chains, off-the-shelf gradient amplifiers suitable for teaching, gradient coils for signal localization, and a lighter-weight Halbach magnet. In addition to validating successful system operation, each lab of the course will be integrated with current materials to comply with the new equipment. Hardware and software resources will also be prepared and scaled to meet classroom needs and ensure a smooth transition. The goal of the project is to use the new system starting in the fall 2023 semester.

Poster #9

3D Investigation on Carbon Storage Capacity in Qatari Carbonate Reservoirs

Aditya Bhagat, Romeo Robert IV Indico, and Mohammed Malyah

Texas A&M University at Qatar

Faculty Advisor(s): Dr. Harris Sajjad Rabbani

While CO2 sequestration to mitigate anthropogenic emissions has been a subject of broad and current interest, effect of pore geometry on CO2 sequestration has not been studied quite extensively. Previous studies have not addressed many aspects of the pore scale physics that would be essential to consider while estimating the capacity and efficacy of carbon sequestration projects in geological porous media.

Most of the previous research on this subject has been conducted considering only sandstone reservoirs. With a large portion of hydrocarbon reservoirs in the world being carbonate reservoirs, these could be ideal storage sites for captured CO2 having proven capacity. This is especially relevant in the Middle East where many of the world's supergiant oil and gas fields are carbonate reservoirs and these could be a major component of the energy transition strategies of the region and the world. The most significant trapping mechanism involved in storage of CO2 in geological media is capillary trapping. A survey of published literature revealed that one of the two main factors affecting capillary trapping in formations is pore structure. Previous studies on effect of pore geometry have been primarily done either through conventional experimental methods or analysis of 2D renditions of rocks. In this project, 3D investigation using numerical simulation was performed conducted using OpenFOAM and a thorough analysis on effect of pore geometry on CO2 storage in Qatari carbonate reservoirs was performed. Preliminary analysis of results obtained through simulations revealed that pore geometry parameters had direct impact on entrapment of CO2. In general tight rock formations generally favoured capillary trapping of CO2 compared to loosely consolidated formations.

Poster #10

The Effects of Acute and Chronic Transplantation on Neural Progenitor Cell Synaptogenesis following SCI

Joshua Moses

Faculty Advisor(s): Dr. Jennifer Dulin

Spinal cord injury (SCI) is a traumatic injury that often results in lifelong neurological impairments. Although the majority of the patient population has a chronic SCI, much of experimental research focuses on acute SCI rather than chronic. Neural progenitor cells (NPCs) are a promising treatment for SCI, due to their ability to extend their axons and differentiate into many of the neuronal subtypes found in the spinal cord. In this project, we will analyze graft viability, axon extension, and synaptogenesis in acute and chronic injury models. The acute and chronic injury group will be separated by time from when the injury has occurred. Both groups received a T-12 contusion and transplantation of NPCs. For a 10-week time period following injury, we performed behavioral testing to look at recovery of motor function between the two groups. After 10 weeks, each subject received injections of the AAV-SynTAG virus into the NPC graft to highlight the differences in axon extension and where NPCs may have formed synapses. Three weeks later, the subjects were then perfused. We have performed all dissections, cryosectioning, and immunohistochemistry of the tissue. Currently we are conducting fluorescent imaging, and image analysis. Results that have been collected come from the behavior test BMS, and from this it can be noted that there was no difference in recovery between the acute and chronic groups. Through further analysis, we will be able to mark differences in graft viability, axon extendability and any possible synaptic connections. This project will give insight to whether the phase of injury is an important factor when designing NPC transplantation experiments, and more broadly will inform the development of future treatments for SCI.

Poster #11

Recognizing Helmet Wearing Behaviour with Wearable Technology and Machine Learning

Akhil Cutinha

Faculty Advisor(s): Dr. Tracy Hammond

Many preventable intracranial head injuries are tied to riding bicycles without helmets. Despite this, there are no safety sensors or warning indicators embedded within two-wheeled vehicles to encourage the safe riding practice of wearing a helmet. Activity recognition using wearable sensors has been previously applied to many health-related fields with high accuracy. In this paper, activity recognition is used to generate an algorithm for real-time recognition of putting on a bicycle helmet using a smartwatch, leveraging the model built in "Recognizing Seatbelt Wearing Activity using Machine Learning". Initial data was collected from participants to determine the validity of the approach. Novel features were extracted from the data and used to classify the action. Then, a real-time recognition user study was conducted to investigate the classification accuracy of the built model in a naturalistic setting. This work forms the basis for further studies which will aim to provide user feedback to encourage helmet use while riding bicycles.

Poster #12

A Retrospective Study of the Mechanism, Diagnoses, Treatments and Prognoses of Osteochondritis Dissecans and an Analysis of the Different Treatments' Effectiveness in the Horse

Kevin Rekoff

Faculty Advisor(s): Dr. Nancy H. Ing

Osteochondritis dissecans (OCD) is a joint disease in which the cartilage and/or bone dissociates from the articular bone, causing chondronecrosis and lameness. As such, OCD is a major issue in the equine sports industry and general equine industry. OCD can develop in virtually any joint, presenting bilaterally or unilaterally in multiple or single joints. The mechanisms that cause OCD are hypothesized to include developmental issues (anatomic and genetic) and possible positive correlations with over-training. This review was performed via gathering data from previous studies to inform the reader about OCD in horses including the various methods of identifying and treating OCD. The diagnostic methods discussed include the lameness exam, radiography, ultrasonography and arthroscopy. The primary goal is to ascertain whether surgical or regenerative treatments were more successful based on information in previous studies. The treatments discussed include conservative management, arthrotomy and arthroscopy, polydioxanone (PDS) pinning and tissue grafts with incorporated gene therapy for the regenerative treatments. To discern between the success of the surgical and regenerative treatments, several criteria were discussed including time for recovery, risk of fibrous cartilage replacement, limitations based on the lesion severity within the joint and treatment costs. It was determined that there are positive and negative aspects to both types of treatment with regenerative treatments being

more successful when applicable. Further research topics that would be beneficial include the development of regenerative treatments that are more viable in a given OCD case and identifying which gene can support hyaline cartilage repair instead of fibrous cartilage replacement.

Poster #13

On Efficient Data Distribution for Non-Uniform Keys

Evan Krohn

Faculty Advisor(s): Dr. Dmitri Loguinov

Increased utilization of streaming architectures and bulk storage for large-scale data drives a need for algorithms that can efficiently divide data into smaller chunks to maximize both parallelism and the benefits of in-memory performance. These setups generally are optimized for long sequential data accesses, which can be a significant issue for algorithms such as sorting which rely heavily on random accesses. We investigate the use of distribution sort algorithms to break down an initial dataset into chunks that can then be fed into RAM for conventional sorting methods to finish. Our focus is on non-uniform key bucketing for 32-bit and 64-bit keys on CPUs supporting AVX2, where we use SIMD instruction sets to increase per-core effectiveness. In addition to fast algorithms for distributing keys while maintaining the stable sort property, we detail multiple discoveries, including a workaround to the conflict detection problem by implementing a fast lookup table in L1d cache for small variants, how to approach cases of non-uniformity, and how to maximize recursion structure performance for large quantities of buckets. Using these techniques we are able to split into 8 buckets at 2 billion 32-bit keys per second per core on Coffee Lake CPUs and can efficiently scale to larger bucket counts.

Poster #14

Progressive Activity Recognition for Parkinson's Disease

Jacob Gartrell

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

Parkinson's Disease is a progressive neurological disorder that affects 930,000 people in the United States and 10 million people globally. Resting tremors characteristic of the disease occur in 67% of cases. The most prevalent treatments for resting tremors are Deep Brain Stimulation (DBS) and drugs increase the amount of dopamine in a patient's brain. However, these treatments are often implemented in an ineffective manner. A neurologist must guess how the patient's disease state is changing from only the qualitative information gathered during the appointment. In this paper, a preliminary tremor classification model was developed with the aim of giving neurologists more actionable information when programming DBS devices and changing the dosage of medication. The model proposed will aim to classify everyday tremor data from Parkinson's patients in a way that neurologists can effectively utilize to gain further insight into variable disease progression. Features extracted from the model will be used to rate tremor severity and frequency. The convolutional neural network developed was 72% accurate at determining Parkinson's patients from controls almost matching the clinical diagnosis

accuracy rate of 73%. This model's success means that the progression of Parkinson's disease can be successfully monitored and recorded with wearable devices that do not hinder patient autonomy. This model was a successful first step in developing adaptive DBS devices and dosing practices to counteract variable resting tremor states. This project can be applied to improve the clinical outcomes of Parkinson's patients.

Poster #15

Coordinated Botnet Detection in Social Networks via Clustering Analysis

Preston C. Piercey

Faculty Advisor(s): Dr. Nate Veldt and Dr. Roger Pearce

Graphs are a widely used tool in modeling social or human interaction networks. In a network that consists of authors and posts with time-stamped interactions between one post and one author, we can model the network as a bipartite temporal graph. These graphs are particularly useful in modeling the temporal relationships between users and pages on social media networks such as Reddit, Twitter, or Facebook. This project lays out an algorithmic framework for the identification of highly coordinated behavior in these massive networks with a three step approach and applies it at scale to real-world data from the Reddit platform. Because of the scale of this data, direct computation in the bipartite graph is too expensive and does not take into account the temporal aspect of the data. To address this problem, the bipartite temporal graph between authors and pages is projected into a one-mode weighted graph of authors by specifying a maximum time between interactions and recording how many times each author interacted on the same page as another author in that window of time. The weight of the edge between these two authors in the projected graph is the count of these interactions; higher edge weights indicate greater potential coordination. In the second step, we query the projected graph for high edge weight triangles. This highlights triplets of authors that repeatedly interact with the same posts at the same time. Finally, after the author groups of interest have been pruned to a much smaller search space, we return to the more informative metrics on the bipartite graph to confirm what was approximated by the two earlier steps.

Poster #16

Differential Activation of AhR by Environmental Toxins and a Microbial Metabolite in the Brain

Lauren Hillbrick

Faculty Advisor(s): Dr. Shoshana Eitan

Recent studies from our laboratory demonstrated that 1,4-dihydroxy-2-naphthoic acid (DHNA) has potential to be an antidepressant. DHNA is a microbial-derived metabolite and ligand for the aryl hydrocarbon receptor (AhR). The AhR was suggested to be a key regulator in the microbiome pertaining to the gut-brain axis, which is suggested to modulate mood, emotion, and cognition. However, the AhR

responds to many ligands, some of which are environmental toxins, such as 2,3,7,8-tetrachlorodibenzodioxin (TCDD), which is also known for its neurotoxicity. Presently, little is known about the molecular mechanisms in which various AhR ligands differentially affect activation of neural pathways. Thus, this study compared the effects of the microbial-derived metabolite DHNA and the environmental toxin TCDD on mood, anxiety, cognition, and gene expression in the hippocampus. Mice were fed daily with 20 or 100 mg/kg of DHNA, 0.1 Âµg/kg of TCDD, or vehicle as a placebo prior to being subjected to unpredictable chronic mild stress (UCMS) or remained unstressed. They were tested for depression-like behaviors (sucrose preference test and forced swim test) and spatial learning (Morris water maze). As expected, UCMS induced depression-like behaviors. TCDD induced depression-like behaviors in unstressed mice that were indistinguishable from the effects of UCMS alone. The 20 mg/kg DHNA dose did not have effects by itself and prevented the effects of UCMS on mood. Interestingly, the 100 mg/kg dose was less effective than 20 mg/kg in preventing some depression-like behaviors. An improved understanding of the differential effects of different AhR ligands is likely to aid in the understanding of the etiology of depression and facilitate the generation of safe and novel treatments for depression.

Poster #17

Epistemic Reasoning in Intelligent Agents using an Algorithm for Resolving Modal Clauses

Kyle Mrosko

Faculty Advisor(s): Dr. Thomas Ioerger

The ability to reason about other agents' beliefs has many applications in multi-agent systems, including facilitating coordinated behavior, teamwork, and information exchange. Modal logics are commonly used to formally capture and reason about knowledge/belief states. Unlike in propositional logic, it is computationally complex to create an automatic deduction algorithm capable of proving entailment when modal operators are considered. In this paper, we present an extension of a propositional logic resolution theorem prover to resolve modal clauses based on a complete set of inference rules for KD45 that was previously published by Enjalbert and del Cerro in 1989. We demonstrate that this modal resolution theorem prover, EpiRes, can be used for epistemic belief reasoning in an Information Privacy application domain by showing what an observer can infer by monitoring the actions of another agent. In this setting, a robot inspects nuclear reactor facilities for high or low radiation levels in varying locations depending on the reactor type. The goal of the observer is to try to infer the reactor type by monitoring the actions of the robot, which requires reasoning about the robot's goals, information obtained by actions, and justifying why the robot took the actions it took. To more easily model this scenario, we created a modal, meta operator "œknows whether"□ (KW) for writing rules that are agnostic to the true state of the world and provide the equivalent translation in KD45. We conclude by showing that EpiRes was successful in showing what information can or cannot be inferred by the observer from different actions (plans) of the robot, without having to model belief states explicitly as sets of possible worlds.

Poster #18

Multimodal Data Fusion Models Pretrained With VICReg

Nick Cheng

Faculty Advisor(s): Dr. Bobak Mortazavi

Prediction models can be applied to hospital ICUs in order to improve patient care, through predicting patient behavior through the duration of their stay. The current field for mortality and length of stay predictions in the ICU consists of mainly single modal models, such as Shukla & Marlin's Interpolation Network, or Futoma et al.s' Multitask Gaussian Network. However, they are incapable of leveraging inter-modal patterns where each mode is strongest, which should allow for improved model performance when compared to single modal models. This is especially applicable in a hospital setting, as different modes of time series data are gathered when patients are admitted, such as clinical notes and machine output. Multimodal fusion models for this context have been proposed, and offer a notable performance improvement when compared to their single modal cousins. I believe that the performance of these multimodal models can be further improved through a pretraining step that leverages the large amount of unlabeled data that the hospital accumulates daily. Supervised models can only use a small amount of hospital data that includes the mortality or length of stay labels, while an unsupervised step allows the model to process unlabelled data. The unsupervised step is also expected to increase model performance when transferred to hospitals with different operating conditions or little labelled data when compared to standard supervised multimodal models. My results show that VICReg failed to create any noticeable performance benefit when compared to baseline multimodal models. Despite this outcome, I still believe that VICReg can be used to boost multimodal model performance, and I will discuss potential steps that could create a performance boost.

Poster #19

The Impact of Novelty on the Context-Dependence of Avoidance

Denise Carriaga

Faculty Advisor(s): Dr. Stephen Maren

Avoidance is a coping mechanism that helps an individual adapt to a potentially harmful environment by reducing exposure to danger. When this adaptive behavior interferes with daily life, it becomes maladaptive and can contribute to post-traumatic stress disorder (PTSD). Maladaptive avoidance can occur when this coping mechanism extends to safe environments or contexts instead of being contained to harmful contexts. In a previous experiment, we have found that avoidance behavior is context dependent because rats perform significantly fewer avoidance responses in the novel context compared to the training context. However, due to the nature of the methods, this result may have been due to neophobic behaviors because rats are anxious in novel environments which could lead to more freezing and less avoidance behavior. Therefore, we will be conducting this experiment to analyze whether the novelty of the alternate context is necessary for avoidance to be context dependent in Sprague Dawley rats. Using two-way signaled active avoidance, the rats were trained to avoid a potential shock by shuttling between two chambers during a tone. All rats were trained for four days in the training context but half also experienced equal exposure to the alternate context during training. Both the exposure

and non-exposure groups were tested in the training and alternate context with ten tones under extinction conditions. The contexts differed greatly in sensory stimuli to allow the rats to distinguish between the two. The results showed no differences in the overall performance of the two groups indicating that novelty does not impact the context-dependence of avoidance. For future research, we can explore if the context dependence of healthy avoidance is altered in fear disorders.

Poster #20

Exploring Rheology Additives for Robocasting 3D Alumina-Structured Supports

Fawziya Ahmed Al-Darwish
Texas A&M University at Qatar

Faculty Advisor(s): Dr. Ma'moun Al-rawashdeh, Dr. Yasser Al-Hamidi, and Dr. Eyad Masad

Regulations regarding industrial gas emissions such as CO2 became stringent over the years. Additive manufacturing is a key enabling technology that could develop innovative solutions to meet this application. It has strict requirements on pressure drop, high temperature, pore structures, and catalytic chemical performance. Structured "intricate" ceramic materials are an ideal candidate to meet these application requirements. This research takes advantage of the wealth of literature available for alumina ceramic extrusion but explores it for additive manufacturing via "Robocasting". This is a promising method to make 3D-printed geometries that meet the chemical and physical requirements of gas emission control applications. Paste rheology is one of the most critical manufacturing parameters that affect the quality of the 3D printed geometry. Three rheology modifiers for alumina paste will be investigated and evaluated on benchmarking 3D printed geometries made via robocasting. Then, they will be evaluated on their physical properties only. Chemical evaluation is outside the scope of this research and will be the natural follow-up research built on the generated knowledge reached from this research.

Poster #21

Efficient Vehicle Motion Prediction Based on HD Map Prior

Austin Veselka

Faculty Advisor(s): Dr. Dezhen Song

Self-driving vehicles are a technology with the potential to impact a massive number of people and improve the safety and efficiency of the roads. Part of an intelligent self-driving system is the ability to predict the future to be cautious of potentially dangerous situations and to better plan its own actions. Anticipating a lane change or a left turn that would cause a collision can allow the vehicle to take action beforehand and avoid accidents. To this end, vehicle motion prediction is the task of estimating the future trajectories of other vehicles on the road, which can serve to inform the vehicle's planning. We propose Pcurvenet, an architecture built off Vectornet, for accurate and highly efficient trajectory estimation. Central to the model is the full use of the HD map prior information which in combination with traffic rules determine the road lane structure and likely vehicle behaviors, simplifying the model's

task. Typical motion prediction models predict the future trajectory of only a single vehicle at a time, therefore requiring multiple forward passes to predict trajectories for all vehicles in the scene. More recent research takes advantage of ensembles to achieve higher accuracy. Without high computational power for a vehicle, these methods are impractical. We improve the efficiency of this task by predicting trajectories in parallel which makes this architecture well suited to real self-driving systems, where limited compute can be an issue. This also allows predictions to be made on a shorter time horizon, but more often. Since shorter time horizon predictions are generally easier, this lets our more efficient but less accurate model compete with a less efficient but more accurate model by making predictions more often.

Poster Session 3: 1:00 PM-2:00 PM CT

Room: MSC 2300 C

Poster #1

Evaluating the Biocompatibility of Artificial and Synthetic Materials Via Macrophage Response and Collagen Deposition

Del Donehoo

Faculty Advisor(s): Dr. Shreya Raghavan

Vascular occlusion devices are used to treat aneurysms, but there have historically been complications such as device-associated clotting and rebleeding associated with this method of treatment. Previous work has established that shape memory polymer foam-coated coil (FCC) devices promote a pro-regenerative macrophage activation phenotype compared to bare platinum coil (BPC) devices. This project observes the macrophage differentiation (pro-inflammatory (M1-like), or pro-healing (M2-like)) and activation of revascularization through the VEGF pathway in response to a broader selection of competing aneurysm occlusion devices, including the BPC and FCC devices tested previously, an entirely shape memory polymer (SMM) device, and others, through qPCR at 6, 24, 72, and 96 hours. Additionally, this study compares collagen deposition by fibroblasts in response to macrophages collected from each device, thereby presenting a developed in vitro testing framework for evaluating the immune response to aneurysm occlusion devices with a focus on how a shape memory foam plug device compares to the other devices tested. Electro-spun small intestine submucosa tissue samples were examined through qPCR using similar methods to those used to examine the aneurysm occlusion device samples to evaluate the applicability of the testing framework to biologically-derived material samples. Through this study, the shape memory polymer device was found to induce a statistically significant increase in VEGF production from macrophages at 96 h compared to every other device tested.

Poster #2

The Smell of Death: A Literature Review on the Compounds That Cause the Smell of Death and Their Biochemical Origins

Hannah M. Roe

Faculty Advisor(s): Dr. Jeffery Tomberlin

Volatile organic compounds (VOCs) are released as the primary component of smell released during the decomposition of organic matter. Over the past 30 years, researchers have studied VOC emissions to create better training aid for cadaver detection dogs (CDDs) and understand insect attraction to remains. There have been many articles published documenting VOC profiles however these studies

have revealed the lack of consistency between each article's results. Using a systematic literature search into databases PubMed, Medline, and ScienceDirect, 29 articles were identified and reported 1,056 unique VOCs during decomposition. The articles and the VOC reported therein were placed into a database that reported the number of times a VOC was noted in the articles. The most common compounds were dimethyl disulfide in 27 articles, dimethyl trisulfide in 24 articles, and acetophenone in 15 articles. Additionally, 66% of the VOCs identified during the literature search were only reported in one article. Using this database, 106 compounds were selected to research with a keyword search for biochemical origins to determine possible reasons for the variety of VOCs reported. One possible way to explain the difference between VOC reported relates to one compound that can be transformed into more than one product based on the microorganisms present. The amino acid phenylalanine has been thought to be the starting point for all cyclic aromatic compounds such as acetophenone, benzaldehyde, and phenol. By the conclusion of the project, a database will be created that includes information about articles in VOC emission research and possible origins for these VOCs. Future researchers could use the database to determine areas for future research.

Poster #3

Synthetic Hand Gesture Dataset Generation

Samuel Oncken and Steven Claypool

Faculty Advisor(s): Dr. Stavros Kalafatis

The development of human-computer interaction has led to an increasing need for large and diverse hand gesture datasets for image classification in machine learning. However, generating such datasets leads to many issues with cost, privacy, and time. This research aims to streamline the dataset generation process using synthetic data. A Leap Motion Controller hand tracking device is used to record hand gestures of existing or new datasets. A virtual environment is simulated in the Unity game engine, where the recorded hand gestures are applied to human models generated with MakeHuman software and recorded to generate a synthetic dataset of any specified size and structure. In the virtual environment, diverse backgrounds and human models are used to add complexity to the data to further improve the robustness when training machine learning models. Tests will be run using these datasets on various machine learning models to determine the viability of augmenting or replacing existing or new real hand gesture datasets. The models will be trained and tested for image classification, and once trained, will be converted into a faster R-CNN model for testing object detection and localization. The training and tests will consist of varying data compositions using real, synthetic, and mixed data.

Poster #4

Bone Touched: A Religious Redemption Arc

Faith Kinney
Aggie Creative Collective

Faculty Advisor(s): Dr. Jason Harris

Given the often-whimsical nature of religion, fantasy is the perfect genre with which to critique it. Many fantasy novels, especially more modern, pop culture novels, prefer to describe the corruption or depict a corruption arc regarding religion. The main characters have to avoid bigoted and often violent zealots, as in Robert Jordan and Brandon Sanderson's Wheel of Time series. They uncover the rotten underbelly of their own religion, like in Robin LaFever's His Fair Assassin trilogy. Or they are thrust into the middle of the workings of a complicated, flawed religion, usually against their will, like in Sabaa Tahir's An Ember in the Ashes series. This trend is most likely due to the increasing hostility toward organized religions like Christianity and Islam. Their corruption and prejudice are becoming more and more publicized, resulting in people's decreasing faith in them. Thus artists, in this case writers, want to further expose the horrible things religious leaders have done and propose alternatives. This creative artifact takes a different approach. The main character is forced into service to an ominous, death god. She resents this god for taking over her life without giving her a choice. Having entered this new world with all the worst experiences and expectations, she only wants to rebuild her life and shove her memories and duties to this god to the farthest corner of her mind. But as she becomes more entangled in this religion and gets to know more people who are in her situation, she slowly comes to see the good and necessity of it. This redemption arc will hopefully be symbolic of the recompence organized religion will undergo. Human beings have a tendency to lean toward religion and the current ones are built on good principles.

Poster #5

Analysis of Macrophage Polarization Under Influence of Biomimetic Peristaltic Forces

Anirudh Madyastha

Faculty Advisor(s): Dr. Shreya Raghavan

The body exists in constant dynamic motion driven by mechanical forces that impact many cellular functions. One example of this dynamic motion is peristalsis, or the multiaxial strain and concurrent fluid shear forces found in the gastrointestinal tract and other smooth muscle hollow organs. Peristalsis is a unique mechanical stimulus which drives cellular mechanotransduction. In the colorectal cancer (CRC) tumor microenvironment, cells in the intestinal lumen are continuously exposed to mechanical forces associated with colonic peristalsis. Within the cancer microenvironment, immune cells like macrophages, which associate with CRC, may be impacted by peristalsis forces. Macrophages are immune cells that largely exist in two phenotypes: M1, or pro-inflammatory; and M2, or pro-healing/pro-tumoral. Macrophages lack the ability to detect cancer cells when they have an M2-like

phenotype. Presently, little is known about how mechanical forces, like peristalsis, influence the polarization of macrophages and contribute to cancer immune evasion. Therefore, this work aims to illuminate the connection between peristalsis mechanical forces and macrophage polarization in relation to cancer immune evasion. Using our biomimetic peristalsis bioreactor, we exposed unpolarized (M0)macrophages to peristalsis forces for 24 hrs. Cells were then collected for gene expression analysis of polarization or mechanotransduction markers, or fixed onto PDMS and imaged through immunofluorescence staining and confocal microscopy. Our results indicate that peristalsis forces can influence the polarization patterns of macrophages towards an M2, pro-healing/pro-tumoral phenotype. We established that mechanical forces contribute to macrophage polarization, potentially driving CRC progression.

Poster #6

Tissue Engineered Constructs for Wound Healing

Sarah Voon

Faculty Advisor(s): Dr. Feng Zhao

The wound healing process consists of hemostasis, inflammation, proliferation, and remodeling. When this process lasts for at least three months or longer, a wound is considered chronic, often forming when inflammation is persistent, macrophage function is disturbed, and levels of cytokines are dysregulated, amongst many other reasons. Due to the severity, long-term nature, and risk of amputation of chronic wounds, chronic wound healing is an urgent clinical need to be met. One method to heal chronic wounds consists of engineering a tissue construct which can mimic the native extracellular matrix (ECM) to promote cellular growth. A novel micro-grated interwoven pattern fabricated polydopamine (PD) and collagen-coated polydimethylsiloxane (PDMS) has been analysed by our laboratory. The growth of cells such as human mesenchymal stem cells (hMSCs), human dermal fibroblasts (hDFs), and THP-1 cells on a micro-grated interwoven pattern guides cell growth to mimic the native skin ECM. This specific project aims to focus on investigating the tissue-engineered construct through different studies such as in vitro characterizations, Western blot, cytokine array assays, and macrophage polarization in vivo. Thus, this project seeks to delve deeper into the potential of interwoven tissue engineered constructs to generate a biologically compatible and effectively mimicked ECM that can be used for chronic wound healing.

Poster #7

Proposed Systems Engineering Management Methods in a Student-Run Environment

Marco Peredo and Shirish Pandam

Faculty Advisor(s): Dr. Koen Groot and Dr. Helen Reed

Students are often exposed to engineering design projects beyond classroom curriculum. Extracurriculars such as student organizations that participate in engineering design competitions help students develop leadership, teamwork, communication, and technical skills. It is of special interest when these engineering environments are led and managed by students. Teams often employ project management and systems engineering tools for a better organized and more successful project. It was the focus of this research to deduct which of these tactics are most useful to student-led engineering projects. These project management and systems engineering tactics, in conjunction referred to as "project advancement methods," are used professionally in industry; however, it was recognized that the academic setting is quite different from industry. Three factors were taken into account in evaluating project advancement methods: the ability to follow a timeline, the project staying under budget, and the members' overall comprehension of the subject matter. Across four ongoing project teams, teams used various structures for team organization and varied on how iterative the design process was. When taken in conjunction with interviews of other student organizations and current literature, it is suggested that the most fundamental and traditional project advancement methods were the easiest for student management to implement. In addition, the nature of the competition or project impacted the amount of iterations the project design could undergo.

Poster #8

Detecting Mental Age of Children Through Analysis of Sketches Using Machine Learning

Ibrahim Ozgel

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

During early childhood, sensory and (fine) motor skills are a critical part of healthy development. The impact of these skills, however, goes far beyond the immediately apparent. Fine motor skills in particular, are linked to cognitive, socio-emotional, and academic development. As such, it is important to have means to analyze sketching ability as an extension of early child development. Currently, tests and questionnaires can be performed on children to gauge motor skills, however, this can be expensive and time consuming, and at times lead to inaccuracy. This research proposes a machine learning based system for assessing fine motor skills through the analysis of sketches. In doing so, we aim to gauge a child's mental age via an analysis of their sketches.

Poster #9

Measuring Reading Comprehension Using Eye Tracking

Kornel Harmati and Alexandria Kwon

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

With the capability of modern eye tracking, and in anticipation of its further development, the number of applications for its relevancy continues to grow. Having already impacted commercial and psychological fields, we look to see how eye tracking can be of further use in the classroom. Within the educational field, the ability to identify what words or phrases of text a reader is looking at allows for further insight into the reading process, and subsequently, reading comprehension. By observing eye fixations, saccades, and re-fixations during the reading process, it is possible to identify patterns which can measure how much a reader understands a given section of text. We first look to replicate this measurement process before exploring the possibility of effectively modifying difficult areas of text to improve the reader's understanding. We conduct a round of interviews in which participants read through assorted texts of different topics while being recorded by eye tracking software. By observing these results to analyze the reader's comprehension of the text, we isolate difficult sections and modify them to improve their clarity. Then, with a second round of interviews using the modified texts, we determine how these changes affect the reader's ability to comprehend the passage. With the results, we demonstrate the usefulness of eye tracking as it relates to reading comprehension, and whether this methodology could prove to be useful to instructors and students as a learning aid.

Poster #10

TOROS Image Reduction

Alexandra Boone

Faculty Advisor(s): Dr. Jennifer Marshall

The Transient Optical Robotic Observatory of the South (TOROS) is a robotic observatory being deployed to the Atacama Desert in Argentina to detect the electromagnetic counterparts of gravitational wave sources. Gravitational wave (GW) signals allow for the detection of events like neutron-star-neutron-star or neutron-star-black-hole mergers, and follow-up observations of electromagnetic counterparts made by TOROS will give astronomers more information about these events that could not be acquired through gravitational wave detection. This project focused on the characterization of the Charged Couple Device (CCD) detector system. Several sets of bias images and dark images were taken by the TOROS camera in the lab in order to estimate the dark current at different exposure times. The images were put into a data cube and combined using a median and subtracted in order to estimate the dark current of the camera and ensure the instrument was working properly after several years in storage due to the pandemic. The results showed that while the noise is correlated with the exposure time, as is expected, the mean dark current noise is close to zero, indicating the dark current should only minimally affect the camera's ultimate precision. This result indicates that the instrument is functioning as it should.

Poster #11

What's On Your Mind? An Individual Differences Investigation of Mind-Wandering

Li Wen Jan

Faculty Advisor(s): Dr. Heather Lench

Mind-wandering is a ubiquitous human experience characterized by task-unrelated thought, or thought that deviates from the present task. The majority of existing literature on mind-wandering examines task-unrelated thought when participants are instructed to attend to an external task. Few studies have investigated mind-wandering in the absence of external stimulation where participants are left alone with their thoughts. Additionally, research on individual differences in mind-wandering is limited, especially within the context of personality traits. We take data from a preliminary study conducted by our group that investigated boredom as an aversive state. The study randomly assigned participants to conditions where they were either instructed to watch a boring video or watch nothing under the premise that researchers would be right back. Personality traits were assessed prior to the study, whereas affect, thoughts, and cognition were assessed following a period of 20 minutes. The present study focuses on the condition in which participants received no external stimulation. We seek to explore individual differences in mind-wandering in an environment without any external distractions. Specifically, we will investigate the relationship between dispositional traits and various dimensions of mind-wandering, such as thought valence, temporal orientation, categories of thought, and affect through both a quantitative and qualitative analysis of survey data. Potential findings can further aid our understanding of the phenomenon of mind-wandering as it remains to be a vital aspect of emotional and cognitive functioning.

Poster #12

Improvements on pyIAST

Adam Wyman

Faculty Advisor(s): Dr. Hae-Kwon Jeong

Ideal Adsorbed Solution Theory, IAST, is a set of assumptions used to estimate multi-species adsorbed loading data given the adsorption data of each pure species for a given adsorbent. Currently, there exists a python package, pyIAST, that implements the IAST calculations for general adsorption cases using the Langmuir adsorption isotherm, Quadratic adsorption isotherms, dual-site Langmuir adsorption isotherm, Brunauer-Emmett-Teller (BET) adsorption isotherm, and Temkin adsorption isotherm to model adsorption data. However, since the creation of the original pyIAST new isotherms have been created to model the previously inapplicable situations like adsorption in a metal-organic framework. In the case of metal-organic frameworks, the dual-site Langmuir-Ferudlich adsorption isotherm shows promise in modeling the adsorption data at a high coefficient of determination value. After using pyIAST with the goal of performing IAST calculations with a metal-organic framework, it became clear that improvements could be made for a better user experience. Moving forward with the objective of improving pyIAST to create a more user-friendly program, two goals were created. Firstly to ensure wider applicability for arbitrary models of adsorption data, like the dual-site Langmuir-Ferudlich

adsorption isotherm, a user-side framework for researchers to freely define adsorption isotherms was sought to be created. Secondly, the implementation of quality-of-life functions to allow users to more readily obtain results without extensive programming knowledge was created.

Poster #13

High-Performance External-Memory Mergesort

Nicholas Robert

Faculty Advisor(s): Dr. Dmitri Loguinov

Data holds an important place in today's world. In virtually every field, there exists a need for processing the relevant data to inform actions and decisions to improve, advance, maintain, or build in that field. This is easily understood when considering the present-day impact and widespread use of computers and the internet in general. The amount of data itself has grown exponentially in recent years, and to discover anything useful out of this vast array of information, efficient algorithms need to be created, especially ones that consider datasets that are bigger than RAM, often by orders of magnitude. It's also often useful and necessary to sort very large datasets; one example of a popular application that relies on sorted data is Apple Maps. Therefore, it's useful to explore solutions that can optimize the speed of these external-memory algorithms. When sorting large datasets, the data can come from different files, parts of files, or streams, which poses a problem when trying to create truly high-performance algorithms since the underlying hardware can be slow, specifically in the I/O speed of magnetic drives. My thesis utilizes techniques that can reduce and minimize the number of seeks from these HDDs, therefore maximizing the overall performance of the external-memory merge sort algorithm.

Poster #14

Construction of an Optical CT Scanner for Accessibility in the Classroom

Madison White

Faculty Advisor(s): Dr. Mary P. McDougall

Bioinstrumentation constitutes an entire field of research, industry, and academia in biomedical engineering. The development of this technology has awarded the ability to see how the body works without invasive discovery. Allowing for improved ease and succinct detection, medical imaging is imperative to the diagnosis and treatment of disease within the body. The education on this topic holds equal importance and added difficulty in an attempt to move from abstract to tangible learning. With the expense and wide inaccessibility associated with medical imaging machines, there is a further challenge in the ability to learn through an interactive experience. Optical imaging is a non-ionizing and non-invasive technology that uses light as the basis of functionality and allows for a high spatial resolution to provide quantitative information. Building on previous research, an optical CT scanner can be constructed using attainable and accessible materials. Current materials call for a USB camera, a LED lamp light source, and a computer that can read images as the subject rotates. This work can be adjusted, allowing for a smartphone with video capability to be the image capture device and a single kit to provide rotation of the subject and to act as the light source. The simplicity and accessibility of the

construction of an imaging device allow for tangible learning through assembly. As the technology in engineering progresses, as does the inaccessibility to materials and education. As a result of this research, I hope to provide an interactive and compelling educational opportunity that is inexpensive and attainable.

Poster #15

Design and Optimization of DNA Hairpins for miRNA Detection

Alberto Gutierrez-Irizarry

Faculty Advisor(s): Dr. Samuel Mabbott

DNA hairpins are a category of hardware materials in the domain of nucleic acid circuits that are capable of executing algorithms. The key mechanism that enables nucleic acid circuits to be rationally programmed is known as toehold-mediated strand displacement (TMSD). Catalytic Hairpin Assembly (CHA) and Hybridization Chain Reaction (HCR) are two well-described non-enzymatic methods that use TMSD for the amplification of signals typically associated with a minimal amount of miRNA that is differentially expressed in diseased conditions. However, as presently applied, these methods involve arbitrary rules that ultimately result in low amplification and poor analytical performance. This project will build on existing mechanisms elucidated in literature while developing systematic criteria for DNA hairpin design. Simulation tools such as Nupack and Mfold will be used to understand interactions between nucleic acid probes and targets to minimize cross-talk and reduce background signals. Gel electrophoresis and fluorescence spectrometry will be used to gauge the analytical performance of our designed systems. The aim of this project is to develop a category of DNA hairpin probes for the sensitive detection of microRNA (miRNA) targets via the aforementioned methods to enable the development of diagnostic assays for point-of-care (POC) applications. We expect to draft novel circuits which will involve cascading of DNA hairpins to enhance sensitivity and perform specific detection of lowly occurring miRNA targets.

Poster #16

Global Warming and its Extreme Temperature Effects on Triatoma Gerstaeckeri

John Grant Arrington

Faculty Advisor(s): Dr. Sarah Hamer

Kissing bugs are vectors for the parasite Trypanosoma cruzi, which causes Chagas disease. T. cruzi is transmitted through the feces of an infected kissing bug via an open wound or through mucous membranes located around the face and mouth. Once infected, Chagas disease can cause inflammation of internal organs like the heart and colon, and sometimes can be fatal. Harsh winter months prevent many arthropod species from entering new ecosystems located in colder climates and higher latitudes. However, global warming is expanding range distribution of many arthropods. The rise in global temperatures has allowed arthropod species to expand into higher latitude extremes. In the United States, triatomines are mainly distributed in the southern states, but little is known about their cold

tolerance and critical minimum temperature experienced during winter months. In this study, the survivorship of Triatoma gerstaeckeri in a simulated cold environment was observed to characterize their cold thermal tolerance. The environment mimicked overnight winter cold fronts occurring in Texas. Uninfected 5th-instar nymphs were exposed for 24 hours at varying temperatures: 28°C, 0°C, -5°C, -10°C, or -20°C. After 24 hours, the kissing bugs were observed for 2 weeks at room temperature. All kissing bugs exposed to –5°C and colder treatments died either during the cold treatment period or within 2 days after. No kissing bugs at 28°C died, and only 1 out of 10 kissing bugs died at 0°C after 5 days. There was no significant correlation between body mass and insect outcome (survival or death). Likewise, there was no significant correlation between engorgement score (amount of blood in the insect's abdomen) and insect outcome (survival or death). This research will discover the critical minimum temperatures for triatomine survival under laboratory conditions. Knowing the cold tolerance of T. gerstaeckeri is important because it is an abundant vector species found in Texas for a life-threatening disease affecting all aspects of One Health.

Poster #17

Transparent Bacterial Cellulose Composite for Wearable Optical Sensing Applications

Ananya H. Elati

Faculty Advisor(s): Dr. Limei Tian

Biosensors are used to detect relevant biomolecules such as proteins, antibodies, pathogens, hormones, and enzymes in samples of blood, urine, sweat, tears, and saliva. Their presence can be an important indicator of disease, so biosensors possess great value as diagnostic tools and for disease monitoring purposes. Optical sensors are generally made from optical fibers and can be used to sense many physical parameters such as strain and stress. Optical fibers are typically made of materials with a high level of stiffness and a low breaking strain such as silica glass. However, research has shown that fabricating optical fibers with materials that possess a lower Young's modulus could help provide the fibers with greater sensitivity and robustness. Additionally, other substrates such as paper and plastic present certain challenges including optical opaqueness, low mechanical strength and stability in aqueous media, and high surface roughness. Hence, this study has chosen bacterial cellulose as a suitable alternative material for the development of optical sensors due to its optical transparency, high flexibility, high mechanical, thermal, and chemical stability, and biodegradability. Fabrication strategies such as freeze-drying and dip coating were tested to determine the best method to utilize during the fabrication of a bacterial cellulose composite. Preliminary mechanical testing was also conducted, and further characterization will be carried out to ensure a transparent, tough, and stretchable composite is developed for optical sensing applications.

Poster #18

Classical Reception of Greek Mythology in Pop Culture, Video Games, and Entertainment

Hannah Eckenfels

Aggie Creative Collective

Faculty Advisor(s): Samuel Woodfin

The classical reception of mythology in western media has resulted in the revitalization and rewriting of ancient Greece's most well-known myths. This research explores myths that have been adapted into popular video games, movies, and novels and relate the myths to their respective original context. The primary purpose behind using mythology as a vessel for storytelling is investigated, and the question of why it is a popular thematic element in modern media is explored. Story elements of mythology from the past and mythology in pop culture are compared and contrasted using the theory of classical reception. The myths examined in this research are selected from a variety of entertainment sources, video games, and movies that utilize Greek mythology as a central theme of the work. Modern entertainment has developed rapidly over the past few decades, resulting in the mass production of various mythologically themed pieces of media. Mythology serves as a vessel of truth and familiarity, as the stories are well-known and widespread. The purpose of this project is to explore the way that classical reception has adapted mythology to the perspective and bias of the storyteller. The themes, common story elements, and research are culminated into the form of a creative artifact. The creative artifact of this thesis takes the form of an art book, a form of media that will be used to visually express the results of this research. Motifs and imagery in each illustration are tailored to the modern interpretations of each myth, which will be elaborated on in both the creative artifact as well as the contents of the thesis.

Poster #19

Quantum Dynamics of Qubits

Brandon Torres

Faculty Advisor(s): Dr. Alexey Belyanin

The basic unit of information within quantum mechanics can be modeled through two-level systems to provide a foundational understanding of quantum information theory. These quantum systems, which can be represented by qubits, can be transformed and manipulated when strongly coupled to an applied electromagnetic field. I study the quantum dynamics of two-level systems strongly coupled to a classical electromagnetic field, with the inclusion of dissipation and decoherence, to understand the method of using state transitions to transmit information. Using the advantages of Ï€ pulses, I solve for analytical solutions of differing electromagnetic pulses that would create transitions within a variety of particles serving as qubit candidates. The stochastic Schroedinger equation approach for the Lindbald approximation is used to provide insight into including dissipation of the states and decoherence of the electromagnetic field within the quantum systems. The electromagnetic effects of a qubit-cavity system

are observed to establish a realistic understanding of the scenario and provide the experimental requirements to create transitions through the use of pulsed light. I also study the coupled interaction of electromagnetic pulses between multiple qubits to determine the conditions for interchanging states between the qubits. The goal of these theoretical topics is to create a quantum system of qubits that can be used to function as a quantum gate for computation.

Poster #20

Development of a Hall Probe Device for the Mapping of Magnetic Fields in a Solenoid

Christian Ratcliff

Faculty Advisor(s): Dr. Peter M. McIntyre

Electron beam technology is growing field with applications in industrial processes, the medical field, and the physical sciences. To accelerate the electrons to the required speed, they are sent through an electron beam tube, which uses magnetic fields to both accelerate and change the path of the electrons. In order to effectively construct an electron beam transport, its constituent solenoids must have their magnetic field flux correctly measured, and its lensing properties calculated. First a custom apparatus will be constructed to measure the field flux and current pulse properties, which will then be processed to extract a single current value and magnetic field flux value in each of the 3-dimensions. Next a prior derivation of the magnetic field flux will be adapted to fit the specifications of the solenoid, and compared to the data that was collected. Thirdly, a simulation software COMSOL will be used to simulate the magnetic field flux, and those values will be compared to the two other sets of values. Utilizing the principle of superposition, a beam tube consisting of 14 identical solenoids will be simulated, with the data gathered from one solenoid. Then the properties of a final, lensing solenoid will be measured, and it too will be added to the transport beam. Finally, the path of an electron will be simulated through the beam tube in order to establish the focal properties of the tube. Ensuring the exact output location of the electron from the input location is of paramount importance as it reduces the overall uncertainty in the final data. This project will contribute to an ongoing collaboration between Lawrence Livermore National Laboratory and Texas A&M's Accelerator Research Lab.

Poster #21

Effects of Surface Functionalization on the Protein Corona Composition of Gold Nanoparticles In-vitro

Amulya Kadaba

Faculty Advisor(s): Dr. Isaac Adjei

Gold nanoparticles (AuNP) have potential for drug delivery and diagnostic imaging due to the tunability of their physicochemical properties. Once AuNPs are injected into the bloodstream, their surface is covered by proteins, forming a layer known as protein corona (PC). Understanding how the

physicochemical properties, such as surface chemistry and surface charge, of the AuNPs affect the formation and composition of the PC is critical to designing clinically effective AuNPs. Most studies have found that the PC composition indeed changes by manipulating both surface chemistry and charge, however, it is still unclear whether those changes are due to the surface charge or chemistry. This study examines the sensitivity of PC towards AuNP's surface chemistry by studying the effect of a removal of a carbon atom on the abundance and composition of PC while maintaining the surface charge. To test this, I used cationic AuNPs conjugated to two branched-chain amino acids: Alanine (Ala) and Glycine (Gly). Both are hydrophobic and possess structurally identical chemical signature, differing only by a carbon atom. To confirm their conjugation, the AuNPs were characterized by measuring the hydrodynamic diameter of the particles and analyzing the zeta potential. The AuNPs were then interacted with plasma proteins to examine the effects of the difference in surface chemistry on the PC composition. The PC was then characterized by performing a micro-BCA assay to quantify the amount of proteins and gel electrophoresis to compare the type of proteins. These findings will provide an insight into how subtle changes in surface chemistry could result in observable changes in the PC. Therefore, careful consideration of the surface chemistry of NPs is crucial when designing NPs.

Poster #22

An FPGA Based Rowhammer Attack on DDR3

Caleb H. Norton

Faculty Advisor(s): Dr. Stavros Kalafatis

Beginning with Boolean logic in the mid-19th century, 1s and 0s have been integral to the evolution of man's computational power. For a computer, being able to write data in the form of binary bits and read it back is essential to minimize the necessary human input when making calculations. Early computers used relays, mechanical counters, or delay lines for their memory functions, but such component's limitations made it clear that further innovation was required to increase the speed and efficiency of computers. The invention of the metal oxide semiconductor field effect transistor (MOSFET) in 1959 and subsequent invention of MOS memory and MOS integrated circuits (ICs) in 1964 and 1968 respectively caused the older, more expensive core memory commonly used at the time to be replaced by the cheaper, faster semiconductor equivalents. In the proceeding decades, MOS technology has achieved exponential growth as observed by Moore's law and has enabled the invention and development of increasingly smaller and more powerful electronics. However, the increasing power and efficiency of memory are not without limitations. The denser the MOS memory cells become, the more they are susceptible to leakage between neighboring cells, and in some cases, cells can flip from 1 to 0 or vice versa just by being near other cells that are changing state. Studies have been conducted and exploits have been written that repeatedly read from ("hammer") a certain subsets of memory cells ("rows") to intentionally attack and corrupt other nearby cells leading to publications beginning in 2014 on this "Rowhammer" attack methodology. In this paper I will demonstrate the specification, design, and implementation of an FPGA based Rowhammer attack performed on DDR3 SDRAM.

Poster #23

Analyzing Media's Role in the Depp v. Heard Trial

Noah Baughman

Faculty Advisor(s): Dr. Alexander Hernandez

Few trials in recent memory have garnered as much public attention as the defamation suit against actress Amber Heard by her ex-husband, the actor, Johnny Depp. After Heard publicly accused Depp of domestic violence by publishing an article in The Washington Post, Depp claimed to have lost millions of dollars of work when he was dropped by Hollywood from his many high-profile roles. In the early parts of 2022, many people were focused on real world issues such as inflation, or the aftermath of the pandemic, but millions more were instead focusing on the Depp v. Heard case, a civil trial that took place on two continents, but mostly played out over the internet in the court of public opinion. Since the infamous trial of OJ Simpson, Americans have been infatuated with high profile celebrity trials. That desire to constantly know all the gritty details of celebrity legal drama led to an overwhelming wave of news coverage of the Depp v. Heard defamation case. In this presentation, I will analyze and present you with the different ways that different news outlets covered the Depp v. Heard trial, the prevalence of social media coverage of the trial, as well as how these may have affected the decisions of the jury.

Poster #24

Magnetic Activated Carbon as PFAS Treatment Technology in Soil

Andersen French

Faculty Advisor(s): Dr. Bella Chu

Per- and poly-fluoroalkyl substances or PFAS are a group of common and extremely hazardous pollutants that are persistent in the environment. With their hydro- and lipo-phobic properties as well as their Carbon-Fluorine bonds, PFAS are generally quite difficult to treat. PFAS are man-made, with pollution entering water, air, and soil from areas of production or heavy use. PFAS in soil serves as a store for the contaminant, allowing it to continue leaching into other parts of the environment over the long term if not treated. Unfortunately, treatment in the soil environment is difficult. Conventional treatments for soil remediation have proven either too ineffective or too costly. Activated Carbon is one such treatment, effective as an adsorpent for PFAS in soil, but its inability to be removed or otherwise further treated is a major limitation. Magnetic Activated Carbon (MAC) is activated carbon with iron deposited on its surface. Treating soil with MAC allows PFAS to be removed from the soil via magnetic separation after adsorption to the activated carbon. Two PFAS contaminated soils with different compositions (San Antonio, TX & PFAS Spiked Sandy Soil) were treated in a laboratory setting using MAC at a 1:20 MAC to Soil mass ratio. Two sets were tested for each soil type with the condition being a difference in frequency of MAC application, in one case every week and in the other every 4 weeks with replicates for each as well as a control case with no MAC treatment. Soil was extracted on each MAC application and analyzed for PFAS content. Results will reveal suitability of MAC as a treatment for different soil types and the best conditions for such treatment.

Poster #25

Enhancing User Detection

Holly Roper

Faculty Advisor(s): Dr. Krishna Narayanan

The internet is all around us. From our cell phones to our doorbells, almost everything is connected to the internet. With the number of devices accessing the internet surpassing the number of people on the earth how do we coordinate all those signals and make sure everyone still receives service? This research focuses on expanding cell coverage and resiliency. This will be done by developing an algorithm that allows a device to simultaneously communicate with multiple base stations. Specifically, focusing on user detection within a given region. The goal is for the base station to accurately determine which users are trying to communicate at a given moment in time. This project will examine the capabilities of algorithms already in place and attempt to enhance them through deep learning, creating a neural network in place of an iterative algorithm. The goal is that the computer will learn some of the parameters such as the thresholding parameter and vary it as needed throughout the network to optimize the traditional iterative approach. My research will also expand these algorithms to enable them to work with multiple base stations simultaneously. This research will detail and document a new algorithm and its effectiveness in terms of low complexity and low error probability.

Poster #26

Using Machine Learning to Optimize a Fast Generation Unit Commitment

Dillon Bartt Richards

Faculty Advisor(s): Dr. Thomas Overbye

The purpose of this research study is to investigate the use of machine learning to run unit commitment for large-scale optimization problems in a resource efficient manner while generating initial AC unit commitment results using a separate python script. One of the main applications of this tool would be determining when generator units should be deployed on an hourly basis depending on the available generation, the variable load, and weather conditions. Since unit commitment is very resource-intensive when determined using raw calculations (in both DC and AC optimal power flow, or OPF), it is inefficient when being used for any applications to a synthetic or real grid. If the grid being tested is very large and the studied time horizon is long, the calculations would not be solvable in a timely manner. Additionally, assumptions would have to be simplified to make the case solvable in the required time, making the results of unit commitment less valuable. With renewable generation steadily increasing across the nation, certain factors such as weather and the time of day can heavily influence how much renewable energy is available at a given time and how much non-renewable energy is necessary to meet the load requirements of the grid at a given time. By training the algorithm to prioritize turning off more expensive generation when load requirements are already being met and turning on the cheapest generation when the requirements are not being met, energy could be conserved, money could be saved, and the amount of carbon emissions produced to power the grid could be reduced.

Poster #27

Project Title Pending

Jose Solis
Glasscock Summer Scholar

Faculty Advisor(s):

Abstract Pending

Poster Session 4: 2:15 PM-3:15 PM CT

Room: MSC 2300 C

Poster #1

The Impact of Working Memory Load on Error Monitoring

Brandon K. Watanabe
Academy of Undergraduate Researchers Across Texas – Texas A&M University

Faculty Advisor(s): Dr. Annmarie MacNamara

To effectively avoid making the same mistakes, people must be able to monitor and adjust their behavior in response to errors. Since error monitoring is a cognitively demanding process, it may be inhibited by competing processes that use cognitive resources, like working memory. Hence, this study examined the effect of working memory load on error monitoring. Changes in brain activity associated with erroneous behavior were measured using event-related potentials (ERPs), like the error-related negativity (ERN) and error positivity (Pe). Prior work has shown that the ERN is associated with the immediate detection of an error, while the Pe is more reflective of elaborative and conscious error processing. Given that past research had found that working memory load reduces the elaborative processing of salient stimuli and the Pe reflects the elaborative processing of errors, we hypothesized that working memory load would reduce the Pe but not the ERN. Fifty-four participants completed a working memory task (low load versus high load) with an interspersed arrowhead flanker task (correct responses versus error responses). Results showed that while ERN amplitude was not impacted by working memory load, working memory load effected the Pe such that there was a greater difference between error and correct responses under low load versus high load. These results indicate that working memory load may inhibit the elaborative processing of errors, but might not influence more immediate error detection processes.

Poster #2

High-Speed Accurate Robot Control using Learned Forward Kinodynamics and Non-linear Least Squares Optimization

Pranav Atreya
Academy of Undergraduate Researchers Across Texas – University of Texas at Austin

Faculty Advisor(s): Dr. Joydeep Biswas

Accurate control of robots at high speeds requires a control system that can take into account the kinodynamic interactions of the robot with the environment. Prior works on learning inverse kinodynamic (IKD) models of robots have shown success in capturing the complex kinodynamic effects. However, the types of control problems these approaches can be applied to are limited only to that of

following pre-computed kinodynamically feasible trajectories. In this paper we present Optim-FKD, a new formulation for accurate, high-speed robot control that makes use of a learned forward kinodynamic (FKD) model and non-linear least squares optimization. Optim-FKD can be used for accurate, high speed control on any control task specifiable by a non-linear least squares objective. Optim-FKD can solve for control objectives such as path following and time-optimal control in real time, without needing access to pre-computed kinodynamically feasible trajectories. We empirically demonstrate these abilities of our approach through experiments on a scale one-tenth autonomous car. Our results show that Optim-FKD can follow desired trajectories more accurately and can find better solutions to optimal control problems than baseline approaches.

Poster #3

Energy Inequality in Climate Hazards: Empirical Evidence of Social and Spatial Disparities in Managed and Hazard-Induced Power Outages

Natalie Coleman

Academy of Undergraduate Researchers Across Texas – Texas A&M University

Faculty Advisor(s): Dr. Ali Mostafavi

The energy sector in the United States is ever more vulnerable to extreme climatic hazards. Utility companies reportedly prioritize the restoration of power systems based on the number of outages and the size of affected populations. This approach fails to account for unequal impacts of power outages such as the disproportionate impacts on certain demographic populations and the element of spatial vulnerabilities on the connected network. However, little empirical evidence exists regarding the presence and extent of energy inequality. A main roadblock is that the outage data is often perishable and not found at granular spatial scales. This research addresses these knowledge gaps by collecting and analyzing observational data related to the managed power outages during Winter Storm Uri and the hazard-induced outages during Hurricane Ida. The research quantified the period of recovery at a granular spatial scale using an equitable-focused analysis to detect social and spatial inequalities. In the managed outages of Winter Storm Uri, census tracts with lower income and more Hispanic households had a higher median duration of outages. In the hazard-induced outages of Hurricane Ida, zip codes with lower income and more black households had a higher median duration of power outages. Both the managed and hazard-induced outages had moderate levels of spatial inequality as shown through the spatial Gini and infrastructure index analyses. The findings also showed a greater extent of spatial inequality during managed power outages compared with the hazard-induced outages. The findings provide evidence of pervasive social and spatial inequality in power outages. It highlights the importance of integrating equity into the manner in which utility managers restore power.

Poster #4

Investigation of Microstructural and Hardness Properties of Molybdenum Alloys

Sucharita Banerjee

Academy of Undergraduate Researchers Across Texas – University of Texas at Austin

Faculty Advisor(s): Dr. Eric Taleff

Molybdenum (Mo) is a refractory metal with a high melting point of 2896 K (2623 °C), which allows it to be used at elevated temperatures. Many applications of Mo involve high-temperature service, such as furnace hardware and heating elements. Like many refractory metals and their alloys, Mo retains some room-temperature ductility in the worked (plastically deformed) condition but loses most ductility at room temperature after it recrystallizes. This is generally a result of brittle grain boundaries leading to grain-boundary fracture in the recrystallized condition. Because of this and other behaviors associated with microstructure, determining the recrystallization and grain-growth behaviors of Mo is important. Therefore, this study investigates the mechanical and microstructural properties of a commercial-purity Mo sheet material and four Mo alloy sheet materials. The Mo alloys tested were either lanthanated(La) or combined with titanium and zirconium (TZM). First Vickers Hardness tests were conducted on Mo specimens which were annealed at temperatures ranging from 1400C- 1700C. This experiment indicated that all the Moly compositions experienced a hardness drop by 1700 C alluding to all the Moly alloys being recrystallized. However, when coldworked metals are annealed, their microstructure evolves due to the processes of recovery, recrystallization, and grain growth. Since analyzing only hardness data cannot distinguish between the specific microstructural changes, metallographic analysis of all the annealed specimens was conducted. Then, the hardness values combined with microstructural analysis showed that all the alloys had undergone some degree of recrystallization by 1700C. Furthermore, tensile tests were conducted to determine the strengths of the Mo alloys at the annealing temperatures.

Poster #5

Effect of Crime Victims' Compensation Program on Reported Sexual Assault across Texas

Yilin Li

Academy of Undergraduate Researchers Across Texas – Texas A&M University

Faculty Advisor(s): Dr. George Naufal

This paper studies funding given by the Texas Attorney General's Office through the Crime Victim's Compensation Program and the relationship with reported cases of sexual assault. We studied the effect of victim services grants that are given to counties in Texas to aid survivors and provide resources. We hypothesized and found a positive and statistically significant relationship between the funding that flows into a county and the number of cases reported.

Poster #6

Pronouns Surrounding Emotion Language in the Lab and Real World

Emma S. Gueorguieva

Academy of Undergraduate Researchers Across Texas – University of Texas at Austin

Faculty Advisor(s): Dr. James W. Pennebaker

Emotions are products of our interactions with the world—particularly our interactions between others and ourselves—which makes them inherently social. Language, by definition, is social in that it is used to convey our thoughts and feelings to others. The language individuals use can reveal important details about their cognitive, social, and psychological states surrounding their emotions. Therefore, analyzing language use during emotional expression may reveal valuable insight about emotions. In this study, we collected emotionally expressive writing samples from over 24,000 individuals in both experimental (Prolific) and naturalistic (Reddit) contexts. Using LIWC-22 to analyze the text data, we examine (a) potential differences in language use between the expression of five emotions (anger, anxiety, happiness, love, and sadness), and (b) potential differences in emotional expression between context (the lab vs. the real world). Our findings indicate that function words (particularly pronouns), social references, and emotion words differed between emotions. Traditional research in psychology and computer science tends to consider emotional experiences as revealed through the use of emotion language. However, the present research suggests that—although they are non-emotion words—pronouns and other social references serve as an important contextual variable in emotional expression. Moreover, the differences between emotions across contexts for non-emotion words suggest that emotional expression in the lab differs from the "real-world" setting. Studying the usage of non-emotion words during emotional expression can reveal meaningful insights that can aid in the development of a reliable emotion detection model for text.

Poster #7

Marketing Misery and Selling Sang: Commercialization of Demotivation

Emily Curtis

Academy of Undergraduate Researchers Across Texas – Texas A&M University

Faculty Advisor(s): Dr. Jun Lei

In recent years, depressingly-marketed products are appealing to American and Chinese youth alike who identify with demotivation practices like quiet quitting, tǎng píng (躺平, “lie flat”), bǎi làn (摆烂, “let it rot''), and sàng wénhuà (丧文化, “funeral culture”). Within the rigorous work cultures of two global leaders, recent generations resonate with movements that suggest quiet resistance, ranging from doing less, to the bare minimum, to nothing at all. Despite historically rival economic policies, both the United States and China are struggling to control the “pandemic” of millennial and Gen Z workforce disengagement. Publications, seminars, and even public campaigns are being dedicated to concerns that demotivation movements exacerbate problems from generational disconnect and COVID-19. However, these discussions focus on what is lost, with little attention to what is being created: “youth misery

culture" as both a significant product and marketing strategy. This project examines current mechanisms of commercializing demotivation movements and considers possible effects of commercialization on the future of these movements. These discussions review previously commercialized countercultures, such as hippie and goth; analyze relatability marketing campaigns; and explore the use of humor, mascots, slogans, and aesthetics. Based on previous movements, commercialization can be expected to influence three aspects of current demotivation movements' futures: public acceptance, longevity, and integrity. This project hypothesizes that the inevitability and profitability of American and Chinese demotivation movements could ensure a degree of continued sustainment in society at the cost of impact and authenticity.

Poster #8

Aptamer Selection Methodology for Emerging Aptamer Research Laboratories and Classrooms

Nadia F. Khalil

Academy of Undergraduate Researchers Across Texas – University of Texas at Austin

Faculty Advisor(s): Dr. Gwen Stovall

Although antibodies have high affinity and specificity to their targets, there is a significant risk of eliciting unwanted immune responses and the costly isolation methods. However, their nucleic acid analogues, aptamers, have the same advantages as antibodies while still being cost-effective and less immunogenic. Aptamers can be isolated from a diverse pool of nucleotides by an in vitro selection (SELEX) method, in which only the strands with the greatest affinity for the target molecule will be retained for subsequent experiments. Aptamers' high binding affinity and specificity to targets leads to a wide range of applications which include high-sensitivity diagnostics, targeted drug delivery, and therapeutics. Despite these advantages, there is an overemphasis on developing new methods for aptamer selection and studying discovered aptamers and lack of discovery of novel aptamers. This is believed to be caused at least in part by the desire to lower the barrier to publication and the inaccessibility of some SELEX methods. To diversify the targets for which aptamers are discovered, a SELEX method that is even more affordable and accessible is being communicated. With this, the goal is to disseminate the aptamer selection methodology to undergraduate researchers in order to increase discoveries of novel aptamers.

Poster #9

The Colocalizationator: A Novel ImageJ Plugin for Automated Cell Colocalization Analysis

Joseph Chen

Academy of Undergraduate Researchers Across Texas – Texas A&M University

Faculty Advisor(s): Dr. Jennifer Dulin

Colocalization refers to the spatial overlap between two or more distinct fluorophores on the same cell or structure within a tissue sample, and is frequently used to determine cellular identity. This process can be optimized by using image analysis programs such as ImageJ to compare regions of interest (ROIs) to identify colocalized areas across multiple channels. However, a significant portion of this process still requires manual input of functions by the researcher, which can end up taking hours of work for multiple images. Hence, there is a great need for software that can perform colocalization analysis with minimal input. To address this issue, we created a plugin, the Colocalizationator, that semi-automates the process of identifying colocalized cells and regions. The plugin emphasizes customizability and adjustability revolving around two functions of quantification: point and area colocalization. The point colocalization function works by quantifying two separate image channels to obtain ROIs for each channel, while area colocalization relies on quantifying a single channel and overlaying the resulting ROIs onto the second channel. The customizability of the plugin is incorporated in the quantification of each channel. Users can select prewritten macros to incorporate into the process, ensuring the most accurate computation of colocalization. Once the plugin is setup and run, the user is free to walk away and let the program run on its own until complete. When finished, all the data points, along with the total area in pixels that is colocalized, is recorded and saved into an xlsx file. Although testing is still ongoing, comparison of results obtained with the Colocalizationator compared to hand counting methods confirmed 95% accuracy between the two methods.

Poster #10

Hypoxic Regulation of Glioblastoma Tumor Growth through L(3)MBTL1

David C. Park

Academy of Undergraduate Researchers Across Texas – University of Texas at Austin

Faculty Advisor(s): Dr. Daniel J. Brat

Glioblastoma (GBM) is the most aggressive and common type of brain tumor. Studies using Drosophila brain tumors models have revealed pathways that control tumor growth similar to GBM in humans. Our research using fruit flies led to the discovery of a potential tumor suppressor called Lethal (3) malignant brain tumor (L3MBT), which causes overgrowth of tumors in the optic lobes when mutated. L3MBT and its human counterparts, L3MBTL1-L3MBTL4, all contain a Malignant Brain Tumor domain that recognizes methylated lysines on histone tails. Similar to the Drosophila version, the human protein L3MBTL1 acts as a factor that compacts chromatin and suppresses gene activity to inhibit cytokinesis in GBM cells. The microenvironment in GBM tumors, which is often hypoxic, contributes to the tumor's progression,

recurrence, and resistance to treatment. However, it is not known if L3MBTL1's activity is affected by this environment. Our research suggests that low oxygen levels directly influence L3MBTL1 to promote GBM growth. Analysis of TCGA data for IDH-wildtype gliomas revealed that L3MBTL1 gene expression is downregulated in GBM, which are necrotic and severely hypoxic, compared to histologic grade 2/3 gliomas, which do not contain necrosis, indicating that hypoxia could potentially suppress L3MBTL1 to enhance glioma progression. TCGA data also revealed a number of HIF pathway and hypoxia-inducible genes strongly correlating with L3MBTL1 expression, including HIF1a and VHL. Using patient-derived GBM neurosphere cultures, we exposed glioma cells to hypoxia (1% O2 for 72hrs) and found that L3MBTL1 protein levels were suppressed compared to normoxia (21%). Under these same conditions, we found more rapid cell proliferation under hypoxia. Exploration of hypoxic TME regulation of the novel tumor suppressor L3MBTL1 in glioma progression has the potential to uncover novel mechanisms involving epigenetic modulation and potentially new therapeutic strategies.

Poster #11

Digitally Reviving Tilled Earth: A Historical GIS Analysis of the Privatization of Spanish Colonial Mission Lands in the Late Eighteenth and Early Nineteenth Centuries

John Erard

Faculty Advisor(s): Dr. Matthew Butler

While historical interest in pre-1836 Texas has grown considerably, studies of Spanish and Mexican Texas have been unable to clearly elucidate the decline and secularization of the Franciscan missions. This little understood period, spanning from 1793 to 1824, also entailed the privatization and sale of the missions' vast agrarian holdings—which included Texas' earliest ranchlands. The effect the disamortization of mission lands had on the trajectory of Spanish and Mexican Texas, including the character of Texas ranching and agriculture in the ensuing decades and centuries, has not been looked at in detail. In order to better understand the historical contours of this currently murky period, this project employed archival research to determine the location, size, and relative position of the privatized mission lands of the San Antonio mission chain, as well as which individuals would go on to receive them and on what terms. Never-before translated Spanish colonial documents from the General Land Office and the Bexar County Spanish Archives were used to undertake an analysis of how the political and legal processes of secularization and privatization created an unequal distribution of fertile, irrigable land. Historical geographic information systems (HGIS) aided in this process, allowing for the digital mapping of the mission ranches and storing of information gleaned from archival research in a related geodatabase. Upon completing the GIS setup, a novel land classification system was used to recreate the historical nature of the landscape and determine the overall quality of land received by the indigenous neophytes, Spanish Bexareños, Canary Isleños, and white Texians. The inventive HGIS methodology, combined with theoretical insights from the disciplines of agrarian and environmental history, demonstrated that white recipients of ex-mission land disproportionately benefited from the disamortization, receiving land parcels or suertes that were far more agriculturally productive than their native and tejano counterparts.

Poster #12

Exciting an Iodine Reference Cell

Christopher Shanks

Faculty Advisor(s): Dr. Hans Schuessler

Vapor reference cells are one of the more valuable reference tools available for lab use in laser and optical setups. Their utility and importance provided in lab settings stems from their application in stabilization setups, by using the atomic transitions of the elemental vapor inside as a stable reference to lock the beam's frequency. Of these cells, molecular iodine is one of the most commonly used in research settings, where its use is employed in ultraviolet and visible light setups. There has been a large amount of published data for their use in these wavelengths over the years, however this data is mostly confined to room temperature setups without exploring the possibilities available for higher energy transitions. In this research, our aim was to observe the behavior of an Iodine reference cell when excited via different means, and see what useful results could be provided for stabilization setups. For this purpose, two setups were used to excite the cell, one approach based on directly heating the cell and the other by exciting it into a plasma state. The resulting spectra were analyzed and compared to each other and previous data to determine which energy levels were being observed in each. Additionally, practical uses for the excitation setups were explored.

Poster #13

The Bidirectional Association Between Maternal Anxiety and Children's Cognitive Control

Ashley L. Walker, Anahid Akbaryan, Reese C. Burkey, and Peter J. Ramirez

Faculty Advisor(s): Dr. Rebecca J. Brooker

Cognitive control, or the ability to voluntarily guide one's own behavior, continually improves throughout childhood (Luna et al., 2010). Over time, children move from reflexive and reactionary behaviors to greater control over volitional responses to environmental signals (Derryberry & Rothbart, 1988). Such shifts reflect developmental increases in proactive forms of cognitive control, where children are self-directed in their intentions to recruit cognitive control in anticipation of needing it for a task (Munakata et al., 2012). Better cognitive control in children positively predicts important life outcomes, such as success in school and the workplace. (Blackwell & Munakata, 2014; Coldren, 2013). Postpartum anxiety syndromes, which affect 8.5% of mothers, negatively affect the development of cognitive control in offspring (Goodman et al., 2016; Reck et al., 2008). However, focus on unidirectional effects from mother to child ignores the true nature of the mother-child dyad, which comprises numerous bidirectional associations. Indeed, offspring characteristics that may make parenting more difficult can impact the course of maternal anxiety symptoms (Brooker, Mistry-Patel, et al., 2023), though such an association has not been investigated with regard to children's developing cognitive control. The present study examined bidirectional associations between maternal anxiety symptoms and children's cognitive control between child ages 3 and 5 years. During annual assessments, mothers completed surveys to measure anxiety symptoms. Scales from three separate surveys were used to form a latent variable reflecting maternal anxiety at each age. Electroencephalography (EEG) data was collected from children at each age during a computerized Go/No-Go Task. Event-related potentials were derived to assess cognitive control. We hypothesize that greater maternal anxiety will predict less cognitive control in children at subsequent assessments. We hypothesize that lower cognitive control in children will predict higher levels of maternal anxiety at subsequent assessments. This perspective offers a powerful and novel insight into the bidirectional relation between maternal and child development that can be leveraged to enhance outcomes for both members of the dyad.

Poster #14

Interruption of the NADH Biosynthesis Pathway in Mycobacterium Tuberculosis through the Identification of Small-molecule Inhibitors of NadD

Allen J. Brewton

Faculty Advisor(s): Dr. James Sacchettini and Dr. Inna Krieger

With a publicly declared and supported need for the discovery of novel treatments for Mycobacterium Tuberculosis, this paper outlines the discovery and characterization of multiple small-molecule inhibitors of the nicotinic acid mononucleotide andenyltransferase (NadD) enzyme in the NADH biosynthesis pathway of M. tuberculosis. Both active and dormant Mtb synthesize the biologically essential cofactor

NAD(H) from aspartic acid through a complex of enzymes, and therefore the NadD enzyme has been identified as a high potential target for all forms of Mtb infection. Prior to beginning high-throughput screening, whole-cell active molecules were screened against the prospective active site of the enzyme to provide a basis for choosing drug plates. In order to successfully screen the aforementioned library, Mtb gene Rv2421c, which codes for the NadD enzyme, was isolated, expressed, and purified to provide the active enzyme used for the in-vitro screening of compounds. Enzyme activity was measured using an endpoint phosphate detection agent which was validated to identify and kinetically characterize NadD inhibitors. Thus far, more than 40 active compounds have been identified through the end-point assay detection method. Each of these compounds have undergone a dose response to determine their IC50 and other inhibitory characteristics. Furthermore, a mode of action experiment was performed on two of the confirmed inhibitors. An analysis of crystal structures is currently being pursued in order to provide even further confirmation of compound binding in the active site of the target enzyme.

Poster #15

TX-7K-2030 Network Planning

Esu Ekeruche

Faculty Advisor(s): Dr. Thomas Overbye

Texas' electric grid is changing with an evolution and modernization of the grid. Solar energy will increase by more than ten times and wind energy by more than two times when compared to the current grid. There will also be an increase in the electric load across the electric transmission system. Accordingly, it is necessary for the synthetic grid to reflect these transformations. Transmission lines need to be modified in order to adapt to and keep up with the changes in Texas' grid. This research focuses on network planning for a Texas 2030 power system model. Transmission lines of an existing Texas 2016 synthetic power grid are modified to operate under future load and renewable generation scenarios for 2030. The process entails modifying a network model with DC power flow then performing AC Reactive Power Planning (RPP) for AC power flow convergence. In this work, various algorithms are utilized in making alterations to the 2016 grid, resulting in a well-functioning synthetic grid for 2030. The first set of functions determine the topology, admittances, and power flowing across the network model and the other set of functions update respective line impedances in order to modify overloaded transmission lines. The overall system updates transmission line capacities using power flows, thereby adapting the Texas 2016 grid for the year 2030. As a result of this research and paper, contributions are made towards the transition to clean energy and valuable power flow algorithms are added to the power systems community.

Poster #16

Genetic Fidelity Assessment of Callus-Induced Regenerated Queen's Crapemyrtle Plantlets

Nicholas Zhang, Sofya Kan, and Alanna Layton

Faculty Advisor(s): Dr. Hongmin Qin

Crapemyrtles (Lagerstroemia spp.) are widely popular flowering trees, especially in warmer climates around the world. One of the largest threats to many different crapemyrtle species in the southern United States is the invasive insect crapemyrtle bark scale (CMBS; Acanthococcus lagerstroemiae), which feeds on host phloem. Because of the popularity of these flowering plants, commercial planters and hobbyists alike want a CMBS-resistant crapemyrtle cultivar. A previous study conducted by our lab showed that Queen's crapemyrtle (L. speciosa) was one of the crapemyrtle species resistant to CMBS. With the goal of transferring CMBS resistance to other crapemyrtle species, we designed a study to establish an efficient plant regeneration system. Using this system, plants could more easily be generated for future stages of our project, namely the genetic transformation of resistance genes from Queen's Crapemyrtle to non-resistant species. However, before transformation experimentation can be done, we must ensure the genetic fidelity of our plantlets. Several genetic mutations are commonly found in plants that are rapidly grown through callus-derived regeneration systems such as our own. To test that our system is clear of these mutations, we used a set of 10 Inter Simple Sequence Repeat (ISSR) primers to measure genetic fidelity between our mother plant sample and five regenerated plantlets. The success of our mutation-free callus-induced regeneration system allows for aseptic in-vitro propagation of Queen's crapemyrtle, paving the way for future genetic transformation experiments.

Poster #17

Gene Expression Analysis of FGF8 Induced Synovial Joint Regeneration in Mice

Hannah Smith

Faculty Advisor(s): Dr. Lindsay Dawson

In both humans and mice, amputation of the digit tip (P3) results in complete bone and tissue regeneration, whereas amputation at more proximal levels, such as the middle phalanx (P2), results in regenerative failure, characterized by bone truncation at the amputation plane. Therefore, with the goal of regenerating human limbs, the P2 mouse model is used as a wound site for testing potential regenerative medicine therapies that may stimulate regeneration at non-regenerative amputation levels. For example, we recently identified FGF8 as an inducer of synovial joint regeneration after P2 amputation. FGF8 induces tendon, ligament, synovial cavity, and cartilaginous nodule regeneration, and importantly, cartilage that lines the P2 bone stump and serves as a template for bone regeneration. Here, we investigated early FGF8-induced gene expression to test the hypothesis that FGF8 induces a joint regeneration response reminiscent of joint development. Moreover, we performed skeletal analysis to determine if FGF8 restores the P2 bone length. P2 amputations were performed on post-natal day 3 (PN3) mice, and at PN7 one agarose bead soaked in FGF8 (500ng/Âµl) or BSA-control (0.1%

in PBS) was implanted into the neonate P2 digit. At 24 hours post treatment, qRT-PCR analysis demonstrated that gene expression associated with joint development (GDF2, Chrdl2, Has2, CD44, Prg4, Sox9, Acan, Col11a2) was significantly increased after FGF8 treatment. Skeletal analysis showed P2 bone length was partially restored following FGF8 treatment. Collectively, this study demonstrates that FGF8 induces a joint regeneration response transcriptionally similar to joint development, and results in a multi-tissue level regenerative response that includes the partial restoration of P2 bone length.

Poster #18

Affordable Frequency Selective Hearing Amplifier

AlMaha A. Bahzad and Hind S. Al-Mulla

Texas A&M University at Qatar

Faculty Advisor(s): Dr. Muhammad Zilany and Dr. Joseph Boutros

One of the most prevalent diseases affecting human communication is hearing loss. About one in every six people has a hearing deficit globally. Many people suffer from hearing loss but cannot afford a hearing aid because of the high cost set by manufacturers. In this study we aim to design a frequency-selective hearing amplifier that could be used an alternative to hearing aids by having an external controller and separate earpieces. The controller will allow the user to select the correct frequency bands to be amplified according to the listeners' degree of hearing loss. As a starting point, we have divided the frequency range into three bands only: 125 Hz to 1 kHz, 1 to 4 kHz, and 4 to 8 kHz, which could be extended to number of bands matching the range of frequencies in the audiogram. The microphone picks up the signal, the analog to digital converter (ADC) converts the signal to digital form which then goes through a Arduino UNO microcontroller where filtering and amplification take place. The second-order Butterworth filter is implemented digitally using the matched z-transform, and the signal in the desired band was amplified according to the degree of hearing loss (average from the audiogram with-in the band). However, the maximum amplification is mostly limited to 50-60 dB for the defined bands. The amplified frequency-band of the signal is then added back to the rest of the signal before a digital to analog converter (DAC) converting the signal to analog form that can be heard via the earpiece. In the testing stage, to ensure the device is working properly, a Raspberry Pi microcontroller was used to amplify the signal from the microphone and the testing was successful. The circuit components could be adjusted to produce the desired amount of amplification. The proposed design will be printed on a printed circuit board and tested thoroughly to ensure that a wide range of amplification is achieved for a wide range of listeners with various degrees of hearing loss.

Poster #19

Investigating the Stability of Inhibitors Against 3CL Protease After Chemical Modifications

Abigail Ramos

Faculty Advisor(s): Dr. James Sacchettini

In 2020 and 2021, the COVID-19 pandemic was the third leading cause of death in the United States, following heart disease and cancer as the first and second, respectively. Although there are numerous vaccines available as prophylactic measures, antiviral drugs for active case treatment are just arriving. The most recent success for COVID-19 antiviral drugs was Paxlovid, a peptide-based treatment widely prescribed throughout the United States. Paxlovid received emergency use by the FDA under a EUA. Two other COVID-19 drugs to have received emergency use authorization prior to Paxlovid were molupriavr, a ribonucleoside analog, and remdesviri, a peptide-based treatment. Remdesviri was the only COVID-19 antiviral treatment to be approved by the FDA and has recently been authorized for the treatment of children less than 12 years of age. However, remdesivir and Paxlovid both include adverse side effects such as diarrhea, muscle aches, nausea and vomiting, and difficulty swallowing. These side effects may be related to remdesivir and Paxlovid being peptide-based treatments. Therefore, the Sacchettini lab synthesized non-peptide-based non-covalent main protease inhibitors that could effectively treat COVID-19. The first series of inhibitors were urea derivatives previously determined by a structure-driven high-throughput screening process. Of the twelve inhibitors, one was active against the 3CL protease. The next series of inhibitors were amide derivatives; unfortunately, none showed enzymatic activity against the main protease. The Sacchettini lab continues to synthesize inhibitors against 3CL protease as well as contribute to a deeper understanding of the mechanisms used by 3CL protease inhibitors for the treatment of COVID-19.

Poster #20

Effect of Omega-3 and Omega-6 Polyunsaturated Fatty Acids on Gene Expression

Sophia Valdez

Faculty Advisor(s): Dr. Ivan Ivanov

Foods play an essential role in the management of disease; it is becoming increasingly common for individuals to turn to foods as a form of therapy or even prevention of progressive conditions, such as cancer. The biochemical makeup of a particular food can alter gene expression at a cellular level, possibly resulting in the prevention of cellular replication processes that ultimately lead to the unwanted initiation and growth of tumors. This project investigates the effects of both n-3 (fish oil) and n-6 (corn oil) polyunsaturated fatty acids in preventing the initiation and progression of colon cancer by gathering statistical trends in the presence of mRNA and miRNA, using samples retrieved from the colon of rats. This is accomplished using a data science programming language, R Studio, that can efficiently understand and manipulate expansive genomic data and visualize these analyses. Earlier research suggests that n-3 polyunsaturated fatty acids can alter gene expression in the colon, meaning that they

have highly useful chemopreventive properties. It is also expected that results will suggest that the presence of n-6 polyunsaturated fatty acids does not assist in the initiation of cancer; but nonetheless, provides no statistically substantial prevention. Our hypothesis is that the proposed analyses and data integration will validate the importance of incorporating foods that are contain n-3 polyunsaturated fatty acids into one's diet. Common sources of this dietary fat include seafood and leafy vegetables, which are easy additions to an everyday diet, and likely carry a multitude of other health benefits as well.

Poster #21

Evaluating the Role of UI/UX for Matching Undergraduate Students to Suitable Research Opportunities

Jordan Hassmann and Taj Bounds

Faculty Advisor(s): Dr. Tracy Hammond

There are many types of matchmaking applications matching users to a desired opportunity. There isn't however a strong application when it comes to matching undergraduates to a desired research area. We seek to match researchers to opportunities in a way where the researcher has the skills and the interest needed to fully satisfy themselves and fulfill what is required of the research. By utilizing other matchmaking areas and their UI/UX that has been shown to be successful, we will develop a UI/UX focused solution that will ideally expand the number of people in research and doing research they wish to do. The results of this research will be dependent on how users respond and how accurate the system is in matching qualified researchers to opportunities they are interested in. In order to systematically judge the effectiveness, functionality, and satisfiability of the system, we plan to leverage the Herzberg Two-Factor Motivation-Hygiene Theory in order to divide our system components into two categories: motivation factors and hygiene factors. Hygiene factors will be judged on how well they achieve the desired functionality, whereas the motivation factors will be judged more so on user satisfaction. The system components will be created with a respective goal in mind. Hygiene factors will be focused on providing the required functionality, while the motivation factors will be focused on maximizing the user's enjoyment while using the component.

Poster #22

Resolving Softbody Collisions with Machine Learning

Ahsan Yahya

Faculty Advisor(s): Dr. Shinjiro Sueda

A key aspect of 3D animation is physics based simulation. To create realistic animations for objects such as cloth and fabric, a category of mathematical models known as softbody simulations are used. There are a wide variety of techniques for simulating the behavior of cloth, with varying degrees of performance and visual fidelity. One such technique that this project builds off of involves calculating

the frictional forces between a cloth and intersecting geometries. This ensures that cloth objects display realistic behavior when sliding over rigid surfaces or being dragged by high friction materials. It's especially useful for depicting the movement of garments, as this technique can capture how real world clothing clings to the human form. With this technique, as with many, there is a tradeoff between performance and visual realism. While the latter is desirable for many applications in filmmaking and video game development, it can come at the cost of rendering time or real time performance. This friction based simulation produces visually realistic results, but it can be computationally expensive to simulate, especially for complex geometries. This project aims to create a deep learning model that can approximate the results of friction based collision resolution with better performance. By training a model on data collected from the real results of this technique, it could give similar results at potentially greater performance.

Poster #23

AI Powered Sudoku Training Game Using Scaffolding

Feier Chen

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

Sudoku is a puzzle solving game with benefits such as improving concentration, improving problem solving skill, and helping analyze the relation between the whole and part. Currently, there are a lot of online sudoku games available to people to play and provide hints when they get stuck; there is also a lot of research on the different algorithms used to solve a full sudoku game. However, there aren't a lot of games focused on training people to become a better sudoku solver. In order to acquire a new skill, people need to learn the general strategy and then practice it in different scenarios to master it. Simply providing hints when the player gets stuck makes the hints specific to the current scenario, which means the player could fail to apply that strategy to a slightly different scenario which makes the training not efficient enough due to lack of general application of the strategy. In this game, players will be trained to better play sudoku through scaffolding. The players will be able to get hints when they get stuck and will get hints when they make a mistake. The hints will come with a detailed explanation of the specific strategy used in the scenario. The AI will also learn the player's weakness by learning the type of mistakes they make and the hints they ask for to generate mini games that will target that specific scenario that the player can't solve. The game will have means of encouragement such as leaderboard and competition with friends. The result of the study was evaluated by conducting an experiment on 50 people, in which prior to using that application they were asked to play 5 sudoku games of different difficulty levels with hints provided when needed, the number of mistakes made, hints used, and time spent were used to calculate a performance score; then they were ask to train using the application and then play another 5 sudoku games to compare their current performance score with the initial one. In conclusion, the game will be able to train people to become better sudoku solvers, thus encouraging them to play more sudoku games to help with their concentration, problem solving skill, and their analysis of the relationship between the whole and the part.

Poster #24

Using Ultra Leap Hand Tracking to Create a More Efficient System of Recognizing User Input in Nemeth Braille

Preksha Vaghela and Maja Schermuly

Faculty Advisor(s): Dr. Tracy Hammond

Communication of algebraic expressions to those who are blind and visually impaired through the use of Nemeth Braille is a critical necessity that can be improved through advancements in current technology. Despite the proven efficiency of typing patterns for braille as a viable input mechanism, utilizing hand tracking technology as an alternative input method has recently caught attention as a less invasive and more efficient alternative. The purpose of this study is to evaluate the use of motion tracking technology for braille typing input using UltraLeap's Hand Tracking Camera and a supplementary application that translates hand gestures into algebraic expressions. The study will involve participant trials in which users will be instructed to perform hand gestures that correspond to braille keystrokes. The analyzed data will include user data pertaining to finger placement and alignment, which will be used to evaluate the effectiveness of current model-based hand-tracking algorithms and technology as a Nemeth braille input system. The findings of this research will contribute to the growing body of literature on the use of motion-tracking technology in the field of accessibility. The expected outcome is that the results will demonstrate a positive correlation between the use of motion-tracking technology and the recognition of braille typing patterns. This will have significant implications for the development of more efficient and user-friendly input methods for those who are blind and visually impaired and will ultimately improve the communication of algebraic expressions in the Nemeth Braille system.

Poster #25

The Effects of ML Architecture on Hybrid Meeting Speaker Detection Accuracy

Derek Viet

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

In the last few years, the world has become increasingly reliant on videoconferencing software for conducting meetings. A common feature of videoconferencing software is the ability to detect and highlight which meeting participants are speaking in a fully remote meeting based on whose microphone is active at a given moment. However, this feature loses its usefulness in the context of a hybrid meeting where multiple participants may be present in a meeting under a single account using a single microphone. As a step towards a solution to this problem, this research project explores the application of various machine learning models towards the detection of the current speaker in a hybrid meeting. In doing so, we will discover trends, issues, and important factors to consider in the design of a machine learning architecture for speaker detection. Performance will be evaluated using the percent accuracy of each model's output given testing data. The performance of various models will be compared and contrasted in order to determine what factors affect performance the most and what types of architectures lead to the greatest performance. This paper serves as a resource for future

researchers and industry developers who are attempting to implement their own model for hybrid meeting speaker detection or similar purposes.

Poster Session 5: 3:30 PM-4:30 PM CT

Room: MSC 2300 C

Poster #1

Synthesizing Novel Views with Diffusion Models

Brandon G. Nguyen

Faculty Advisor(s): Dr. Nima Kalantari

Diffusion models are an extremely powerful class of generative models that in image-to-image tasks such as super-resolution, coloration, and image synthesis have accomplished state-of-the-art performance. Until recently, there had not been much success with the specific task of novel view synthesis. The recent 3DiM model is a geometry-free model that takes the existing UNet/ResNet framework established in previous diffusion work. 3DiM introduces a cross attention layer where the two frames are able to query each other's feature maps to leverage the scene information that is available in both frames. This ability allows the model to synthesize views that are consistent with one another; a property that many other geometry-free models that either require a complex workflow, or are unable to attain. Additionally, the noisy and reference frames are allowed to have differing noise levels, allowing the noisy frame to always be conditioned against the clean reference frame. Finally, each block in the 3DiM UNet architecture modulate the positional embeddings are used to encode pose information in addition to the noise, allowing the model to learn both at the same time.

Poster #2

The Life and Death of Identity after Death in Texas Medical Schools

Adam T. Ross
Texas A&M University at Galveston

Faculty Advisor(s): Dr. Samuel Mark and Dr. Laura White

The current state of research with regards to the use of exhumed paupers' graves in the 19th century is well established, but the extent to which attempts to preserve the documentation of personal and cultural identities based on known medical information and forensic context have yet to be properly examined. Furthermore, the extent to which said documentation may or may not have improved in relation to changes in codified rules of ethics and the growth of medical schools in Texas remains to be properly examined. In order to better uphold the responsibilities medical institutions have to accurately document the identities of the deceased, they would benefit from the context of my preliminary findings for any genuine consideration of their respective recommendations for changes in law and policy. In this research, I verify the existing archival and physical records of human remains used for study in the UTMB John Sealy School of Medicine, one of the State's largest and oldest medical schools, and trace the observable improvements or downturns in the quality of documentation with regards to

the individual and cultural identities of the deceased throughout the respective histories of the institution. In so doing, I identify correlations between the quality of documentation and any changes either to the expansion of said institutions or the existence of codified rules of ethics with regards to the acquisition of human remains for study. This will contribute to the body of knowledge surrounding the preservation of identity in medical research and ideally help us to better understand how the relationship between marginalized communities and institutions of medicine can be improved.

Poster #3

Applications of Neural Architecure Search to Deep Reinforcement Learning Methods

William J. Allen and Zachary P. Lindsey

Faculty Advisor(s): Dr. Sarah J. Witherspoon

All Neural Networks(NN) are constructed according to a certain Neural Architecture(NA). Different applications of Neural Networks may, according to a given task, require a different type of Neural Architecture for that task. An emerging field in Deep Learning called Neural Architecture Search(NAS) seeks to understand which neural architectures produce optimal performance for a given problem. This may involve searching a large space of different architectures, or optimizing a specific one to perform better. Indeed, it has been shown that different architectures achieve drastically varied performance as models for solving a given problem. However, the question of which Neural Architecture will perform the best for a given problem is unsolved. Many modern Deep Learning methods are heavily bounded by scale. They often require large amounts of electricity and other computational resources to be effectively utilized. It follows that any marginal improvement in performance may have outsized payoffs. Answering the question of finding an optimal Neural Architecture for a given problem may be a key step in improving model efficiency. In this research, we explore how searching Neural Architectures to play the board game Othello, using AlphaZero as a baseline, affects a variety of metrics including agent win-rate and training time. Additionally, a strong emphasis is placed on finding an architecture with high computational resource efficiency. We seek to provide intuition regarding the selection, composition, and optimization of Neural Architectures for problem-solving contexts similar to that of Othello. We also seek to demonstrate the growing flexibility of deep learning for applications restricted to consumer-scale computation.

Poster #4

Interdigitated Electrodes in Microfluidics

Erin Ingram and Omar Mahmood

Faculty Advisor(s): Dr. Arum Han

Droplet microfluidics deals with the manipulation of discrete volumes of fluid as small as several microliters through small microchannel devices, and it has shown promise in many different biological

and chemical applications, including cell biology, drug screening, and nucleic acid analysis applications. However, regardless of the generation structures, the viscoelasticity led to the problem of formation of satellite droplets during generation. These are undesired since they can negatively affect the precise manipulation of desired droplets. In addition, these droplets in biological applications are seen in the cross contamination between fluids during downstream processing. To address these issues, a new method and system must be proposed to alleviate the problem by addressing the issue of satellite droplet generation. Size-based filtration uses electric forces and spatial channels to help direct specific sized droplets to certain outlets to be processed and analyzed. The size-based filtration method can be further enhanced using interdigitated electrode (IDE) arrays. IDE arrays can more finely tune and control electric fields which allows the method to be more sensitive when attempting to spatially filter droplets by DEP force. As a relatively novel solution, the IDE bandpass filtration method has potential to usher in a breakthrough in the quality control of satellite droplet formation.

Poster #5

Evaluating Podcasting as a Delivery Method of Science Communication in Higher Education

Kristina L. Samuel

Faculty Advisor(s): Dr. Benjamin Neuman

The overall aim of this study is to understand the contributions that Podcasting as a form of Science Communication can make to the quality and effectiveness of collegiate educational practices. Surprisingly little comprehensive research has been done concerning the efficacy of Podcast Implementation in Education, despite the fact that it is quickly growing in popularity. The objectives of this paper are to (1) review literature where Podcasting is utilized both in classroom and out-of-classroom environments, (2) to investigate the impact of Podcasting on Knowledge Acquisition, Knowledge Retention, Student Engagement, and Student Perception, and (3) to identify and recommend Auditory Delivery Methods with the greatest positive impact on students. The literature surrounding this podcasting in education is found to be wide and varied in design and focus; different definitions of podcasts are used and at different stages of educational careers. However, there is still some debate about the usefulness of podcasts in the classroom. The consensus among current literature is that podcasts are most conducive as supplemental material in classroom instruction. There is significant evidence supporting the notion that podcasts can serve as a vital tool contributing to a student's active learning approach to science education by increasing their engagement and overall motivation. Although there are calls for more studies measuring the actual efficacy of podcast implementation as a formal learning tool, these studies serve as a step towards increasing the accessibility of science education in higher education.

Poster #6

Optimization of in vitro Development of Thrombi

Ashley Bailly

Faculty Advisor(s): Dr. Fred Clubb and Dr. Staci Horn

Understanding the mechanical properties of blood clots, or thrombi, and how they interact with ventricular assist devices (VADs) and antithrombotic drugs could allow users to monitor the risk of heart-assisting device failure or allow physicians to better prevent strokes. This project aims to better understand the formation of thrombi in vitro and how properties such as stiffness and size affect the associated risk. Three systems were created to induce the formation of blood clots: a rotating mechanical surface secured within a petri dish, a Chandler Loop, and a beaker placed upon a shaker table. The process and results of the three systems were compared to determine which method could best be optimized. The created clots were then subject to mechanical tests and histology, from which the data was used to understand how certain properties affect the interactions with VADs and antithrombotic drugs. It was determined that the use of a 3D printed rotating disc placed within a glass petri dish containing blood was the most effective method for creating the blood clots. Additionally, running the system for 48 hours at 120 RPM allowed for the creation of substantial enough clots while also limiting the effect of air, which dries out the sample after a prolonged period of time. Photos of the clots were collected and compared. Future directions include the use of mechanical testing on the collected clots and the application of the collected data for studying ventricular assist devices and antithrombotic drugs.

Poster #7

Few Shot Learning to Improve Deep Medical Model Transfer

Dayton Berezoski

Faculty Advisor(s): Dr. Bobak Mortazavi

The advent of machine learning has changed the way healthcare providers care for their patients. One example is the ICU mortality prediction model, which takes vital signs of an ICU patient and is able to predict whether the patient will survive the ICU. This model is helpful for physicians as it provides them with a second opinion on their patients and it allows them to classify patients that are in need of immediate care. However, this model is built off of thousands of data points from past patients in the ICU, making it difficult for most health centers to build their own model. The next idea to make these models readily available to health centers is to train an ICU mortality prediction model from a hospital with the required resources and then to give that model to any health center that wants that model. However, researchers have found that since heath centers often have widely vary, there is a definite decrease in model performance after the model is transferred. This paper aims to address this decrease in transfer performance by utilizing a technique called few shot learning. Few shot learning will be utilized to modify an existing health center's ICU mortality prediction model, by taking a small set of data from the receiving hospital's patients and retraining it on that data. In practice, the experiment will create a general model from the MIMIC-IV database, create a deep copy, retrain that deep copy on a

small dataset from the eICU database creating the few shot learning model. There should be an increase in model performance after transfer for the few shot learning model, because its hypothesis space has been modified for the eICU data it was retrained on. This would allow for more accessibility for deep medical models, benefiting physicians and patients.

Poster #8

Gradient Balancing in Auxiliary Task Recommendation

Ronald Lee

Faculty Advisor(s): Dr. James Caverlee

Auxiliary Task Learning has proven to be an effective way to transfer knowledge between tasks. This is the case in many personalized recommendation scenarios, where many auxiliary tasks can boost the performance of the primary task via a shared layer in a multi-task network. However, we often encounter a gradient imbalance issue when updating the parameters of the neural network. For example, the gradient magnitudes for an auxiliary task could vary significantly compared to the target task which leads to imbalanced information transfer between tasks. This could cause a particular auxiliary task to over or under influence the output of the target task. Multiple works have been done to resolve the gradient imbalance issues. Some methods include directly manipulating the gradients with respect to the shared parameters in order to balance gradient magnitudes. Other approaches include accounting for the gradient direction, and dynamically scaling auxiliary gradients depending on their direction agreement with the target task. This thesis seeks to understand the baseline benchmark techniques that exist to improve recommendation accuracy. Gradient-balancing techniques and gradient-direction based methods are currently not combined as they yield sub-optimal results. This work evaluates and compares these different methods on a large, public recommendation data set to explore various ways to combine both methods with the aim of achieving boosted performance.

Poster #9

Effect of Spiroplasma on Drosophila Fly Survival Under Parasitic Wasp Attack

Zoe Hathcoat

Faculty Advisor(s): Dr. Mariana Mateos

The bacteria Spiroplasma are heritable symbionts that infect several species of Drosophila flies. In order to improve their transmission in fly lines, Spiroplasma have developed the ability to manipulate host reproduction (male-killing) or protect them from enemies. Previous studies have shown that the presence of Spiroplasma can protect their hosts from parasitic wasp attacks. However, the level of this protection varies between fly and wasp species, so it is necessary to examine each combination of fly, wasp, and Spiroplasma species. The purpose of this research is to determine the nature of the symbiotic relationship between the parasitic wasps Lc01 (Ganaspis sp.) and Lc03 (Leptopilina sp.), the Oregon R strain of Drosophila melanogaster flies, and Melanogaster Sex Ratio Organism (MSRO) Spiroplasma. A non-infected Spiroplasma-negative control group and an infected Spiroplasma-positive group were

established. These groups were divided and subjected to three different wasp treatments: a no-wasp control, Lc01, and Lc03. Protection was determined by counting the number of pupae, adult flies, and adult wasps that emerged from a set of larvae and comparing the ratios of these values between groups. The presence of Spiroplasma in the original mating groups and the progeny was confirmed using PCR. Preliminary results indicate Spiroplasma does have an effect on wasp survival and fly survival in the larva-to-pupa stage, but further analysis of this significance is required. The results of this experiment can help elucidate evolutionary history and potential biological control methods.

Poster #10

Examining the Impact of Acetaminophen on Early Attentional Processing of Emotional Images

Felicity R. Woodson

Faculty Advisor(s): Dr. Brian A. Anderson

In addition to pain relief, previous research has shown that acetaminophen can blunt evaluative and emotional processing. The extent to which these pharmacological effects of acetaminophen can be attributed to changes in attentional processing remains unknown. Here we used the emotional attentional blink (EAB) paradigm to assess acetaminophen's impact on emotion-attention interactions. The EAB consists of a rapid serial visual presentation of 17 images that last for 100ms each. Participants were instructed to identify and indicate the orientation of a rotated target image while ignoring positive, negative, or neutral distractors. The target could appear either 2 or 5 positions after the critical distractor (lag-2 or lag-5). If acetaminophen blunts the prioritization of emotionally valent images at early stages of attention, then we should see improved lag-2 target accuracy for the treatment group compared to the control groups. We randomly assigned participants to either a control (cornstarch placebo) or treatment (acetaminophen) group in a double-blind manner before having them perform the EAB task. Although we replicate a robust emotional attentional blink for both positive and negative images, our results show no differences in performance between groups, suggesting that acetaminophen did not attenuate the magnitude of distraction by the emotionally valent images. However, it is possible that participants were insufficiently processing the semantic content of the distractors to see a modulatory effect of acetaminophen, or that acetaminophen delays the disengagement of attention from emotional distractors rather than influencing attentional engagement, which might be more robustly evident at intermediate lags.

Poster #11

Investigating the Anti-Cancer Properties of a Novel Nanomaterial

James Sampson

Faculty Advisor(s): Dr. Tapasree Roy Sarkar

Triple-negative breast cancer (TNBC) presents a particular challenge for treatment because of its lack of estrogen, progesterone, and human epidermal growth factor (HER2) receptors. Traditional endocrine or HER2 targeting therapies cannot be used, usually resulting in the use of chemotherapy for treatment. TNBC is considered an aggressive form of cancer and also has relatively high rates of metastasis and recurrence. One important mechanism of metastasis for TNBC is epithelial-mesenchymal transition (EMT), where epithelial cells undergo a transformation into mesenchymal stem cells. This gives cells a higher migratory capacity, leading to an increased risk of distal metastasis. Previous studies have implicated the use of nanoparticles as a potential cancer treatment due to their anti-EMT properties. Photothermal therapy (PTT) using near-infrared radiation (NIR) has also been shown to inhibit tumor progression by ablation of cancer cells through hyperthermia. This study examines novel nanomaterials as a potential treatment for TNBC. The materials are composed of folic acid (FA), copper sulfide (CuS), and a combination of both (FA-HEP-CuS). FA and CuS were selected because of their cancer cell targeting and photothermal transduction abilities respectively. These materials were studied in MDA-231 breast cancer cell lines in vitro to examine their anti-cancer effects on various cell characteristics such as viability and motility.

Poster #12

Intelligent Internet Traffic Management Using Machine Learning and Software Defined Networking

Andy White and Malcolm Lyn

Faculty Advisor(s): Dr. Stavros Kalafatis

This research seeks to provide a novel solution for managing internet traffic within data centers, specifically in selecting where to send certain requests for processing within a server rack. Most current solutions are hardware based, which are incredibly expensive and complex, even though they are quite fast. To process requests efficiently, this research aims to develop a Software-Defined Network (SDN) which utilizes packet preprocessing and machine learning combined into a "smart switch" to route packets to the best server for handling, as well as a machine learning model that predictively caches data more efficiently for quick access based off parameters such as the type of data being requested, data popularity, and current network congestion. Additionally, a technique for embedding extra information about a given packet into an Internet Protocol (IP) header is presented. To design and test this proposed system, a custom topology is designed using Mininet, and a Ryu controller application is created to execute the machine learning prediction. This research builds upon work done in networking, including defining virtual switches using an SDN, header modification in OpenFlow, and packet

classification using machine learning. The goal of this project is for the smart switch to provide a simple, cost-effective, and highly optimized solution to packet processing in data centers.

Poster #13

Exploring Practices and Principles for Educational Software User Interfaces to Determine Effective Learning Reinforcement and Development

Sidharth Edupuganti and Sameer Hussain

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

In recent years, learning—especially in post-secondary education—has rapidly digitized to a hybrid-online environment. With expedited changes occurring due to the COVID-19 pandemic, many Universities have had to steadfastly adopt this new hybrid environment system. One of the most integral components of these systems is the user interface, which helps users reinforce learning. These interfaces must support the student, and help reinforce their learning environment inside a classroom, as well as from their homes. Considering these changes, user interface evaluation is necessary to determine the reinforcement of learning to students within an e-learning environment. The effectiveness of e-learning systems needs to be evaluated for students within the current state of the world. By creating a tool named Educational Learning Tool (ELT), we can assess students in their learning as well as the reinforcement effectiveness of ELT. The immediate objective is to measure and analyze participant performance through multiple mathematical, verbal, and quantitative reasoning assessments which includes differing UI components. This will indicate which components of these UIs most effectively promote learning reinforcement and development. Through varying the subject content and feedback type in each question, additional comparisons can be made to indicate which type of UI best reinforces learning for a particular subject-matter or question type. With an expected increase in recall and learning from audio and visual feedback types. In the future, as institutions continue to move to an online learning environment, more nuanced considerations and decisions can be made about how and when to use specific types of user interfaces in the design of educational software.

Poster #14

A Video Game-based Approach to Handwriting Practice: The Development and Evaluation of "Neon Signs"

Connor Bowling

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

Handwriting is a fundamental skill that plays a crucial role in communication and learning for all ages. However, many individuals struggle with this complex skill, particularly children with developmental disorders and older adults with deteriorating motor and cognitive functions. In addition, traditional methods of handwriting practice that one might use to improve, such as writing exercises and worksheets, can be tedious and unengaging. To address this problem, "Neon Signs" was created, a video

game that uses online handwriting recognition to recognize and assess what the player has written. The game consists of playing as the owner of a business that creates custom neon signs. Players are given a random 4 to 7-character noun which they are to write down on a sign for the customer, after which they are then rewarded based on how clear and fast they wrote, with bonus points added for cursive and extra flair. These points can then be redeemed for more cosmetic options, such as sign backgrounds and neon colors, serving as a means of extrinsic motivation. This game was used to conduct a study with college undergraduates, who played the game for 30 minutes and filled out surveys about their experience and perceived improvement. The results of this study demonstrate the potential of using video games as an engaging and effective tool for practicing and improving handwriting skills.

Poster #15

ZenSketch Gaming Updates and Web Integration

Mahalie Scasta

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

Possessing the ability to create quality sketches is important to developing and communicating new ideas across disciplines. Furthermore, developing sketching skills has been shown to have benefits across a plethora of other mental functions. Despite the importance of these skills, many people are unmotivated to draw. This can be caused by a lack of confidence or loss at where to begin. At a certain point, it is common for people to abandon attempts at improvement altogether if they feel unworthy of the title of 'artist'. The ZenSketch game is a feature of the Sketchtivity application, which provides a learning environment for sketching skills. ZenSketch specifically focuses on linework, and provides an engaging and low-entry method for users to develop their skills. As line work provides the basis of drawings, this is both a simple and important place to start. Real time feedback is provided to users as they learn how to improve their linework in the form of game incentives. This feedback focuses on the metrics of speed, accuracy, and smoothness. Utilizing these incentives allows for greater motivation and encourages users to continue practicing. This research outlines the updates made to the ZenSketch game to be compatible with the existing Sketchtivity web application. The game was modified to function in a React website framework. Drawing upon previous studies using machine learning and sketch recognition, features of the game have been designed to provide an effective environment for cultivating sketching skills. In addition, a user study was conducted to analyze the impact of the updated ZenSketch interface and game features on improving the line work of players. The results show improvement along the metrics of accuracy and smoothness of lines drawn.

Poster #16

Addressing User Experience for Co-creative Drawing Systems Through User Interface and Drawing Style

Erika Yao and Brianna Brown

Faculty Advisor(s): Dr. Tracy Hammond and Dr. Paul Taele

With the rise of artificial intelligence and its integration into society, the exploration of human interaction with AI agents has led to the creation of co-creative drawing systems, computer programs which collaborate with humans in the creative drawing space. These systems are designed to help users expand their imaginations in the course of completing creative tasks by providing additional stimulation for users to work off of as they draw. Unfortunately, studies have shown that current AI agents can cause discomfort to users when they demonstrate inconsistent drawing styles from human-like to non-human-like, impeding on their intended positive impacts. To improve upon AI drawing, we implemented new interface features, allowing the user to adjust the drawing speed and style of the AI agent, based on suggestions provided by previous papers. These solutions focus on modifying the UI to properly show the boundaries of the agent's generation and using human centered design to establish the user preferences between the UI's expressiveness and the model's breaking points. Five participants agreed to a brief observation using the modified interface, where they were asked to complete a series of tasks to evaluate the effectiveness of our proposed improvements. This was followed by an informal interview discussing their experiences as a whole to identify their positive and negative perceptions of the co-creative system. Through our project, we aim to identify traits in promising solutions to improve the user experiences of future co-creative drawing systems for all users. These insights can aid future researchers in identifying key features to include when developing increasingly advanced co-creative drawing systems to collaborate with people.

Poster #17

Identifying Conditions and Trends on the Support or Opposition to Immigration in the U.S.

Daniel J. Robinson

Faculty Advisor(s): Dr. Alexander Pacek

In the U.S., the divisive issues surrounding immigration have been as enduring as the U.S. itself. Particularly in the past few years, politicians and political commentators have shined a spotlight on the issue, heightening its place in the national discourse. Numerous pollsters have conducted consistent surveys that can be used to track public perception over time. The framework of this analysis is drawn from and a continuation of Muste's 2013 Public Opinion Quarterly review of Americans' attitudes toward immigration. His work is heavily built upon Segovia and DeFever's 2010 Public Opinion Quarterly article on immigration and immigration policy, which itself is built upon the Lapinski et al. 1997 Public Opinion Quarterly article. Like these works that have come before, this review examines polling data from ANES, GSS, Pew, Gallup, and a number of other quality sources. This work differs from the

aforementioned articles by largely focusing on the past decade, a time frame the articles do not cover. As such, special focus will be provided to examine shifting public opinion on a U.S. border wall along the Mexican border, an immigration issue that only rose to prominence in recent years. While some fear surrounding immigration persists, especially when discussing illegal immigrants, the data shows a continuation of the U.S. population's decades-long softening attitude on the issue. This review is solely focused on immigration issues as perceived by the general U.S. population, however, it is not concentrated on immigrants from a specific country or a specific type. By analyzing a compilation of poll trends, it is possible to track the projection of public opinion on the issue in the coming years.

Poster #18

The Role of Striatal Ensembles and MOR-Expressing Neurons in Opioid Reward and Withdrawal

Lucas Rodriggs

Faculty Advisor(s): Dr. Jun Wang

Addiction is widely considered as a maladaptive form of learning and memory. Memory is encoded in the brain by neurons known as engrams. While usually formed through normal behaviors, these engrams can be recruited through the use of addictive substances like opioids. When stopping the intake of opioids, withdrawal occurs. This causes hypodopaminergic states as well as negative emotions. It is believed that withdrawal-induced negative emotions are one of the main factors leading to relapse. Extensive evidence suggests that the striatum mediates drug-seeking behaviors and contributes to opioid relapse. Opioid addiction is mediated within the patch compartment of the striatum by the direct-pathway medium spiny neurons (dMSNs) containing mu-opioid receptors (MORs). It remains unclear how drug-activated dMSNs encode drug-seeking memory and how chronic opioid exposure and withdrawal impact these MOR-expressing dMSNs. Here, we report that dMSNs that were activated by repeated fentanyl injections encoded contextual memory between the rewarding effect of fentanyl and the environment. Chemogenetic inhibition of fentanyl-activated dMSNs suppressed conditioned place preference. Importantly, striatal MOR-containing neurons mediate fentanyl withdrawal-induced negative emotions. Chemogenetic inhibition of these striatal MOR-containing neurons reduced fentanyl withdrawal-induced physical symptoms and alleviated anxiety-like behaviors. These data suggest that repeated opioid use recruits striatal dMSNs and enhances path dMSN outputs to SNc dopamine (DA) neurons, which may suppress DA activity and cause a hypodopaminergic state that leads to negative emotions and, consequently, relapse.

Poster #19

Footshock Stress Recruits Inhibitory Parvalbumin Interneurons in the Medial Prefrontal Cortex of Rats

Kennedi Crayton

Faculty Advisor(s): Dr. Steve Maren

Stress is a major contributor to many psychiatric disorders, particularly trauma- and anxiety-related disorders such as post-traumatic stress disorder. Studies have shown that stress activates the basolateral amygdala), which dampens activity in the infralimbic cortex, a region of the medial prefrontal cortex that is critical for the reduction of learned fear (i.e., fear extinction). We propose that the basolateral amygdala has an inhibitory effect on the activity of IL principal neurons via inhibitory parvalbumin interneurons. We explored whether footshock increases Fos expression in PV interneurons in the infralimbic and prelimbic subdivisions of the mPFC. Male and female Long Evans rats were randomly assigned to three groups: Shock, No Shock, and Home. Perfusions took place 90 minutes after the conditioning protocol and brains were extracted for immunostaining. As expected, there were no differences in the overall number of PV-positive neurons between groups, however, the PL contained a greater density of PV-positive neurons in comparison to the IL. In terms of overall Fos expression, the Shock group showed significantly more Fos-positive neurons in both the IL and PL in comparison to the control groups. In terms of PV-Fos colocalization, the Shock group showed a significantly greater proportion of Fos-positive PV neurons in both the IL and PL in comparison to the control groups. Interestingly, the IL showed a greater proportion of Fos-positive PV neurons in comparison to the PL within the Shock group. These results demonstrate that footshock stress does activate inhibitory parvalbumin interneurons in the medial prefrontal cortex, particularly in the infralimbic subdivision.

Poster #20

Effects of Extraterrestrial Life on Meaning, Mattering, and Spirituality

Ronin Deemer

Faculty Advisor(s): Dr. Joshua Hicks

The psychological effects of the belief in the existence of extraterrestrial life have been associated with having an increased number of paranoid beliefs, which in turn have physical health ramifications, and modern research around the topic has centered around distinguishing the belief in the existence of extraterrestrial life with paranoid beliefs in topics such as U.F.Os. However, there has been little research done to understand the personal psychological effects of the belief. With recent pictures from NASA's Hubble Space Telescope being released, it has become increasingly important to understand the effects that thoughts about the universe and life outside of Earth have on the individual. In this study we will be randomly assigning participants from Texas A&M University to read a prompt stating that scientists have come to the conclusion that life is either scarce to non-existent outside of Earth, or highly likely and abundant while looking at photos taken from the Hubble Space Telescope. The differences between the two groups average responses to items measuring meaning, mattering, and spirituality, as

well as other items, will be examined. It is hypothesized that those within the scarce-life group will have a decreased meaning and mattering, with an increase in spirituality when compared to those within the abundant-life group. Surveys are currently in the process of being completed and examined. Our findings hope to reveal the association between belief in extra-terrestrial life with concepts such as religiosity and spirituality, and meaning and mattering. We also hope to remove the negative stigma surrounding extraterrestrial beliefs with having been largely associated with paranormal beliefs.

Poster #21

Innovation and Stagnation: The Union Army in the Department of the South

Lance Jeter

Faculty Advisor(s): Dr. Lorien Foote

Despite the vast amounts of research done on the Civil War, the Department of the South, made up of South Carolina, Georgia, and Florida, and the operations within it are relatively understudied and not well understood. Although historians portray the department as a stagnant and unimportant section of the conflict, it was marked by innovation in military tactics, use of Black troops in combat, and in the use of combined arms to take on the Rebels. The department is a case study of how military innovation can still lead to stagnation. General David Hunter, the first general to lead Union armies in the department, was a radical abolitionist who applied his belief to the way he fought the Confederates. When General Hunter began operations in the department, he raised Black regiments such as the 1st South Carolina Volunteers under Col. T. W. Higginson, which immediately began raiding Rebel towns and freeing slaves up and down the coast. Innovative combined arms support with the Navy also occurred during the raids and expeditions, using gunboats and ironclads sometimes under the direct command of an Army officer. However, operations stagnated under Hunter as the troops only took part in some small battles which ended in defeat. The troops were then primarily relegated to raiding and digging earthworks. Because of this and the struggle for equal pay morale became an issue, with some of the men even deserting their posts. The Army and Navy also could never coordinate on a large scale to make a true difference, despite seeing great success on a small scale. The Department of the South is a case study that shows that an army with innovative ideas is not guaranteed success and can still stagnate when innovation is not applied properly and capitalized upon.

Poster #22

How the Values Promoted by 18th Century Transcendentalist Philosophy has Affected the American Evangelical Church

Chloe Breig

Faculty Advisor(s): Dr. Theodore George

Following an analysis of the current religious demographic trends in America, The Pew Research Center suggests that the percentage of individuals who identify as Christian could decline to half of the current

population in the next few decades. However, this claim is shocking since Christianity has seen a slight and steady increase around the globe. The recent trend in newer generations disaffiliating from Christianity at rapid rates is a change that is unique to the United States. The distribution of self-identified Christians in the U.S. can be broken down into two major groups: Catholic and Evangelical Protestant. Even though Evangelical Protestants make up the largest percentage of American Christians at 25.4%, the percentage of young adults who identify with no religious affiliation is now 22.8%, trailing behind by only 2.6%. The data also shows that the majority of Mainline Protestant Denominations, which means any Christian group with a uniform structure and set of doctrine, have seen a steady decline in membership since 2007. However, Non-denominational churches in the U.S. have seen a dramatic growth in membership, especially in young adults. Young adults from various denominational backgrounds have been flocking towards these churches, yet their age group is consistently decreasing in Christian affiliation. Thus, the American Evangelical Non-denominational church is not slowing the pace of disaffiliation. Furthermore, some of the major religious and philosophical movements in America, specifically the Transcendentalist philosophy of Ralph Waldo Emerson, have caused the values of self-reliance and individualism to be further embedded into the fabric of the country, and how they are contributing to the decline of Christianity in America.

Poster #23

Design of a Radiation-Hardened Optical Transceiver

Alexander Anderson

Faculty Advisor(s): Dr. Samuel Palermo

Reliable and efficient communication links are vital in harsh environments where ionizing radiation is present. Optical links specifically are necessary to support the growing need for higher data rates and faster signal processing requirements of devices in these environments. For many years, radiation hardness in electronics has been achieved via specialized manufacturing processes by dedicated foundries. These techniques have failed to scale at the rate of commercial CMOS processes, disallowing for faster and more efficient circuits. One strategy to create radiation tolerant circuits while still using commercial fabrication is to use a hard-by-design methodology. Techniques such as enclosed layout technique (ELT) and triple modular redundancy (TMR) can be used to design devices tolerant to ionizing radiation.

Poster #24

Directed Energy Deposition Additive Manufacturing for Pharmaceutical Printlets

Natalia Garcia

Faculty Advisor(s): Dr. Mathew Kuttolamadom

The objective of this research work is to develop, modify, and test a directed energy deposition (DED) machine tailored for pharmaceutical additive manufacturing. DED is a process most often used for the 3D printing of metals that utilizes a focused energy source, such as lasers and electron beams, to

provide the energy and heat needed to melt powder deposited onto the build plate. This process allows for greater customization of the prints from material composition to geometric accuracy and detail. In the pharmaceutical industry, this greater control of customization is an important quality to consider for patients with specific needs including geriatric and pediatric. The potential of DED fabrication of pharmaceuticals is a field that is yet to be explored and tested. This research work will discuss the potential benefits of DED and prove the concept of this additive manufacturing process of pharmaceuticals by developing a working DED machine prototype. The prototyped DED machine was built by modifying a traditional FDM printer to integrate an enclosed building area, a laser, and a powder deposition mechanism that works together to build pharmaceutical tables. This printer will be capable of printing tablets showing the difference that process parameters have on the quality of the print produced. The use of DED in the pharmaceutical industry could open many doors to aid patients.

Poster #25

Analysis of the Photospheric Velocity of Type Ia Supernovae

Andrew Jozwiak

Faculty Advisor(s): Dr. Ergin Sezgin and Dr. Peter Brown

The photosphere of a stellar object, such as a Supernova, is the depth that you can see inside of the object. When studying Supernovae, the velocity of the photosphere is an extremely useful datapoint to have. To this end, the author set out to measure this value. To determine the velocity of the photosphere of Type Ia Supernovae, first a Python code was created. To determine the photospheric velocity, this code detected the Silicon II absorption feature, as this feature is present in most Type Ia Supernovae. By determining the change in frequency of the Silicon II absorption feature between the rest frame and the observed frame, the velocity could be determined by using the Doppler Shift equation. For each snapshot of the Supernovae explosion, the photospheric velocity was determined. From this data, the photospheric velocity over a period of time was plotted, and compared against the results of previous researchers. This process was then repeated for other Type Ia Supernovae. These results were then calibrated so that they could be compared against each other regardless of explosion duration. Using the astronomical standard of fifteen days after the maximum brightness of the supernovae explosion, the photospheric velocities of the supernovae were compared.

Poster #26

Fiber Optic Characterization for Unprecedented Sky Subtraction

Shravan V. Menon

Faculty Advisor(s): Dr. Jennifer L. Marshall

Observations taken from ground-based telescopes and large spectroscopic facilities are contaminated by emission from the Earth's atmosphere and must be subtracted from astronomical measurements to recover the true target spectrum of an object. Precise and accurate sky subtraction is imperative to achieving reliable science results since many astronomical objects are fainter than the sky background.

The Fiber Optic Characterization for Unprecedented Sky Subtraction (FOCUSS) project aims to obtain an accurate subtraction of the sky background using calibrated fiber-fed spectroscopic instruments for the next generation of spectroscopic facilities such as the Maunakea Spectroscopic Explorer (MSE). The fundamental basis of FOCUSS is to take detailed measurements of individual fibers that will be used in these spectroscopic facilities, locate and analyze the primary depreciators of fiber performance, and identify solutions and techniques to limit these effects. The fiber characteristics tested in the project include focal ratio degradation (FRD) and the relative transmission of the fibers. Ultimately, we should be able to choose a group of fibers for any spectroscopic facility that effectively minimize the effect of fiber differences to achieve accurate sky subtraction and maximize the accuracy of the spectroscopic data collected.

Poster #27

RhoA Activation Causes Epithelial Acinar Eversion

Kathryn A. Leach

Faculty Advisor(s): Dr. Tanmay Lele

Epithelial cells line surfaces of the human body. Since they define the boundary between internal and external environments, these cells maintain a polarity, created by localizing proteins at opposite ends of each cell, in order to facilitate transport of substances between these environments. Basal proteins, which face the external environment, and apical proteins, which face the internal environment, define this polarity. When grown in vitro using a 3D culture, epithelial cells group together to form hollow, fluid-filled spheroids of cells called acini. These acini reflect in vivo polarity with basal proteins facing the 3D matrix and the apical proteins facing the fluid-filled interior. In some cancers, the polarity of epithelial cells becomes inverted which may play a role in cancer metastasis. Previous research projects investigated the mechanism responsible for inverting the acini and found a variety of mechanisms. This research project builds on past discovery of using RhoA activation to initiate acinar eversion. Activating RhoA increases the activity of myosin, resulting in higher contractility in the cell. This higher contractility was found to disrupt the mechanical equilibrium of the acini, resulting in breakage, breach, and eversion of acini's polarity as they collapse and flip inside-out. To further investigate this mechanism involving RhoA, this project attempts to form acini from the previously untested cell lines of 344SQ_shCTL, 344SQ_shZEB1, 393P_Vec, and 393P_ZEB1: cancerous lung epithelial cells. The cell lines that do form lumens will also be tested with Rho to see if inversion of the acinar polarity occurs. Currently, it is expected that the cell lines with upregulated RhoA activity, such as 393P_ZEB1, will not form acini.

Poster #28

Characterizing Best Methods for Improving Light Yield in CsI(Tl) Scintillators

Kensington N. Vincent

Faculty Advisor(s): Dr. Rupak Mahapatra

In the search for dark matter, very low energy sensitive detectors are needed that would be able to distinguish minute differences in closely residing energy peaks. In an effort to increase the ability of a CsI(Tl) scintillator detector to do so, a new wrapping material will be used on the innermost layer of the detector. The new wrapping material is a 3MTM Enhanced Specular Reflector (ESR) material which is hypothesized to produce a higher light yield with better resolution than the original wrapping of plumber's tape due to its high reflectivity. Two different types of tests were performed to test this hypothesis. First, a source of Co-60 was used to test the difference between the wrappings. The test was run for an hour for each original and new wrapping. There was more than a 35% increase in the recorded mean value for each Co-60 peak, and more than a 15% decrease in the standard deviation for the new material. Secondly, a source of Am-241 was used to test the low energy capabilities of the new material. There was a significant increase of 50% in the mean of the first range of low energy peaks and a smaller, but significant increase of 14% for the 0.06MeV energy peak. Because of this significant increase in light yield and general decrease in standard deviation, it is clear that the ESR material has a greater ability to gather more and higher resolution data than its predecessor. This could lead to a greater understanding of detecting low energy particles which in turn could help us understand what dark matter really is.

Poster #29

Microservices Management for Distributed Computation

Elizabeth G. Weichel

Faculty Advisor(s): Dr. Srinivas Shakkottai

With the rise of machine learning and artificial intelligence (AI), applications that run machines using code have become much larger and more complex. As such, a new method for increased efficiency in computation is to decompose these applications into smaller "sub applications" called microservices. These are like pieces that fit together and work simultaneously to complete a much larger puzzle. One challenge with these microservices is allocating space for them to compute and complete their function. Managing these microservices is the goal of the research I have completed last semester and am continuing to work on this semester. The purpose of this project is to create a machine-learning algorithm to analyze and evaluate specifications of microservices to automatically scale the resource allocation of an application. This project will not be creating a new application but rather creating an algorithm that manages the resource allocation of the application. The algorithm will take as input the latency of the microservices or the end-to-end latency of the workload request and output a new CPU allocation for the microservice containers (using Docker containers). By either decreasing or increasing CPU allocation, the latency will be affected. The algorithm will learn from its actions to create the optimal allocation resulting in lowest latency. The end goal of the algorithm is to use a multi-arm bandit

algorithm (a method of reinforcement learning [RL]) to optimize the application. A thresholding algorithm has been already implemented, and the RL algorithm is currently being worked on.