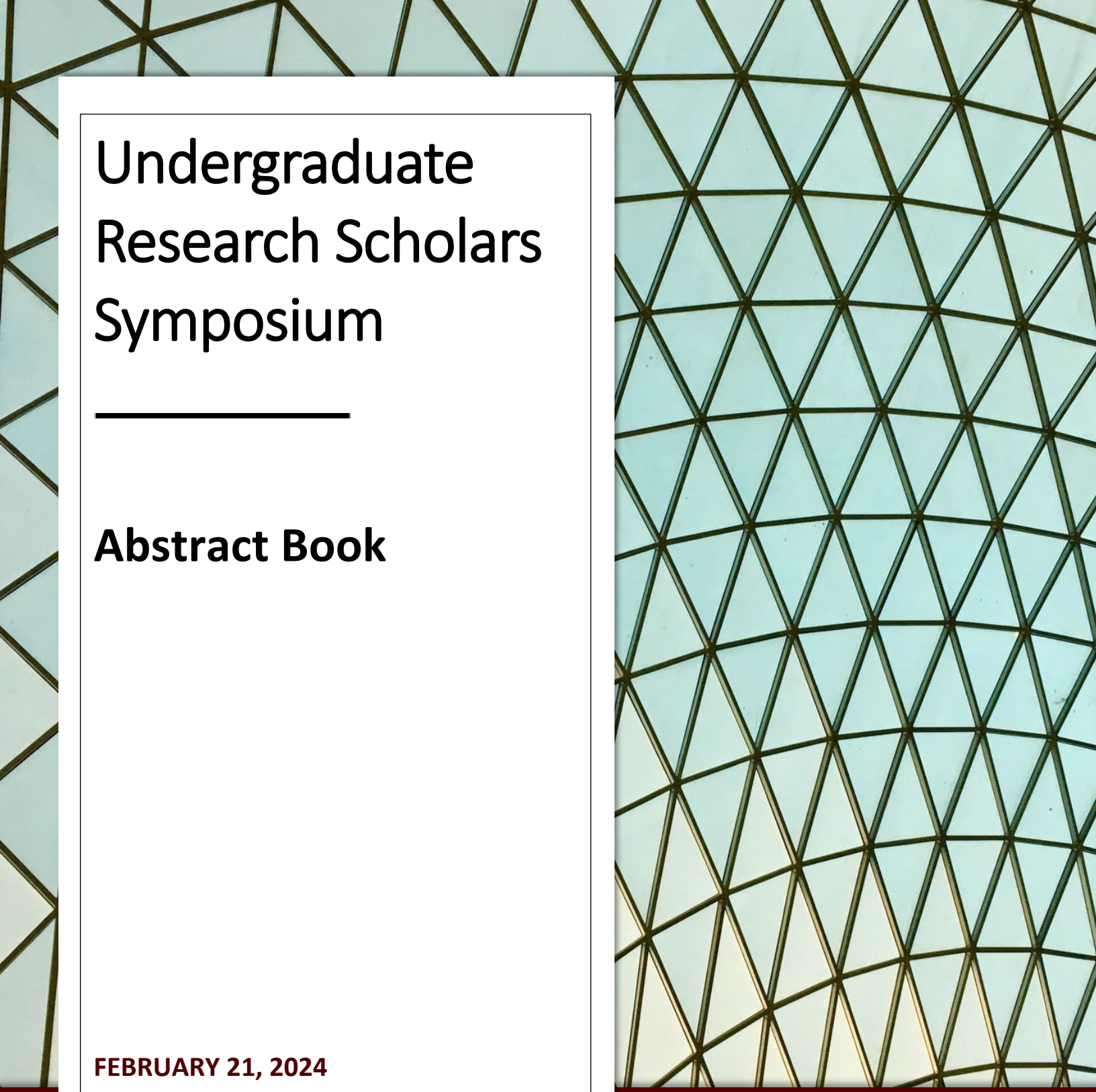

Undergraduate Research Scholars Symposium

Abstract Book

FEBRUARY 21, 2024

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.

About LAUNCH

LAUNCH is 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.

Contents

Oral Sessions

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

Room: MSC 2300 A

The Role of Transcription Factor pou3f3b in Zebrafish Inner Ear Development

Sydney Christensen

Faculty Advisor(s): Dr. Bruce Riley

Hearing loss is a serious condition that afflicts much of the population through many age groups. An intriguing route to study hearing loss and its potential treatments is to study initial hearing development. To deepen our understanding of this complex process, we must learn more about the network of genes involved in the development of the saccule and the process of sensorineural development, both of which are required for the development of hearing function. One gene of interest in these processes is pou3f3b. pou3f3b is a transcription factor that is commonly used as a saccular marker, but has not yet been investigated thoroughly. The transcription factor has orthologs in humans and mice, and experiments with mice revealed hearing deficits in mutants, but were largely inconclusive as knockout of the gene is lethal in mice. Zebrafish pou3f3b-/- mutants are viable, however, making it an ideal model organism for this novel research. Through this project, we characterized the role of pou3f3b in the development of the inner ear. We found that pou3f3b is necessary for proper sensorineural development, where it supports sensory fates. It does this via a dual function of repressing ngn1 and activating fgf3. That combination, in turn, supports atoh1a and stimulates hair cell production in the saccule. Through this role, pou3f3b appears to be essential for maintaining a proper balance of sensorineural domains and production of hair cells.

Poetry as an Educational Medium for the Natural Sciences

Abigail O. Rector

Faculty Advisor(s): Dr. Lowell White, Dr. Rich Cooper

As doubts about the efficacy of the American education system rise, the importance of core school subjects is more frequently called into question. Science is not exempt from this evaluation as many find it irrelevant to their lives and career fields. Amid climate change and runaway pollution, the necessity of science education grows as it informs audiences about the environment and their possible role in its destruction and preservation. Although not a core subject, poetry is similarly disparaged for its apparent irrelevance. However, my research examines the importance of poetry, not as a subject of education, but as a means of education for the natural sciences. My research illustrates poetry's potential to engage readers by revealing the applicability and novelty of science in everyday life. The objective nature of science may appear at odds with a medium as subjective as poetry, and much of the science poetry that does exist tends to be overly technical and riddled with niche jargon. However, I intend to demonstrate how poetry allows even complex scientific topics to be accurately simplified and conveyed to an audience unfamiliar with the content. My poetry collection employs several poetic devices my

research has found to be common in children's poetry, including meter, rhyme, humor, narrative frameworks, and visual art, to make technical content more approachable, digestible, and enjoyable for a layman reader. Guided by research concerning environmentalism, poetic forms, and the pedagogy of science, I present Nothing Old Under Our Sun, a poetry collection designed to attract, inform, and excite readers about the natural sciences.

A Deep Learning Approach to LLM Text Detection using the LibAUC Library

Shantanu Thorat

Faculty Advisor(s): Dr. Tianbao Yang

As large language models (LLMs) continue to grow and improve, it becomes harder to distinguish between AI and human written texts. The growing popularity of LLMs has also led to numerous models being developed, such as OpenAI's ChatGPT or Meta's LLaMa models. Identifying LLM generated texts has useful applications across several fields such as academia, industry, and law. However, there are many challenges such as adversarial texts, imbalanced datasets, and out-of-distribution (OOD) performance (i.e., generalizability of detection models). Fortunately, the transformers library can be used to classify and detect AI generated text. Additionally, the LibAUC library, a deep learning library for X-risk optimization, shows strong performance on imbalanced datasets. We apply the LibAUC library on transformer models for text classification on two LLM/human text datasets. The first is the AuTexTifcation detection subtask (English only) dataset which covers three domains: WIkipedia style paragraphs, tweets, and legal texts. Model performance is evaluated on a test set spanning two external domains: news and reviews. Despite this OOD test set, We show that our LibAUC trained DebertaV3-large model is able to achieve a higher macro-F1 score compared to the current top scorer on the leaderboard. Additionally, we demonstrate a LibAUC-trained transformer model's performance on adversarial texts, specifically on student essays in the OUTFOX dataset.

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

Room: MSC 2300 B

Exploring the Potential Mechanistic Interaction between Single-minded 2s/sirtuin 3

Kaitlin Kelly

Faculty Advisor(s): Dr. Weston Porter

Metastasis has become an increased phenomenon among women with breast cancer. The underlying mechanism driving this dissemination is intricately tied to cellular stress induced by mitochondrial dysregulation. Single-minded 2s (SIM2s) is a transcriptional repressor that governs the cellular stress that yields metastasis. Recent studies have shown that the proteins, Sirtuins, play a similar role to SIM2s and that Sirtuin 3 (SirT3) may be a regulatory factor that influences the stability of SIM2s. To gain a better understanding of what is happening at a molecular level, the different Sirtuin activities were examined during the progression of breast cancer. Utilizing quantitative PCR and immunoblotting techniques, the activity of sirtuins was analyzed to determine how much SirT3 is present in MCF7 cells. It was discovered that when SIM2s is selectively knocked out, there is no observable modification in the expression or activity of SirT3. Furthermore, siRNA was employed to inhibit the expression of SirT3, and immunoblotting verified this knockdown while also assessing the expression of SIM2s under conditions of SirT3 presence or absence. Results have shown that when SirT3 is knocked down, SIM2s is knocked down as well. This observation lays the foundation for a deeper exploration into the regulatory dynamics between SirT3 and Sim2s. It is expected that after further analysis of this relationship, the outcome will show that SirT3 has a direct correlation with SIM2s. Understanding the underlying mechanisms behind this interaction provides a valuable insight into how this mitochondrial dysregulation instigates metastasis. This unravels the possibility of looking into other interactions within the mitochondria that can lead to the progression of breast cancer.

Soviet Democracy: A Principled Examination

Colin Peek

Faculty Advisor(s): Dr. Linda Radzik, Dr. Katherine Unterman

Early Soviet leaders held out the new 1936 Constitution of the USSR as an emblem of political reform and a new era of Soviet politics. These declarations were accompanied by changes to the ideological rhetoric concerning democracy from Stalin and the party elites, departing from previous conceptions of the Soviet state with democracy at the forefront. Rather than aligning with commonly held Western ideals about a democratic state, however, Stalin set out to delineate the boundaries of a new conception of democracy grounded in Soviet legal and political thought. The philosophical theory underpinning this approach differed from other democratic states in key ways that contributed to the practical functioning of Soviet elections and the Soviet state. Previous research has investigated the international propaganda value of democracy to the USSR and the failure of the USSR to institute free,

liberal democracy, but comparatively little research has sought to examine Soviet democracy on its own merits in terms of the state's own political foundations and philosophy. Through critical analysis of Stalin's political theory and the events surrounding the enactment of the 1936 Constitution, I can develop a Soviet model of democracy based on the foundational principles outlined therein. Examining alternative conceptions of democracy is critical to understanding the limitations of our own institutions and preventing totalitarian backsliding.

Evaluation of Fabrication Method of Patient-Specific Cardiovascular Models for In-Vitro Flow Analysis

Jarrett Fowler

Faculty Advisor(s): Dr. Andrew Jastram, Dr. Andrew B. Robbins

Cardiovascular disease is the leading cause of death globally and has encouraged the use of cardiac assist devices, such as the left ventricular assist device (LVAD), to combat heart disease. The increasing use of LVADs comes with postoperative complications, such as stroke, that persist as a substantial challenge in the field of cardiovascular disease and occur in 15% of patients within 2 years after surgery. The occurrence of stroke is surmised to be correlated with the relationship of the inlet and outlet cannulation angle of the LVAD into the aorta. This observed relationship between hemodynamic irregularities and stroke has been further investigated through computational fluid dynamics studies; however, computational studies require experimental validation through methods such as benchtop flow analysis. A major hurdle in this process is the fabrication of anatomical models fit for flow analysis systems. This study evaluates a fabrication method of patient-specific aortic arch models for utility in a mock circulatory loop. The objective is to establish a cost and time-efficient manufacturing method to produce anatomical models from medical imaging data. The intended outcome is a model that maintains geometric accuracy, minimizes image distortion along the image path, and functions when inserted in an experimental flow loop. Achieving the intended results will aid the study of the cannulation angle of LVAD patients and establish a patient-specific fabrication method useful for device testing and physiological simulations.

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

Room: MSC 2300 D

Invariant Mass of χ_c from Run 15 of STAR

Vishwam Khapre

Faculty Advisor(s): Dr. Saskia Mioduszewski

Quark Gluon Plasma (QGP) is the state of matter theorized to exist right after Big bang and provides a mechanism to help study the primitive universe. The STAR experiment located at Brookehaven National Lab is at the forefront of nuclear physics and the exploration of the properties of QGP. Our experiment collides protons and gold (Au) nuclei at near light speed to and analyzes the particles from the resulting jets produced. Performing these collisions at near light speed provide data on the strong force present in the nuclear matter and recreate the conditions at the beginning of the universe. These collisions are detected through various probes, which provide evidence of QGP production. One of these probes is the production of the particle J/ψ. However, J/ψ particles are not only produced through QGP decay, but also through the decay pathway of the χ_c particle, which is also produced in these collisions, although much more rarely. This particle is important for understanding multi body de- cays in QGP, and important for understanding various non relativistic effective field theories of Quantum Chromodynamics, like the Colored Singlet Model or the Colored Octet Model and testing their predictions. Here, we present the invariant mass of χc reconstructed through the Run 15 of STAR performed in 2015 through proton and Au nuclei collisions.

Study of Environmental Changes Within Tres Palacios Bay Through Benthic Foraminifera Analysis

Zachary Clore

Faculty Advisor(s): Dr. Christina Belanger

How do human impacts on estuarine systems affect the ecology of the system? Sediment records of estuarine systems and benthic foraminifera can tell us about the changes in estuarine conditions over time. Specifically in terms of this study, a sediment core in Tres Palacios Bay will give further insight into the impact of human development that occurred in the Matagorda estuary system starting in the 1950s. Deeper portions of a sediment core record the environmental conditions of the bay further back in time this is because of the geologic principle of superposition. In tandem with this principle, benthic foraminifera are known to be sensitive to subtle changes in the environment. Previous studies have used variations in the relative abundance and body sizes of benthic foraminifera to reconstruct past environmental conditions in areas across the world using varying species of foraminifera. However, in this study, I focus on Ammonia spp. and the Matagorda estuary system to test the hypothesis that Ammonia spp. increases in relative abundance and increases in size after the rise of human impacts

within Matagorda Bay given Ammonia spp. is more tolerant of high-stress environments and, thus, a highly impacted estuary will be more physiologically suitable for Ammonia spp.

Assessing Carbonates as a Feasible Route in Carbon Capture and Utilization

Murtaza Gundru, Fatima Alahen

Faculty Advisor(s): Dr. Patrick Linke

The urgent need for a sustainable carbon-free society requires strategic approaches to address the environmental and economic challenges associated with implementing Carbon Capture Utilization and Storage (CCUS) technologies. This work proposes a streamlined approach to process system engineering to develop cost-effective Carbon Capture and Utilization (CCU) pathways. The high costs related with implementing the CCU technologies discourage investments towards it. Despite this, the importance of a strategic framework and proper research allocation is required in order to implement optimal solutions for reducing CO2 emissions in the atmosphere. The proposed approach serves as a methodological tool to systematically identify and implement profitable routes in CCU. As many possible choices exist, a need to develop a strategy that considers these choices for CO2 capture is crucial. The work presents the choices in a simplistic graphical format that can be interpreted easily by people in the industry. In addition, these graphs will be used to help determine the most cost-optimal CO2 reduction pathways. Recently, a new method has been proposed to perform high level analysis of CO2 reduction by developing integrated minimum marginal abatement cost curves (Mini-MACs). The methodology of our work involves the development of these curves for different carbonates including sodium bicarbonate and dimethyl carbonate. The Mini-MAC curves will be analyzed to determine the lowest cost solutions available for these different carbonates and recommend the most feasible options. In addition, the method will be applied and analyzed on a case study that mainly focuses on the potential of implementing these solutions in the state of Qatar.

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

Room: MSC 2300 A

The Polysemous Associates Test

Jillian M. Hermoso

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

Insight is an essential cognitive process in solving creative problems. Encountering these problems often includes a form of mental restructuring to overcome conceptual obstacles and eventually experience an â€œAha!â€ moment of solution. The Polysemous Association Test (PAT) introduces a tool for evaluating insight within this type of creative thinking. Similar to its predecessor, the Remote Associates Test (RAT), the PAT consists of verbal problems in which a single solution word is connected to each problem word. PAT problems are comprised of pairs of words (e.g., RIVER MONEY) and the attendant solutions are polysemous words (e.g., BANK), with one meaning associated with each problem word. Considering the capacity to perceive various ambiguous meanings is a fundamental aspect of creative cognition, word association problems are well-suited for investigating creative thinking skills. Additionally, the advantage of having only two prompt words for each PAT problem, as opposed to the three words in RAT problems, offers certain benefits for experimental purposes. The simplistic development of word association tests allows for a focused study on identifying a specific insight-triggering event while reducing ambiguity in studying the cognitive experience. Results from our norming studies of the new PAT showed it has a comparable range of solution scores and insight reports to the RAT, affirming solvability and successful production of the insight experience.

The Sticky Note Wall: The Rhetoric of Memory and What Makes it Stick

Peyton E. Clark

Faculty Advisor(s): Dr. Lowell Mick White

The aim of this project is to explore and understand the complexities of grief at the young adult phase of life—where death seems highly unlikely and completely improbable—through review of existing literature concerning trauma studies, published fictional works, and the first ten chapters of an original novel, The Sticky Note Wall. The story features an 18-year-old college freshman named Lauren as she enters her first year at Texas A&M University in the fall of 2020. While processing the recent death of her best friend Emily, Lauren is faced with challenges, joys, and opportunities, such as the chance to take a senior-level creative writing course as a freshman. It is through the work required for this writing class—subtly demonstrated in the a secondary storyline interspersed within the “present day” timeline—that Lauren will learn the true meaning of love and loss. Though the death in this original work is not caused by COVID-19, the pandemic environment surrounding the narrative is integral to the story’s development. In a post-pandemic society grappling with a plethora of death and collective trauma, it is paramount that discussions of loss, grief, and growth take place, particularly in regards to

the construction of memory. As artists and researchers grapple with the implications of COVID-19, both ethically and creatively, post-pandemic media remains in its limbo as humanity decides how it will construct and address the narrative of our collective trauma. The Sticky Note Wall will work to explore this phenomenon through the eyes of a young girl undergoing immense life changes (college, career struggles, relationships, etc.) in the midst of unprecedented circumstances: a global pandemic and the unexpected loss of a close friend.

The Protected Occupation: An Exploration of Female Agency & Gender Performativity in Feminist Poetry

Emma Ehle

Faculty Advisor(s): Dr. Lowell Mick White

The goal of this research is to examine the social construction and subsequent performativity of gender as it relates to femininity, female agency, autonomy, and domesticity. This will be achieved through an analysis of feminist literature and the completion of an original poetry collection, titled The Protected Occupation. Femininity is a concept that has long existed at the mercy of a fickle society. It is a word that is rigid in rules, yet malleable in definition, carefully contorting to fit whatever rhetoric society finds acceptable at a certain point in time and space. In examining the nuances of femininity, as well as the constant performance of gender, several topics are often called into question. For example, what does it mean to be a good wife? A good daughter? A successful woman? A "real" woman? A good woman. From the abstract concept of femininity itself to its implications for both agency and autonomy, the social construction of gender has, and continues to, inform significant elements of women's day-to-day lives. While this is an argued reality, with words like "feminism," "feminist theory," and "intersectionality" often utilized as political buzzwords at the expense of their definitions, it is one that is both supported and informed by considerable scholarship, literature, and countless other artistic avenues. Utilizing these elements in both research and inspiration, The Protected Occupation will act as a critical analysis, not only of gender performativity as it relates to femininity, but also how it is informed by elements such as race, ethnicity, class, and sexual orientation.

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

Room: MSC 2300 B

Muon Event Display for the CMS experiment at the LHC

Shachar Gottlieb

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

The Large Hadron Collider (LHC) is the world's largest particle collider, located at CERN in Geneva, Switzerland. One of its main experiments is the Compact Muon Solenoid (CMS), a general-purpose detector used to make precision measurements of high energy particle collisions. These measurements are used to study the Standard Model of particle physics at high energies, which leads to a deeper understanding of physical phenomena and may uncover some of the mysteries of the universe. To better study these phenomena, the LHC will be upgraded in the upcoming High-Luminosity LHC (HL-LHC) project, which will increase the luminosity of the accelerator to increase the probability of observing rare events that may reveal new physics. As part of the HL-LHC upgrade, the CMS experiment will install new detectors at its endcap section and improve the electronics of existing detectors, in order to maintain good detector efficiency in the higher rate environment. The CMS muon upgrade will include improvement of the current muon endcap trigger algorithm, responsible for construction of muon tracks through the detectors, because it is expected to see some inefficiencies occurring at higher luminosities. In order to improve the muon-finding capabilities of the muon trigger, event visualization tools will be helpful in identifying sources of inefficiencies in the algorithm. In this project, I will be developing improvements to existing detector visualization tools, which will then be capable of detailed analysis of individual muon events and identification of these inefficiencies. These tools will then be tested with simulated and real data to ensure their capabilities of identifying known inefficiencies, and to verify these tools for use in improvement of the CMS muon endcap trigger.

Efficient GPU Implementation of Differentiable Position-Based Dynamics for Deformable and Affine Bodies

Griffith Thomas

Faculty Advisor(s): Dr. Shinjiro Sueda

The field of robotic reinforcement learning has made significant strides in the past few years, but recent approaches have required the simulation of tens or hundreds of thousands of agents. This is time-consuming and resource-intensive, necessitating the development of efficient simulation and reinforcement learning techniques. Several methods have been developed to improve simulation performance, including utilizing parallel execution on a graphics processing unit (GPU) and employing differentiable algorithms to reduce the number of learning steps needed to converge. Previous implementations such as Isaac Gym, GRiD, and Brax have utilized some of these approaches, but either use non-differentiable algorithms or are limited to rigid-body interactions. The extended position-based

dynamics (XPBD) algorithm provides the ability to solve more general constraints but has not yet been adapted to be fully differentiable or optimized for many concurrent simulations. This paper describes a GPU-accelerated physics simulation system that uses an adapted fully differentiable version of the XPBD algorithm. Furthermore, instead of constructing one scene containing all simulated agents, my approach creates a separate simulation environment for each agent. If successful, I expect to show that this approach is more performant than a CPU-based simulation engine or a non-differentiable GPU-based implementation. Additionally, I expect it to be more flexible, including the simulation of more varied constraints due to the XPBD algorithm. In the future, this approach could be combined with a reinforcement learning framework to more efficiently train robotic reinforcement learning models.

Enhancing Feature Matching Performance through Monocular Depth Estimation

Bryan Yan

Faculty Advisor(s): Dr. Dezhen Song

One key problem in computer vision is the need to find correspondences between images. For example, identifying whether two images are of the same item, but taken from different angles, lighting, scale, and other environmental factors. Known as the image matching problem, this is commonly solved through identifying key features of the images and matching them across different images, in a process called feature matching. With a broad range of applications in safety-critical fields such as autonomous vehicles, it is crucial that the matched pairs of features have a high degree of accuracy and that the feature matcher is robust across different situations. One traditional method is to use Scale Invariant Feature Transform (SIFT) to identify features and then applying a ratio test to find matches between the features. However, current feature matching techniques struggle in certain situations, including images of indoor, narrow spaces such as hallways. We examine ways to improve the performance of traditional feature matchers such as the SIFT + ratio test method in the hallway problem by incorporating the use of depth maps generated through monocular depth estimation, which estimate the depth information of a scene from a single, 2-dimensional RGB image. By using the depth maps of a pair of images, we seek to enhance traditional feature matchers by eliminating additional outlier matches based on the percentage difference in depth values. In this paper, we implement the enhanced feature matcher by adding the depth filtering step after the initial match filtering process of the SIFT + ratio test method. We then examine the effectiveness of different elimination thresholds on outliers and compare the performance with that of the traditional feature matchers.

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

Room: MSC 2300 D

Predicting Calorie and Macronutrient Count from Meal Images, Postprandial Glucose Responses, and Covariates

Nathaniel Fernandes

Faculty Advisor(s): Dr. Bobak Mortazavi

Type 2 Diabetes is a leading cause of death worldwide, resulting in more than one million deaths in the United States alone. Monitoring and controlling diet is critical in the effective management of diabetes and pre-diabetes. However, current methods to track macronutrients and calories - like MyFitnessPal or LoseIt! - are tedious and time-consuming, requiring the user to input each item they eat. The explosion of wearable health trackers in recent years – combined with increasingly powerful machine learning and deep learning analytical tools – marks the perfect opportunity to enhance and potentially automate diet monitoring. Despite promising results, current automated macronutrient prediction suffers from low accuracy due to the high variability in the input data sources. For example, individual variability in metabolism and food absorption leads to variability in the post-prandial glucose response (PPGR) even when eating the same meal. Moreover, meal images of the same food fail to capture different food preparation techniques or additives like sugar and salt. To improve upon existing work, we use a multimodal multitask machine learning model that uses PPGR, meal images, a Viome stool sample, and demographic information to predict calorie and macronutrient counts jointly. Additionally, we optimize existing training procedures by using learning rate schedulers and contrastive learning techniques. We have successfully achieved state-of-the-art performance for predicting calorie count and grams of fat, carbohydrates, and proteins. To improve accessibility to the underlying machine learning models for users, we created an iPhone app named FlashMacros that is pending publication to the Apple app store.

Forensic Skeletal Indicators of Gender-Affirming Medical Procedures in the Identification of Transgender and Gender-Diverse Individuals

Kathy Q. Truong

Faculty Advisor(s): Dr. Monya Anderson

In forensic anthropology, current methods of osteological sex estimation are rooted in a rigid binary which treats the concepts of "sex" and "gender" synonymously and categorizes skeletal remains as either female, male, probable female, probable male, or ambiguous. This approach does not reflect contemporary Western models of sex and gender and thus does not serve the transgender and gender-diverse (TGD) communities, who face a disproportionate amount of potentially fatal violence and complications with victim identification relative to their cisgender peers. As the TGD population grows amid increased societal acceptance, forensic anthropologists are re-evaluating and updating sex

estimation protocols to improve resolution of forensic casework involving TGD individuals. My project is a comparative review of both forensic and medical research investigating the effects of gender-affirming hormone therapy and surgery on the human skeleton. There is an emerging body of forensic research exploring whether gender-affirming procedures leave evidence on the skeleton that may be used to identify TGD individuals who have medically transitioned. This research is informed by medical literature on how gender-affirming procedures affect bone structure, growth, and health. However, while gender affirmation has been researched extensively in medical contexts, only a few procedures (i.e., facial feminization surgery) have currently been addressed in forensic contexts. My review aims to 1) identify which gender-affirming procedures have been addressed in forensic research, and 2) identify procedures that, based on medical literature, have the potential to be forensically significant.

The Relationship Between Partner Infidelity and Attachment Security

Simron Biswas

Faculty Advisor(s): Dr. Heather Lench

Adult romantic attachment, a popular topic in the field of social psychology, is often described as a continuum across two latent variables: anxiety (fear of abandonment and related constructs) and avoidance (discomfort with intimacy and related constructs). High scores on one or both of these variables is often referred to as attachment "insecurity." Few articles within adult attachment literature include discussions of infidelity, and even fewer are concerned with the attachment security of those who have experienced partner infidelity (i.e. been cheated on). Couple's therapists often conceptualize infidelity as an attachment injury which may trigger latent attachment insecurities, but little empirical research has been conducted to demonstrate this. The objective of this study is to investigate whether people who have had past experiences of partner infidelity and are currently in a relationship vary in attachment security from those who have not experienced partner infidelity. I will also examine any differences between the characteristics of the infidelity (emotional, sexual, or both), as well as gender. This study will analyze data that has been previously collected in an ongoing study in the Emotion Science Lab. I anticipate that those who have experienced partner infidelity in the past will be more insecurely attached (anxious and/or avoidant) in their current relationships than those who have not experienced partner infidelity. This research seeks to corroborate and empirically validate past clinical impressions of the role of infidelity in attachment insecurity.

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

Room: MSC 2300 E

Capability Denial and Epistemic Injustice in Puerto Rico: Hurricane Maria as a Case Study

America Jimenez

Faculty Advisor(s): Dr. Linda Radzik, Dr. Katherine Unterman

This project aims to delve into the intuition that the U.S.'s relationship with Puerto Rico is unjust. Focusing on the impact of Hurricane Maria, the study evaluates the state of Puerto Rican society before the disaster using the Human Development Approach. Three key capabilities from this approach—senses, imagination, thought; control over one's political environment; and control over one's material environment—become pivotal in revealing injustices post-Maria. This investigation will then pinpoint how Epistemic Injustice occurred post hurricane, specifically Testimonial Injustice, where bias leads U.S. officials to discredit Puerto Ricans' experiences. Published personal narratives will serve as evidence, highlighting the inadequacy of U.S. aid and the harm inflicted. The narrative also explores Hermeneutical Injustice (another subset of Epistemic Injustice), where a lack of interpretive resources puts Puerto Ricans at an unfair disadvantage in making sense of their social experiences. This intertwines with testimonial injustice, perpetuating their marginalized status, heightened after Hurricane Maria. Solutions are proposed based on the paradigms of Martha Nussbaum and Miranda Fricker. While revealing the peril of U.S. aid, the narrative avoids victimization, emphasizing community care post-Maria. Applying care ethics, the essay showcases Puerto Rican initiatives, highlighting community care and resilience as a lens for disaster relief. This essay reveals an overlooked reality using the Human Development approach, pinpoints instances of Epistemic Injustice, and advocates for care ethics as crucial relief during disasters, ultimately acknowledging both challenges and the resilience of the Puerto Rican community.

Molecular Discovery Chatbot

Shreeman Kuppa Jayaram

Faculty Advisor(s): Dr. Yang Shen

The research project builds and deploys an interactive chatbot to extract knowledge about known molecules and to discover new molecules. The chatbot, a conversational artificial intelligence (AI) agent, overcomes limited data and limited GPU computing and integrates Natural Language Processing (NLP) techniques including (1) data pipelines such as data collection, loading, preprocessing and tokenization, (2) tuning a pre-trained, generic Large Language Model (LLM) for specialized molecular contexts through prompt engineering and data retrieval, and (3) deploying the resulting LLMs in local or cloud computing infrastructure. Compared to generic LLMs for natural languages, our specialized LLMs on the backend of the chatbot are for 1D “texts” of molecules, such as amino acid sequences of proteins and SMILES

strings of small-molecule drugs. The chatbot supports interactive engagement for two types of users including (1) educational users learning chemical information about known proteins and (2) advanced research users performing molecular editing to discover new molecules with multiple desired properties (such as particular solubility levels and binding affinity with target proteins). Besides textual responses, our chatbot supports 2D and 3D visualizations of edited molecules and generates explanations from domain knowledge on all molecular edits, which can be exported to a database for future reference. Importantly, the chatbot extracts personalized knowledge about known molecules and suggests editing strategies for broad applications.

Restrictions on Religious Freedom in Central Asia Contributing to Political Instability

Cameryn Jones

Faculty Advisor(s): Dr. Brett Cooke, Prof. Wendi Kaspar

The five countries of Central Asia – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – have a wide variety of religions influencing their history, as well as a past of tribes, dynasties, empires, and eventually the Soviet Union ruling over them. In 1991, the countries gained independence with the dissolution of the Soviet Union and developed their own secular governments. Currently, each of the five countries implements laws that restrict the peaceful religious practices of citizens. These restrictions disrupt the relationship between religion, policy, and people, causing instability. People experience distrust and tension with their governments who prevent them from fully partaking in their identity as members of certain religions. This paper describes the religious history of the region, explores the state policies regarding religious freedom, and analyzes major conflicts since their independence with a particular focus on the role of religion and identity. The Tajik Civil War, revolutions in Kyrgyzstan, and extremist terrorist groups active within the region are all examined as instances of instability. These examples show how religious freedom is essential to maintaining Central Asian peace by recognizing the relationship between religion and people and permitting active religious identity. The research recognizes an urgent need for increased religious freedom in Central Asia.

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

Room: MSC 2300 A

Reliability and Resilience of Chiplets

Erin Gehle

Faculty Advisor(s): Dr. Paul Gratz

Industry is moving towards large-scale systems where processor cores, memories, accelerators, etc. are bundled via 2.5D integration. These various components are fabricated separately as chiplets and then integrated using an interposer. This new design style benefits yield, as well as economies of scale, as many third-party vendor chiplets can be integrated into one system. These benefits, however, come at the cost of new challenges for the system's security and integrity when many third-party component chiplets, some from not fully trusted vendors, are integrated. Hardware Trojans are “malicious hardware inserted by an attacker during a device’s design or manufacturing processor”. However, these Trojans can be designed to only be triggered under specific conditions, which makes their presence exponentially harder to detect. In addition, if a third-party IP is untrustworthy, these Trojans can even potentially be camouflaged by their IP, further increasing the difficulty of detectability [Chacon, et al., IEEE CAL ‘22]. Chacon et al. developed a number of potential Trojan attacks that center around the memory system interconnect, including passive reading, masquerading, modification, and diverting. In addition, in a follow up work, Chacon et al. described a hardware mechanism to prevent these attacks, including a halt and reset protocol, as well as a pause and continue protocol [Chacon, et al., IEEE Cal ‘22]. In Chacon et al’s work, as well as all of the prior work in Trojan defenses we are aware of, after detection of the Trojan, the system is immediately shut down. In this research, I will explore the development of a new approach to hardware attack resilience. In particular, I will look at developing a mechanism where the system can continue.

Artificial Intelligence in Higher Education: How the Introduction of Large Language Models Should Change Academic Integrity

Madelyn Kennedy

Faculty Advisor(s): Dr. Glen Miller

The development and widespread availability of generative AI necessitates a rethinking of how academic institutions view, identify, and respond to academic integrity issues. With the growing number of students using Large Language Models (LLMs), including ChatGPT, there is a growing concern about artificial intelligence (AI) will affect academic integrity within universities. Academic integrity is important within college learning because it provides a code of conduct for students, faculty, and administration. More than that, it is essential to protect the value of education through ensuring that students are doing honest work to further their education. While most of the attention has been given to traditional forms of plagiarism in universities, generative AI is a new, challenging issue which is made

evident through comparing LLMs like ChatGPT against “old-school” plagiarism and Google Search. In order to deepen this analysis, virtue ethics, utilitarianism, duty ethics, and care ethics are used to develop foundational insights on how AI should be used in academia. From this theoretical analysis, a set of principles and guidelines are developed to help students properly evaluate the use of large language models within the realm of academic integrity through regulation, detection software, paper exams, setting clear expectations within the class syllabus, and rewording the universities integrity guidelines. Finally, guidelines are established to help students ensure moral and ethical use of generative AI within their university guidelines.

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

Room: MSC 2300 B

Urban Wildlife Ethics: What Should Urban Human-Animal Relationships Look Like?

Simran Puri

Faculty Advisor(s): Dr. Clare Palmer

Two distinctive trends within environmental ethics and animal ethics have backgrounded questions about urban animals. First, within environmental ethics, a focus on the wilderness has historically been foregrounded over human-influenced environments, and second, within animal ethics, not only has the focus been on more urgent harms but also the ethical prescriptions have traditionally been universalist, based solely on animal capacities, abstracted from their particular contexts. These trends have led to a sort of "invisibilization" of urban wildlife, and, I will argue, that this ignorance is morally culpable, at least to some degree. Since the urban setting consists of many varied human-animal interactions and histories, more careful analysis of ethical relationships in this environment seems to be called for. In this thesis, I will be exploring a distinctively urban animal ethics. I will focus specifically on sentient urban wildlife and will first argue that, on the basis of their sentience and capacity to suffer, animals matter and are morally considerable. I will focus my research on a) feral animals who were formerly companion animals, b) "pest" animals, and c) relict populations that have been trapped within urban pockets. To inform my research, I will draw on existing literature that emphasizes more nuanced, contextual approaches to human-animal relationships, and these approaches will help me to develop a critique of existing human-urban wildlife relationships and ultimately an account of what ethical relations should look like.

Validation of the Performance of the GEM GE2/1 muon Detectors for the CMS Experiment at the LHC Using Cosmic Ray Data

Kyla Martinez

Faculty Advisor(s): Dr. Alexei Safonov

Near Geneva Switzerland, CERN hosts the largest particle collider in the world, the Large Hadron Collider (LHC), where different experiments, such as the Compact Muon Solenoid (CMS), are centered around a collision point to measure the outcomes of the high energy interactions. Analysis of the collision data can lead to multiple results including precision analyses and the discovery of new physics where the leading theory explaining the universe fails. To perform reconstruction of the collision event, particle detectors are used to identify and measure properties of the collision byproducts through the data readout. One of the new detectors developed as part of the High Luminosity-LHC (HL-LHC) upgrade includes the Gas Electron Multiplier (GEM). Each chamber is complex and requires a sophisticated production process to validate its performance. Any defects must be discovered early enough to resolve them. The validation steps include a long period of collecting cosmic ray data to get high statistics on

every channel in the detector. This allows for the efficiencies of the chambers to be calculated and monitored before determining the chamber is ready for installation at the next opportunity. To evaluate the performance, various tools must be developed to ensure important capabilities such as particle path tracking and detector efficiencies can be studied.

The Impact of Model Interpretability in Bankruptcy Prediction

Arjun Kurkal

Faculty Advisor(s): Dr. Tracy Hammond

This paper explores the concept of model interpretability in the context of the utilization of various machine learning paradigms and modeling techniques in predicting corporate bankruptcies from certain publicly available financial and corporate metrics. The goal of this analysis is to explore the gradation between a clearly interpretable model, in which specific inputs can be directly mapped to specific outputs, such as a k-nearest neighbors model or logistic regression model, and a black box model, such as a Convolutional Neural Network, in which it is nearly impossible to efficiently map the importance of each input parameter to its relative contribution to output clarity.. The results of this study can inspire future efforts to optimize the relationship between model accuracy and interpretability and aid actively managed hedge funds in their selection of models to train and utilize in their research. The results of this study are expected to show a generally linear trend across various implementations of models, with decreasing performance as interpretability improves. This exercise hopes first to observe such a trend in the analytical results, and second, regardless of the existence of such a trend, to present a conclusion classifying the most and least optimal strategies to be employed to accurately and justifiably predict bankruptcies in publicly traded companies. These results can be used by both private and corporate entities in the asset management space, for use in their decision-making frameworks to optimize between model accuracy and interpretability in their investment decisions.

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

Room: MSC 2300 D

Fluorescence Study of DdrA in Bacteriophage P1 Reveals Stochastic Packaging into Virions

Trevor O. Smith

Faculty Advisor(s): Dr. Lanying Zeng

Bacteriophage P1 is a temperate, double-stranded DNA phage that has been widely studied because of its broad host range and general transducing abilities. Despite bacteria having various defense mechanisms to protect themselves against infection, bacteriophages also have systems they exploit to overcome these bacterial processes. Specifically, P1 utilizes a novel function that delivers proteins of the defense against restriction (Dar) system to protect against the restriction and modification (RM) system found in various bacteria. We set out to study DdrA, one of the six proteins that comprise the Dar system, and its role when used to overcome the Type I RM system in Escherichia coli. We genetically engineered a functional N-terminal fluorescent protein fusion to DdrA through traditional cloning methods and confirmed its antirestriction phenotype through efficiency of plating (EOP) assays. Produced phages were visualized through fluorescence microscopy and analyzed based on signal colocalization of the fluorescent DdrA fusion and the DAPI-stained viral genome. The genetic fusion elucidated that ~61% of virions exhibit localization of the P1 viral genome and the Ddra protein in the phage head. Collectively, these results reveal that DdrA is packaged stochastically into virions, providing further evidence for diverse P1 populations in relationship to virion contents.

Efficacy of Streptokinase as a Thrombolytic Agent Against Plasma-Only In Vitro Thrombi

Allison Purtle

Faculty Advisor(s): Dr. Staci Horn

Blood-clots, also known as thrombi, can be life threatening medical emergencies. Blood-contacting medical devices have a tendency to induce thrombus formation, which can result in the failure of the device or other complications associated with thrombosis such as heart attacks and strokes. Additional methods are needed for creating in vitro thrombi that facilitate efforts to evaluate the efficacy of various thrombolytic therapies in instances of medical device induced thrombus. Calcium chloride was added to plasma to induce clotting within a rotating mechanical apparatus. Thrombi were then allowed to coagulate for various lengths of time before streptokinase, a thrombolytic drug selected for its practicality and history of success in instances of medical device induced thrombosis, was administered within the apparatus. The degree to which the thrombus was dissolved, as well as the length of time this took, were recorded. Findings regarding the correlation between the age of a thrombus and the efficacy

of streptokinase as a thrombolytic agent for plasma-only clots created in this manner were compared to the results of previous studies. This proof of concept experiment suggests that the rotating mechanical apparatus is an effective method for creating in vitro plasma-only clots, and for testing the efficacy of thrombolytic drugs in such an environment. Further exploration and development of this in vitro method using whole-blood clots of various origins and a variety of thrombolytic therapies has the potential to make progress towards standardizing thrombolytic protocols in instances of medical device induced thrombosis.

Spiritual Identity in Cultural Contexts

Ameena Khan

Faculty Advisor(s): Dr. Jason Harris

My research builds on Islamic theology to evaluate how pursuing self-knowledge allows an individual to know God. It takes the concept of the self (nafs) which contains an individual's desires and fears and does not inherently know God, to discuss what identities inform the relationship between the nafs, the soul, and God. More specifically, how the three communicate and whether that communication can ever be accessed through a process of dreams or premonitions. The culmination and impact of these communications can be understood as one's spiritual identity which is impacted by culture, family history, community traditions, and personal expression. For instance, my work examines how socio-political phenomena such as the Pakistani diaspora, where one may grow up in a secular country such as the United States but have a family rooted in a Muslim majority country, can impact the personal relationship one has with their faith. How growing up in the role of a daughter would affect a soul as compared to growing up as a son. In this context, my anticipated artifact follows a young Muslim woman living in the United States as she faces a spiritual crisis where she must decide what shape her spiritual identity will take outside of the beliefs her parents have raised her with. Her spiritual identity is tied to both to the history of her family and her choice to listen to her soul as it communicates to her through dreams of her late grandmother. In the work, Maira asks herself how far her belief in a divine plan stretches and whether it means every part of her life, from her gender, her family, and her nationality, was chosen for a reason.

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

Room: MSC 2300 E

Deciphering the Structure of dsRNA Recognition by NS1 Protein of Influenza A Virus

Yilin Wu

Faculty Advisor(s): Dr. Wonmuk Hwang

To combat the periodic pandemic caused by influenza A viruses and develop novel antiviral drugs, it is crucial to study the structural changes that occur during the recognition of double-stranded RNA (dsRNA) by the NS1 protein of influenza A virus (NS1A). This research aims to understand how NS1A modulates the immune response by binding to host dsRNA and interfering with the host's antiviral defense mechanisms. The dsRNA recognition inhibits interferon production and dampens the host's innate immune response against the virus. Gaining more clarity on the recognition will enhance pandemic preparedness and advance the fundamental knowledge of influenza A viral infections. The molecular dynamics simulations of the binding process allow a closer inspection of the structural basis, revealing the molecular details that are critical for the recognition. Previous research focuses on the structural alterations in the RNA binding domain of NS1A and revealed the key residues assisting the recognition. This project will scale up the simulation by comparing the bound (protein and dsRNA) and unbound states (protein only) to identify the overall structural differences due to dsRNA binding. The expected outcomes will encompass molecular details of structural changes, achieved by finding more key residues in binding, assessing backbone flexibility, identifying conformational differences, and conducting free energy calculations.

Optimizing Multi-Robot Collaboration: Perception, Planning, and Navigation with Containers

Jack Campbell, Marcus Reece Dobson

Faculty Advisor(s): Dr. Stavros Kalafatis

The purpose of this project is to improve shared hardware resources among robots to enhance multi-robot collaboration. Multi-robot teamwork has been extensively deployed in warehousing, searching, and rescue. This project will simulate a warehouse environment with two robots deployed that must escape while avoiding hazards by collaborating with robots on a network. This will be accomplished by combining these elements into a complete system: a map generating and path planning algorithm, physical robots, a load balancing algorithm, a series of GPUs and microprocessors, and a hybrid computing architecture using software programs like Docker and Kubernetes-like orchestrators. As the load balancing, deployments, and orchestrators have already been deployed together as well as the map generating has already been integrated within the physical robots, integration lies in combining the physical robots to the microprocessors. This project integrates multiple subsystems that are critical to successful robot evacuation. Our subsystems include an object detection algorithm, a path planning

algorithm, containerized programs running with an orchestrator, and a load balancing algorithm in a hybrid computing environment. This project will utilize Robot Operating System bots, or ROSbots. To navigate their environment, the ROSbots will use local cameras and LIDAR sensors to detect their surroundings.

Healthcare.gov and Health Insurance Literacy of Young Adults in America

Samantha McDonald, Mahi Athota, Sydney Migura, Tammy Tran

Faculty Advisor(s): Dr. Stephanie Kirkland

As a part of the Affordable Care Act passed in 2010, the US government operates Healthcare.gov. Part of their initiative has been to increase health insurance coverage across the US, so our question is: how does Healthcare.gov influence young adult health insurance literacy using social media? Health insurance literacy encompasses being able to understand health insurance-related concepts, or ultimately the ability to parse our jargon to make informed decisions regarding health insurance coverage. Health insurance literacy and coverage rates are considerably lower among young adults, ages 19-34.^1 To understand this issue, we analyzed strategies HealthCare.gov uses through its YouTube channel to appeal to young adult consumers. Video analysis was completed for select videos created by Healthcare.gov, which noted presentation choices such as actor demographics, spoken words, and other components such as text characteristics. Data including total views and public responses to each video were also collected. All aspects of each video will be compiled into categorical themes used to convey the benefits of being covered by healthcare. Our results will entail a discussion of the methods used and how this pertains to influencing young adults. Despite low health insurance literacy in our target population, there is not much research on how Healthcare.gov has utilized YouTube as an informational tool in this realm. Implications provided will ideally guide future efforts to create media content advocating young adult health insurance literacy. 1. Conway, Douglas. “Adults Age 26 Had Highest Uninsured Rate among All Ages, Followed by 27-Year-Olds.” Census.gov, 8 Oct. 2021https://www.census.gov/library/stories/2020/10/uninsured-rates-highest-for-young-adults-aged-19-to-34.html.

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

Room: MSC 2300 A

Walk Across Texas: An Analysis of the Economic Impact of a Community-Based Physical Activity Program

Jordan M. Moore

Faculty Advisor(s): Dr. Michael Lopez

Research shows that regular physical activity can reduce the risk of developing certain chronic conditions that impact health, such as cardiovascular disease and type 2 diabetes mellitus. However, the impact of physical activity extends beyond individual health-related outcomes. Routinely meeting physical activity guidelines can also benefit the economy, yet the current evidence is limited. The objective of this research project is to explore the economic impact and benefit of a community-based physical activity program delivered online, specifically the Walk Across Texas (WAT) program. The economic benefit for the WAT program is determined by analyzing worker productivity, disease risk, and estimated lifetime healthcare cost savings as a direct result of increased and sustained physical activity behavior. This resulting dollar value will provide further evidence to support the implementation of physical activity programs, like WAT, and that these programs are worth investment from stakeholders, like funding agencies. The economics benefit is determined using a novel economic impact calculation and WAT program data from 2023 that has been both aggregated and anonymized. Calculations in this study focus on participants who were inactive prior to the start of the WAT program, but self-reported meeting physical activity recommendations up to 150 days after the end of the program. This research project is the first study that systematically documents the use of this calculation and its methodology. Results from this study indicate that the WAT program has reduced lifetime healthcare costs, mitigated disease risk, and boosted worker productivity rates, all resulting in substantial economic benefits.

Theoretical Modeling of Saturation Distortions Observed in Saturated Absorption Spectroscopy

Alexander Hilty

Faculty Advisor(s): Dr. Alexandre Kolomenski

Doppler-free saturated absorption spectroscopy (SAS) is a technique which eliminates Doppler broadening in hyperfine structure (HFS) measurements. In SAS, two counter-propagating laser beams, one strong and one weak, are passed through a gaseous sample. The sample becomes “saturated” by the beams and the counter-propagation setup allows for the elimination of Doppler broadening. Here, we investigate the spectral line distortions observed in experimental Doppler-free SAS data caused by the interaction of the lasers with the saturated system. Experimentally observed changes to the height and base shape of the spectral lines are successfully theoretically modeled in accordance with the

mechanics of Doppler-free SAS. We present a theoretical model developed to specifically capture the interaction of the two lasers with the saturated system. Two distortion features are theoretically investigated: the formation of wings around the base of the signal and the suppression of the central peak height. Within the context of this investigation, an overview of energy levels in atomic systems, spectral line broadening, and Doppler-free SAS is given. We also qualitatively explore the ability of the model to predict optimal laser parameters that could accelerate Doppler-free SAS measurements. Determination of these parameters could reduce the total number of laser frequency scans required to collect a complete spectrum in experiment. Furthermore, we explore the implications of understanding the distortions to the central peak height of a spectral line. This information, combined with previous work on isotopic shifts in the HFS of Xenon, shows promise as a method for the experimental determination of isotopic abundances in a sample via Doppler-free SAS.

Extracorporeal Device Tubing Complication Analysis

Keisha Patel

Faculty Advisor(s): Dr. Staci Horn

The use of cardiovascular pumps in pediatric patients who suffer from heart failure has not been as extensively investigated as compared to adults. As a result, only a few options are available, and they must support functionality as needed to improve cardiac output and deliver benefits to children. These support devices are often extracorporeal and involve tubing that connects the external device to the patient's heart. Previous research points to the structure of external tubing attachments as a cause for malfunctioning concerns, such as clot formation or tubing degradation/fracture after device implantation. In this study, we investigate the characteristics of device tubing fixation. This characterization was achieved through a retrospective study analyzing explanted extracorporeal cardiac pumps. Data collected included the orientation/placement of zip ties (distance and angle measurements) that were used to affix the extracorporeal device to the external tubing. Data were collected in Adobe Photoshop & ImageJ using photographs of the cannula/tubing interface. The angle/placement of the zip ties was then compared to the implantation guidelines provided by the instructions for use documentation. The distance between the cable tie and cannula is not an apparent indication of device failure; however, when utilizing multiple cable ties to secure the tubing attachment, it was found that a deviation from the given guidelines for cable tie placement is evident. Our findings indicate that the use of multiple cable ties did not result in an improvement in the angle of fixation. Regardless of cable tie number, all the devices studied also demonstrated a significant deviation in angle measurement from the given device implantation guidelines.

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

Room: MSC 2300 B

Quantum Algorithm to Solve the Number Partition Problem

Adhithya Vijayakumar

Faculty Advisor(s): Dr. Shenglong Xu

Quantum algorithms emerge from the exploitation of quantum mechanics and a fundamental quantum entity known as a qubit, aiming to significantly reduce the computational time required for tackling complex classical problems, particularly those categorized as NP-hard, such as the number partition problem. Classical computing has made strides in optimizing solutions for this challenge, falling into two primary categories: error optimization and the generation of complete solutions. In this paper, we extensively examine various classical algorithms pursuing both avenues. Furthermore, we introduce a potential quantum algorithm for solving the number partition problem, drawing upon the renowned Grover search algorithm's ability to expedite unsorted database searches. We will also address some of the drawbacks of using Grover search. We will further explore solutions for the number partition problem by introducing measurement and dissipation, harnessing the unique attributes of degenerate quantum states.

Phantom Telemetry: Exploring Alienation and Portrayals of the Other in Sci-fi Literature

Nabila Haque

Faculty Advisor(s): Dr. Jason Marc Harris

This presentation seeks to explore and discuss how works of science fiction literature have historically treated the concept of the Other, and how Otherness can be used as a metaphor for the human experience. Through a process that literary theorist Darko Suvin refers to as "cognitive estrangement," the sci-fi genre can examine and critique aspects of our preexisting reality through fictionalization, operating as a thought experiment that inverts the way that people usually view the world. Some of the common ideas that bind the science fiction genre together are the exploration of future scientific exploration and the implications that they may have for society and civilization as a whole. Even alien experiences and nonhuman entities such as robots and extraterrestrial creatures can reflect feelings of alienation and provide societal critiques of real-life issues. In this presentation, the evolution of Otherness will be traced in relation to societal context, going from the beginnings of the genre in the early 19th century, with Mary Shelley's Frankenstein, all the way through the 20th century and up to the modern day. Additionally, the presenter will be reading a short excerpt of her own fictional work, which seeks to build upon the concepts explored in her research.

Investigation of Nanosecond Pulsed Plasma-Induced Cavitation for Gas Capture

Baxter J. Tindall

Faculty Advisor(s): Dr. David Staack

In-liquid, pulsed plasma events ionize the working fluid between the electrodes and provide high instantaneous input energy to generate active radical species, shockwaves, cavitation bubbles, and high pressure and temperature gradients. Electrically induced plasma events in liquid water initiate a high-pressure expansion of gas and subsequent oscillation of the cavitation bubble as the pressure equalizes. Here, we report our findings on harvesting the gas produced from this gas cavitation and the composition of the collected gas. A high voltage power supply, 10 nF capacitor, and 10 MΩ resistor pulsed power circuit induce a pulsed plasma across two sharpened tungsten electrodes submerged in water. After the plasma event, the hydrogen and oxygen radicals recombine with the newly formed species (H202 or HO2) to produce Hydrogen or Oxygen gas. The physics of the resulting cavitation bubble produced by 10 kV to 14 kV discharges and the interaction between the bubble and 1 to 5 mm inner diameter capillary tubes were studied. Additionally, a water cell was designed and additively manufactured using a FormLabs SLA 3D resin printer to collect the gas produced by plasma discharges pulsing at varying frequencies and breakdown voltages. This study verified the production of gas through underwater pulsed plasmas. Gas chromatography was used to identify the composition of the produced gases and an energy balance was performed to compare the efficiency of gas production to traditional production methods.

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

Room: MSC 2300 D

Demonstration of Current Redistribution in Insulated REBCO Tape Stacks

Connor Bowerman

Faculty Advisor(s): Dr. Peter McIntyre

One of the most interesting and widely-studied superconductors in recent years are Rare-Earth Barium Copper Oxide (REBCO) superconductors. REBCO is exclusively fabricated as a tape, and then often layered to create REBCO tape stacks, allowing for high current density. In a previous work, my lab group theorized that current should automatically be shared between tapes in a REBCO tape stack in a dipole configuration, and simulated results. We have now tested this theory, showing that, when the resistance is sufficiently low between the tapes, current can be shared when the tapes are close to their critical current. Additionally, though, an alternate phenomenon which could account some of the effects is current redistribution, in which the current enters individual tapes in the tape stack at different amounts, rather than the current being shared from one tape to another. To find if this existed, and to what extent it occurs, I created a test in which the REBCO tapes were electrically insulated from one another in the tape stack. This removed the current sharing mechanism, allowing for just the study of the current redistribution mechanism. In this presentation, I discuss the results of this test, as well as its implications and potential applications in superconducting magnet design.

Testing AI Alignment in a Safe and Ethical Framework: Methods and Considerations

Uma Sarkar

Faculty Advisor(s): Dr. Thomas Ioerger, Dr. Glen Miller

AI alignment, the objective of ensuring precise functioning of AI systems, is crucial in the realm of AI Ethics. This paper explores optimal methods for evaluating AI alignment while safeguarding real-world users. Section I delves provides some background and context to the field, going beyond the theoretical basis of Bostrom's paperclip axiom and associated concepts (instrumentality convergence and orthogonality thesis), in order to ground it in a practical exploration of the technical challenges behind AI alignment. These challenges include the out-of-distribution robustness problem, the challenge of developing an adequate reward function, the challenge of developing methodologies to adequately test alignment, and scalability. Section II narrows the focus to the relatively unexplored issue of testing for AI alignment without putting real-world users at risk. Various approaches, such as large-scale human review, debate-based testing, and intentional uncertainty embedding, are discussed. The paper aims to identify promising research and gaps in the literature, providing valuable insights for advancing the field of AI alignment. By scrutinizing different testing methodologies, it strives to contribute to the ongoing dialogue on AI Ethics, concluding with an exploration of the implications of AI alignment on accountability.

Value of the Agricultural Aerial Application Industry in the United States Delineated by Crops Grown and by State: A Counterfactual Study

Kaitlynn Hughes

Faculty Advisor(s): Dr. Senarath Dharmasena

Agricultural aerial application industry in the United States provides important services for American farmers. According to a 2019 National Agricultural Aviation Association (NAAA) survey, the United States agricultural aviation industry treats about 127 million acres of cropland each year, which is approximately 28% of total commercially treated cropland. As an asset to American agriculture, it is important to determine how the state, regional, and national economies would be affected should such an industry become displaced. In this study, all U.S. states are evaluated based on the top five produced crops, measured by gross cash receipts. Data for 2019 provided by the NAAA and the USDA will be used to develop a counterfactual revenue reduction stochastic simulation model to estimate the value of the agricultural aerial application industry for each State's economy, delineated by different crops and forestry products. The estimated simulation model will help understand the impact provided by U.S. agricultural aerial application industry on individual commodities and state economies. Preliminary analysis shows that the total revenue loss of not having agricultural aerial applications to United States. economy is about $37 billion (with probability of occurrence greater than 0.90). The results will aid decision- making for applicators, regulators, and legislators.

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

Room: MSC 2300 A

De La Luna y Aquí: Poems of Mysticism and Wonder

Caroline McFadin

Faculty Advisor(s): Dr. Lowell Mick White

Poetry is a liminal space where the metaphorical and the literal meet in equilibrium, and while this works for its own benefit in conveying profound emotion, poetry often can be lacking in terms of genre overlap. This dichotomy between the metaphorical and literal makes poetry a difficult medium for linear storytelling; difficult yet not impossible. Similarly, the genre of magical realism works to condense the metaphorical and literal into a palatable narrative not unlike a fairytale. Magical realism seeks to break down the supernatural into the natural and tangible.The intended goal of this project is to effectively combine both genres in order to explore the ways bi-ethnic cultures and identities within Latin-American immigrant families impact future generations. Indeed, magical realism as a means of expression has been mostly attributed to the novel as well as the visual arts. I find this medium sorely lacking within poetry and sought to research the potential the two have when in tandem together. Through this study in genre I aspire to investigate Latin-American perspectives on cultural identity. As the child of a Mexican immigrant who grew up surrounded by other children of similar heritage, I desire to create a work that reflects both the benefits and challenges of such an upbringing. This creative thesis will employ both genres and establish a comprehensive poetry collection that is a fictional narrative of a character named Victoria, who learns how to navigate these themes of culture, identity, family, and womanhood.

Shattered Sky: Influence of Institutions on Body Augmentation

Maksim Prokhorov

Faculty Advisor(s): Dr. Jason Harris

The depictions of Cyborgs vary across much of modern science fiction, from Marvel's famous Iron Man to video games like Cyberpunk 2077; as such the concept of body modification continues steadily entering the societal consciousness as an inevitability of the future. However, as can be seen by the emergence of body-hacking communities and the improvement of prosthetics, this future is now in the process of becoming a reality. While body modification is often depicted in media as a positive and exciting prospect, when considering the influence of capitalist, military, religious, and other institutions on their subjects, body modification may serve as another set of chains in society. The goal of this project was to create a fictional anthology in a fantasy setting, with easily accessible body modification, designed to explore how body modification will inevitably vary depending on the institutions presiding over their subjects. To explore this issue, the research covers modern cyborg media as well as more theoretical scholarship surrounding human enhancement as relating to the workplace and religion.

Through the use of a fantasy setting, this project explores body modification in a vacuum separate from modern technology to allow for a more focused analysis of cyborgs. Additionally, the fantasy setting is intended to provide Tolkien's concept of recovery for the concept of body modification and the role of the individual under institutions. This recovery is also meant to be enhanced through the use of body horror aesthetics and impossible fantasy extremes. Ultimately the research posits that body modifications will only further exacerbate and exemplify the best and worst qualities of any given institution by projecting said qualities onto the bodies of its subjects.

The Weakness in Metal

Shubh Mamtora

Faculty Advisor(s): Dr. Jason Harris

Artificial intelligence is a rapidly evolving and loosely regulated field of study with many unresolved social, ethical, moral, and cultural concerns. These concerns are heightened by the accessibility of artificial neural networks, such as large language models and text-to-image models, which imitate and infringe on the work of professionals while mimicking the designs of an animal brain. Additionally, fiction impacts public perceptions and expectations regarding the potential dangers created by artificial intelligence, but often remains disconnected to the nature of the evolving field and fails to address its shifting paradigms. This thesis, The Weakness in Metal, is a creative work that speculates a future where artificial neural networks continue to improve, surpassing the limitations of modern technology until the boundaries between artificial and natural blur. Once this blurring occurs, the lives of both artificial beings and people become entangled with shared stories of hope and fear. Themes for these stories include: posthumanism, whereby machines exceed human nature; transhumanism, where humans slowly become more artificial; and existentialism, where the setting facilitates questions on spirituality and consciousness. Research into operating systems and machine learning models assists the non-anthropomorphic standpoint this work takes to break fictional cliches and dispel stigmas about artificial intelligence.

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

Room: MSC 2300 B

The Nature of Texture: Visual or Tactile?

Stephen Johnson

Faculty Advisor(s): Dr. Yoonsuck Choe

Texture can be processed in two different perceptual modalities. While the visual cortex responds to stimulus passed through the visual system, the somatosensory cortex reacts to surface textures through touch. However, texture processing is commonly considered a visual modality instead of a tactile modality, as it is a common task in computer vision. The modality of a task can be inferred by the type of receptive fields (RFs) commonly used in preprocessing. Receptive fields for the visual cortical neurons and the somatosensory cortical neurons have different patterns, with the visual cortex exhibiting oriented Gabor patterns, and the somatosensory cortex exhibiting an additional inhibitory region around the oriented Gabor patterns. This paper investigates the modality of texture as being inherently either visual or tactile. The method of investigation is based on developing separate convolutional neural networks for natural scene-like images and texture-like images. We find that we get visual or tactile-like receptive fields, respectively. Then, the networks will be cross tested with the opposing stimulus type to obtain results on how the networks learn and recognize features. By analyzing the response distributions of activated neurons alongside convolutional filters, the modality of texture will be determined. Further, fine-tuning the trained models on both new natural scene images and new texture images will give insight into whether the models' learned features are applicable with the same or different kinds of stimuli. Our results indicate that visual cortex-like processing in CNNs are more closely tied with natural scene-like inputs, while somatosensory cortex-like processing with texture-like inputs, establishing the nature of texture as primarily tactile.

Use of External Memory for 2D Navigation in Reinforcement Learning Agents

Anish Karthik

Faculty Advisor(s): Dr. Yoonsuck Choe

What is memory? Memory can be described as the ability to acquire, retain, and recall knowledge or information as necessary. When it comes to humans, memory is essential in most tasks ranging from learning and information retention, decision-making, adaptation, communica- tion, and much more. Likewise, in Neural Networks, memory is a key tool to advance its capabil- ities beyond simple tasks. Currently, there are three main ways to implement memory explicitly in neural networks: Recurrent Neural Networks (RNN), Time-Delayed Neural Networks (TDNN), and Feed Forward Dropper Networks (FFD). In previous works, it is seen that the Feed Forward Dropper network is the fastest to evolve a successful agent when given a simple ball catching task followed by TDNN and RNN. From there, the question arises regarding agent development in more complicated scenarios. To answer this, we design

a foraging experiment in which an agent searches for food while having to avoid a predator. Each agent must move to detect food within an observation range and collect it. It must also avoid the path of a predator to avoid being eliminated. We use the Neuroevolution of Augmenting Topologies (NEAT) algorithm in developing each of the memory implementation strategies allowing the improvement of both network structure and weight. These findings illustrate possible routes of evolution in cognitive agents.

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

Room: MSC 2300 D

Quantum Computing and Legalism: Is the Law Prepared for this Breakthrough?

Jordan Bass

Faculty Advisor(s): Dr. Nicholas Suntzeff

Quantum computing is a developing technology that will soon have a large-scale impact on mankind thanks to its many potential use cases. Industries such as medicine, material science and banking can be improved by enhanced simulations, data security will be easier than ever with truly random encryption, and even the mundane aspects of life like driving or shopping will improve thanks to models optimized by quantum computers. That said, with these benefits also come risks. For example, Shor's algorithm may soon break even our safest modern encryptions leading to massive personal, industrial, or national security data leaks, predatory algorithms may be used by corporations to harvest more data than ever, further eroding online anonymity, and foreign actors could hack into infrastructure systems with ease causing an increase in ransomware attacks which could cost human lives. At this point, it is neither possible nor practical to eliminate quantum computers at a global level, and the technology will almost certainly be developed within the next five to thirty years by current estimates. As a result, to prevent the worst possibilities from becoming a reality, legislators and regulators must intelligently use the law to solve these problems as, or more ideally before, they arise. This paper will thus analyze the current state of the legislation, regulation, and judicial action pertaining to the use of traditional computer and supercomputers to attempt to identify the strengths and shortcomings in the existing legal framework of computers and supercomputers, and how these laws may apply to quantum computers when considering their differences from a technical standpoint.

Global Lithium Competition: Examining the Social, Market, and Environmental Factors of the Global Lithium Trade

Khang Tran Nguyen

Faculty Advisor(s): Dr. Diego Von Vacano, Dr. Rich Cooper

In this dire race towards a sustainable tomorrow, one vital element that holds the power to reshape our world and mitigate the lasting impacts of climate change is Lithium. This lightweight metal, coined as the 21st century “white gold” will play a pivotal role in the development of green energy technologies, electrification of energy systems, and electric vehicles. As the world grapples with solutions to tackle climate change, expand on innovative technologies, and advance global decarbonization, Lithium will be the catalyst that determines whether superpower nations, like the United States and China, will sustain global dominance in this green transition race. Pre-existing research tends to draw relations between industry trends and supply chains in hopes of predicting the outlay of the future, many dive into potentially impactful markets like Bolivia (Narins, 2017). However, this thesis seeks to approach this

global trade competition from different angles to shed light on the nuances of different market limitations, social/governmental challenges, and environmental factors that may contribute to the complexity. Using pre-existing literature, industry intelligence, government reports, and press releases we hope to build a more comprehensive picture of the ferocious competition surrounding this limited resource, in addition to clarifying how vital this rare mineral is to a clean carbon reduced future.

Automating Texas Water Observatory Data Loader

Rishabh Prasad

Faculty Advisor(s): Dr. Tracy Hammond

With the rise of climate change research in the last decade, access to meteorological data has become essential to environmental researchers given the power of modeling in scientific studies and forecasting. To expand the dataset to more diverse geographic areas, Texas A&M is spearheading the development of the Texas Water Observatory (TWO), an agricultural engineering initiative to provide national access to hydrological, biochemical, and atmospheric data in the Brazos River corridor region. More than 300 meter readings are transmitted via the cloud, many of which are real-time. A major bottleneck is the loading of the pure meter data directly into the central SQL database. Previously, the data loading was only implemented for ET Towers, but it had several weaknesses. The quality of the data was not optimal due to empty values, breaks in timestamps, and meter malfunctions. Moreover, the algorithm lacked transparency regarding what is happening to the data for each site. Therefore, this paper seeks to develop a robust, communicative framework that automates the transformation of meter data and its insertion into the central database. Using Python scripting and AWS integration, we propose a performative software solution that seamlessly inputs meter data, performs data preprocessing and imputation, and pushes revised data into the database, which maximizes the quality of the time-series data. Our solution also promotes transparency to the researcher with thorough documentation, production-level code conventions, and a detailed email report enumerating the result of each site's data loading attempt. Ultimately, this tool will strengthen the data loading process and improve the TWO data pipeline, ensuring quick access to high quality data for climatological research.

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

Room: MSC 2300 E

Ultrasonic Phased-Array Transmitter Design for Wireless Power Transfer

Olivia Behne, Thomas Dawson

Faculty Advisor(s): Dr. Aydin Karsilayan, Dr. Jose Silva-Martinez

The research project targets designing an ultrasonic phased-array transmitter for faster charging neurostimulators, a pain management device. The FDA has higher limits for ultrasonic power in human tissue compared to electromagnetic power, therefore faster charging can be achieved using ultrasonic transducers instead of inductive or RF charging. Using a phased-array transmitter and feedback from the implanted device, precise alignment can be achieved by focusing the ultrasonic beam on the implant, which will prevent misalignment problems often encountered when inductively charging the unit by wearing a belt. The transmitter is a two-dimensional array of piezoelectric transducers that generate ultrasonic signals at 1 MHz. Beam formation and steering properties of the transducer arrays are utilized to determine the required phase patterns to drive the entire transmitter array for the given coordinates of a target point. The steering of the beam is adjustable in the x and y coordinates as well as the depth of the beam by using specific phase patterns. The CMOS chip generates all necessary signals at the required phases and patterns to drive the transmitter array, such that beam steering and depth control can be achieved. The initial array size is 4x4, where 16 transducers are expected to be individually controlled by the chip. Using a feedback signal from the implant, a calibration circuit adjusts the phases automatically to focus the beam at the right location and depth. The calibration algorithm is digitally implemented and will be based on maximization of the received power at the implant. For the proposed application, a 180nm CMOS process will be used for the chip design, where Cadence tools will be used for simulation, layout design and verification.

Difference in Electrocortical Response to Predictable Versus Unpredictable Rewards and its Relation to Intolerance of Uncertainty

Jessica Chamberlin

Faculty Advisor(s): Dr. Annmarie MacNamara

A prominent behavioral feature associated with psychopathology is an alteration in reward processing. The present study examined the differences between the reward positivity (RewP), a positive event-related potential component, in three conditions (N = no reward, P = predictable reward, U = unpredictable reward). Sixty-five participants engaged in the NPU-Reward (NPU-R) task, while EEG data was recorded. Previous research has discovered an association between psychopathology and reward processing, especially that reduction is linked to depressive symptoms, but there is limited research on examining the RewPs in the three different reward conditions and how those differences may be impacted by an individual's intolerance of uncertainty. This study looked at the differences of the RewPs

in the predictable vs. unpredictable reward conditions and controlled for an individual's intolerance of uncertainty. Results showed there was a significant difference between the no reward and the two reward conditions (predictable reward and unpredictable reward), but no significant difference between predictable and unpredictable rewards. Results did not change after controlling for intolerance of uncertainty. Future areas of study on the differences between the predictable and unpredictable reward conditions could include using different assessment scales to further investigate the RewP differences, which could shed light on development and treatment of psychopathology.

Poster Sessions

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

Room: MSC 2300 C

Poster #1

Predicting Power Performance of Dye-Sensitized Solar Cells Using Machine Learning Techniques

Deepanjali Chowdhury

Faculty Advisor(s): Dr. Hong Liang, Dr. Katherine Davis

Solar cells hold great promise for the future of energy production. Among the different generations of solar cells, the third generation marks the latest and most significant improvement in solar cell technology, showcasing a notable leap forward in modernizing energy capture and utilization. Dye-Sensitized Solar Cells (DSSCs) hold great potential as third-generation solar cells, primarily due to their unique features, such as the use of a dye-absorbed semiconductor material, which enhances cost-effectiveness and flexibility. They exhibit promising results when paired with materials like carbon-based materials, and ongoing experiments are exploring other semiconductor oxides to enhance their performance, with a particular focus on improving the photoanode for increased efficiency. Semi-conducting oxides show excellent conductivity and porosity, making them promising for electrochemical energy storage and integration into solar cells. Despite their promise, testing various material variations in solar cell and energy storage systems is challenging due to time and resource constraints. This research builds on past studies by introducing machine learning as a cost-effective way to identify high-performance configurations for DSSCs. This study aims to apply to all materials in the periodic table, with a focus on semiconducting oxides. The proposed machine learning model aims to predict the system's performance across various parameters, including Power Conversion Efficiency and Fill Factor. By using machine learning, this study aims to simplify the evaluation process and speed up the identification of optimal configurations of carbon-based materials and semiconductor oxides, contributing to the advancement of sustainable and efficient solar energy technologies.

Poster #2

Clinical Note Embeddings for Dynamic Survival Analysis

Aaron Su

Faculty Advisor(s): Dr. Bobak Mortazavi

Survival analysis in clinical settings monitors patient risk for adverse events, such as invasive ventilation in ICUs. Early and accurate diagnosis is challenging, relying on clinician assessments. Machine learning models like Boosted eXact Hazard Estimator with Dynamic Covariates 2.0 (BoxHED2.0) offer real-time decision support by dynamically monitoring patient risk for adverse events. BoxHED2.0 is trained on electronic health record (EHR) data from The Medical Information Mart for Intensive Care (MIMIC-IV),

containing deidentified patient ICU measurements and clinical notes. While survival analysis with structured EHR data has been explored and validated in the clinical literature, recent developments in natural language processing (NLP) have prompted an increase in the use of unstructured clinical notes for survival analysis. Clinical notes contain nuanced information from clinical professionals about patient symptoms, medical histories, procedures, and more. While unstructured clinical notes have been successfully used in prediction tasks such as mortality analysis, their application in survival analysis is less explored. Furthermore, clinical notes vary semantically and structurally. MIMIC-IV, for example, contains radiology and discharge notes, which differ in their content and structure. This work aims to assess the performance improvement from augmenting structured EHR data with unstructured clinical notes. This work is among the first to combine unstructured clinical notes and structured EHR data for survival analysis and shows potential for improving clinical decision support and risk analysis in ICUs, allowing for less labor for clinicians and better patient outcomes.

Poster #3

Hypergraph Visualization With Terminal Based Interaction in Julia

Nicholus Campbell

Faculty Advisor(s): Dr. Nate Veldt

Graphs are an abstract data structure in which data points are represented by a collection of vertices (sometimes called nodes) and edges, in which the relation between any two vertices is shown by the presence, lack, or weight of an edge connecting them. Hypergraphs are an even more general data structure, in which these relationships can be more complex. Edges in a hypergraph, rather than always connecting exactly two vertices, may connect any number of vertices, allowing it to represent much more complex relationships between vertices. In research related to the utilization and advancement of hypergraphs and hypergraph theory, one hurdle is the difficulty and tediousness required to create a sensical visualization of a hypergraph. Due to the lack of tools made for this purpose, the majority of these visualizations will need to be made by hand. The software package resulting from this research project aims to fill this niche, being a command line, visually interactive program that can create and modify hypergraph components. A common representation of hypergraphs uses convex sets or convex hulls, which are simple polygons that enclose a set of points. In the context of hypergraphs, each point would represent a vertex in the graph in two-dimensional space, and the convex hull would be the representation of the hyperedge, where all of the vertices within the convex hull would be members of that hyperedge, meaning that they are related to each other via whatever that hyperedge represents. One of the issues with this method is that it can situationally generate false positives, by which I am referring to when a point visually appears to be enclosed within a convex hull which represents a hyperedge that the vertex corresponding to that point is not a member of.

Poster #4

Optimization of Immunohistochemical Staining of Osteocalcin in Calvarial and Femoral Bone

Maathanki Balasekar

Faculty Advisor(s): Dr. Daniel Alge

Immunohistochemistry (IHC) uses antibodies targeted against antigens in specific tissues and cells and uses specific binding to detect these antigens. General histology is non-specific and solely uses dyes for staining. IHC offers higher specificity during staining and makes distinguishing signs of bone formation far easier. However, IHC is not standardized between antibodies and requires optimization to achieve clear usable images. The primary aim of this project was to optimize the IHC staining protocol to improve detection of osteocalcin to better evaluate bone formation in femoral and calvarial tissue. Osteocalcin is a small protein synthesized by mature osteoblasts, odontoblasts, and chondrocytes making it an excellent biomarker for bone formation. IHC includes tissue processing and then staining. Tissue processing includes fixation of the sample, tissue decalcification, and antigen retrieval. To achieve improved staining and clear images this, incubation times, temperatures, and concentrations within tissue processing and staining were tested to identify ideal parameters. To determine the efficacy of optimization of fixation and decalcification, micro-CT images the tissue samples from different were compared. To see how changes in both tissue processing and staining stages affected the final image, images taken throughout the study were compared to the images obtained before protocol optimization. The main factors tested were the decalcification times and the presence of an antigen retrieval step and how those variables affected the final staining.

Poster #5

Iron-Catalyzed Stereoselective Multicomponent Cross-Couplings Using Chiral Auxiliaries

Lukas Morehead

Faculty Advisor(s): Dr. Osvaldo Gutierrez

The formation of carbon-carbon bonds is of paramount importance to many industries, such as the pharmaceutical and agrochemical industries. One common method for the formation of carbon-carbon bonds is transition-metal catalyzed cross-coupling reactions. Despite the potential utility of iron catalysis, it has lagged behind other transition metals for cross-coupling attempts. In past works, our group has developed a method for stereoselective dicarbofunctionalization of alkenes using simple iron salt catalysts and chiral ligands. Herein, we developed a method to induce stereocontrol using a chiral alkene auxiliary reagent instead of chiral ligands for multicomponent cross-couplings. Across a diverse substrate scope, we were able to prove the utility of these methods with modest yield and stereoselectivities. A framework will also be established to develop computational and experimental new approaches to induce chirality in these iron-catalyzed multicomponent cross-coupling reactions. A prominent interest is developing chiral solvents that will eliminate the need for chiral ligands and

auxiliary components. In future works, a chiral analog of the common cosolvent in iron-catalyzed cross-coupling reactions, N-Methylpyrollidone (NMP), will be formulated and purified. It is hypothesized that this addition to a reaction will allow stereoselectivity to be induced. Although further mechanistic calculations will be conducted, these preliminary findings are conducive to vast industrial applications.

Poster #6

A Dynamic Voltage Sag Corrector System for Critical Loads

Dev Singhania, Daniel Suh

Faculty Advisor(s): Dr. Prasad Enjeti

Power quality is a major concern for any application sourcing energy from standard power grids found throughout the United States. Of the many types of source disturbances, voltage sag occurs when the power grid's root mean squared (RMS) voltage decreases anywhere from 10% to 80% of the nominal value and will be the main focus of this paper. Sags can last for multiple cycles at varying magnitudes which in turn can cause stability issues and even damage to critical loads if exposed for too long. Although backup infrastructure such as generators exist, they are slow to respond and damage can be sustained in the time it takes for them to start running. Thus, finding a fault proof method that can both detect and mitigate a voltage sag all within a 1/2 of a cycle, or ~8.2ms for 60 Hz, is desired. Here, we present the design of an integrated prototype capable of detecting voltage sags and redirecting a load's source of power to a capacitive backup within the time constraint mentioned above. Implementation of the device's features will be carried out on the F28379D Developmental Kit from Texas Instruments and will be a non-invasive solution for general usage on critical loads. Such a device, would ideally, allow for real time monitoring of power quality with an emphasis on ease of installation and minimal to no maintenance, saving users time and effort.

Poster #7

Applications of Machine Learning to Malware Classification

Kyle Bundick

Faculty Advisor(s): Dr. Martin C. Carlisle

Malware represents a significant threat to modern computing, and with new malware being created every day, it is difficult to effectively detect all malware threats. Many detection systems rely on information about each piece of malware, but obfuscation techniques mean this can often be ineffective. Additionally, it is not able to handle malware that has not been seen before. Because of this, machine learning models can be applied as predictors of the behavior of a program by determining its similarity to other malicious programs. This is beneficial because the model can determine the characteristics of programs that it has never seen before, allowing for more effective malware classification and circumventing obfuscation efforts. However, there are many different machine learning models that can have different strengths for this application. This paper will analyze how varying the size of the feature space and giving the model more data to work with will impact the

efficiency of the process of training a malware classifier, as well as the effect of different network hyperparamaters on the accuracy of the resulting models. Additionally, in order to observe these effects over a more varied feature space, multiple elements of data on each malware sample will be considered, including both static data obtained from the binary file and dynamic data obtained from execution. These characteristics will be investigated for three different learning methods: random forest classifiers, support vector machines, and neural networks.

Poster #8

The Influence of Subcultures on Moral Foundations: Comparison between Westerners and Easterners in the United States

Samika Sequeira

Faculty Advisor(s): Dr. Heather Lench

The Moral Foundations Theory (MFT) was developed to understand cultural differences of moral values and separates them into the two following groups. Individualizing foundations emphasize self-focused concerns and include the values of Harm/care and Fairness/reciprocity. Binding foundations stress larger groups and encompass the values of Ingroup/loyalty, Authority/respect, and Purity/sanctity. Most MFT research has focused on cultural differences between broad cultures, generally finding that Westerners score higher on individualizing foundations and Easterners score higher on binding foundations. However, research has shown that individuals within subcultures differ on moral foundations. This study examines differences between Westerners and Easterners living in the U.S. It was hypothesized that Westerners (White individuals) will score higher on individualizing foundations while Easterners (South Asian, Southeast Asian, and East Asian individuals) will score higher on binding foundations. Participants (N = 4720) were coded based on their ethnicity, with White individuals as Westerners and South Asian, Southeast Asian, and East Asian individuals as Easterners. Participants took the Moral Foundations Questionnaire to assess their levels of different moral foundations. Contrary to the hypotheses, the results showed that Easterners scored higher on individualizing foundations while Easterners and Westerners did not differ on binding foundations. Compared to Westerners, Easterners scored higher in Harm/care, Fairness/reciprocity, and Purity/sanctity but scored lower on Ingroup/loyalty and Authority/respect. These conflicting findings indicate the importance of testing the MFT across cultures and within subcultures to understand cultural differences in moral foundations.

Poster #9

Maternal Depressive Symptoms and Mother-Infant Neural Synchrony: An Electrocortical Study

Kylie McDaniel, Emily L. Mallin, Aliuna Schorn, Chloe Van Noy, Abigail Varghese

Faculty Advisor(s): Dr. Rebecca Brooker

Interpersonal neural synchrony (INS), the temporal matching of behavior, affective states, and biological rhythms, is frequently used to quantify the quality of infant-parent relationships. Greater INS is considered ideal, as it predicts better socioemotional, behavioral, and self-regulatory functioning in infants. However, this perspective overlooks individual differences in mothers' functioning, as depressive symptoms are common among new mothers and can lead to maternal dysregulation. Because synchrony with maternal dysregulation may be maladaptive for infants, more nuance is needed in current views of INS. To address this, we tested whether INS was associated with better or worse behavioral outcomes for infants of depressed and nondepressed mothers. Each mother in our sample of mother-infant dyads completed questionnaires evaluating her child's socioemotional behaviors and her depressive symptoms. Our measure of INS is obtained through an EEG-based assessment of emotional reactivity called the Late Positive Potential (LPP) and calculated based on the correlation between maternal and infant LPP. We will investigate whether the association between INS and infant behaviors varies at high and low levels of maternal depressive symptoms. We expect that INS will be associated with positive socioemotional outcomes in infants at low levels of maternal depression. We also expect that when maternal depression symptoms are high, INS will predict poor infant outcomes. Our work will add nuance to the current literature by identifying the conditions under which INS is most and least beneficial. Findings will provide an additional understanding of how INS affects the mother-infant relationship and its impact on early childhood development.

Poster #10

Generalizability of External Memory Markers in Evolved Neural Networks

John Powell

Faculty Advisor(s): Dr. Yoonsuck Choe

Memory is one of the most widely studied yet most poorly misunderstood mechanisms of human information retrieval, as many questions still remain open about its role in human evolution. This experiment hopes to contribute to a greater understanding about memory, especially external, in the space of spatial locality and evolution. Within the field of AI, a useful model for an entity with a collection of states and behaviors that observes and/or interacts with its environment is called an agent. Its behavior is often studied to make more generalized claims about the evolution and use of intelligence or other natural phenomena. This project seeks to determine if previous research on an AI agent performing a 1-D ball dropping task can be generalized to more complex tasks, such as a 2-D foraging task. The ball dropping task only existed within a 1-D environment and had less environmental input as compared to the foraging task, which existed within a 2-D environment and had a more complex array of sensors and environmental input. Here we attempt to answer the fundamental

question: “Does neural network evolution favor external memory markers as an evolutionarily advantageous aspect of memory?”. If the results from previous research are generalizable to more complex tasks, it gives critical insight into the evolution of memory. This research also has as its focus the genetic algorithm NeuroEvolution of Augmenting Topologies (NEAT) to evolve not just the neural weights but the topology of the neural network as well. The expected outcome is an answer as to whether the previous researchers’ results are generalizable to more complex tasks and whether common neural network behavior and topologies exists.

Poster #11

Characterization of Potential Cardiovascular Disease Biomarkers in Diverse Populations Using Physics Informed Machine-Learning

Ben Dunning

Faculty Advisor(s): Dr. Gerard Cote

Cardiovascular disease is the leading cause of death in the United States and worldwide. Preventative use of continuous monitoring has been shown to significantly reduce mortality rate and strain on the health care system. Photoplethysmography (PPG) is a noninvasive optical technique to continuously monitor biosignals that can accurately measure changes in blood volume within a tissue. Analysis of the waveforms produced by these measures can provide important biomarkers for clinical diagnosis, including blood pressure, respiratory information, sympathetic nervous system activity, heart rate variability, etc. Our previous research has focused on integrating these PPG and various other biosensors into a multi-modal wearable device (MMW) for accurate and convenient continuous monitoring. However, ambient light, motion artifacts, contact pressure, and variation of characteristics across diverse populations (skin tone, age, gender, obesity, etc.) introduce substantial noise sources making straightforward analysis difficult. Thus, our primary goal for this project was to create a more robust method of analysis for these myriad of noise sources. To address this challenge, we trained a physics-informed machine-learning source model using large, published datasets of clinical information on PhysioNet (MIMIC-III and MIMIC-III Waveforms). The creation of this model had three primary steps. First, features were selected using physiological and standard statistical informed methods. Second, the model was trained on training data. Finally, the model's accuracy was evaluated. Once the source model is completed, we will use transfer learning on data collected using the MMW to develop the target model aimed at improving the biomarker analysis of the device.

Poster #12

Multi-Sensor Environmental Drone

Hind M. Fakhroo, Fatima F. Al-Mousawi

Faculty Advisor(s): Dr. Hussein Alnuweiri

The Multi-Sensor Environmental Drone (MSED) is a system that reports vital environmental data at multiple altitudes, without the requirement of multiple measuring instruments and complex data interpretation, as it is clearly shown as graphs in a website. These environmental parameters include Air Quality, UV Radiation, Hydrogen (H2), Carbon Dioxide (CO2), Carbon Monoxide (CO), Atmospheric Pressure, Temperature, Humidity, Dust and Smoke levels. The target demographic consists of individuals working in dangerous locations where these factors are crucial for ensuring a safe working environment. The MSED conducts real-time measurements of these parameters, providing enough time for planning and responding in case an abnormal reading is detected. The current environmental monitoring devices are immobile and provide data from a single altitude, limiting their ability to accurately gather readings of vital parameters at various heights. Furthermore, regular drones equipped with air quality sensors face limitations in flight time and lack portability, decreasing their effectiveness in data collection. To address these issues, the idea of the MSED has been developed and optimized. This drone monitors atmospheric parameters at different altitudes, with a focus on achieving longer flight time and displaying the data collected as graphs, showcasing clearly the 24/7 data that has been collected. Due to the simplicity of accessing these graphs and the drone's portability, the MSED can be an invaluable tool in locations such as construction sites or factories, where the parameters measured can be utilized for everyone's safety. This can include reacting on time when a dangerous gas is detected and acting quickly and accordingly prior to a potential disastrous situation.

Poster #13

Lipid Biomarkers Following Shifts in Historical Plankton Communities

Lee Ochs

Faculty Advisor(s): Dr. Pete van Hengstum, Dr. Karl Kaiser

Lipids are often utilized as biomarkers for ecosystem conditions because of their ability to reflect shifts in species abundance and diversity. This study reports lipid biomarker distributions in sediment cores taken from the Drinkwater sinkhole in the Bahamas, which is affected by local sea level variation. Sinkholes preserve allochthonous and autochthonous sediment deposition over time, making their stratigraphic accumulations useful as paleoenvironmental records. Transitions from lacustrine groundwater fed systems to marine flooded systems in sinkholes are visible in the sedimentary record and forced by sea level fluctuations. Lipid biomarkers, produced by ecologically unique pelagic planktonic communities, were analyzed using gas chromatography (GC) and flame-ionization detection (FID). Samples were taken from identifiable zones of stratigraphy corresponding with certain Greenland Stadials (GS) and Greenland Interstadials (GI) to contextualize them in a preexisting record of hydroclimate fluctuations. Observed trends show that certain lipids are found in elevated quantities exclusively in GS carbonate layers. These layers correspond with lower sea level and a groundwater fed

sinkhole. Other lipids were abundant exclusively in GI sapropel layers, which correspond with periods of higher sea level. These observable shifts in lipid species concentration and compositions are presumably due to changes in the sinkhole ecosystem caused by sea level change. This demonstrates the ability for lipid biomarkers to be a reliable proxy for hydroclimate variability in the subtropical North Atlantic.

Poster #14

Fitting Multilayer Perceptrons to Hill's Muscle Models

Nikki Rad

Faculty Advisor(s): Dr. Shinjiro Sueda

This thesis delves into the innovative application of Multi-Layer Perceptrons (MLPs) in biomechanics, specifically for enhancing the Hill's Muscle Model (HMM). Central to this ex- ploration is the accurate fitting of the four key component curves—Active-Force-Length, Active-Force-Velocity, Passive-Force-Length, and Tendon-Force-Length—using MLPs to compute muscle forces. Uniquely, the research not only focuses on individual curve fitting with distinct MLPs but also on their amalgamation into a comprehensive model. This dual approach allows for an in-depth analysis of MLP adaptability in predicting various muscle force aspects, offering a perspective often not fully addressed in existing research. The methodology involves the deployment of various MLP architectures, each with differing layers and neurons. This is complemented by an extensive hyperparameter tuning process, aimed at optimizing each model's performance for the specific curves of HMM. The research utilizes a combination of programming languages including Python, MATLAB, and C++, and leverages tools like PyTorch and TensorBoard for development and evaluation of the models. A significant aspect of the study is the use of a comprehensive dataset for model training and validation, ensuring a thorough examination of the models' predictive capabilities. The implications of this research extend across multiple domains such as sports science, physical therapy, and robotics, wherein precise muscle force modeling is pivotal. The study exemplifies the convergence of biomechanical modeling and machine learning, highlighting the transformative potential of artificial intelligence in understanding complex biological systems. The outcomes of this research underscore the viability and efficacy of MLPs in biomechanics.

Poster #15

Development of Dry-Aged Beef Characteristics using Starter Cultures and Dry-Aging Bags

Zachary Hoelscher

Faculty Advisor(s): Dr. Kerri Gehring

The dry aging of beef has an appeal among the meat industry for the unique flavor and sensory characteristics that it imparts on the finished meat product. Decades of former research has proven that the flavor of beef is one of the most important factors by which consumers base their decision making

process, whether at home or in a restaurant setting. As it exists today, the practice of dry aging is only a commonplace at certain restaurants and meat processing facilities that can build dedicated dry-aging rooms. The opportunity to provide average consumers and at-home cooks with a means by which to dry age beef with only dry aging bags and starter cultures could expand this product to a much greater array of marketing channels. This study uses the starter cultures Debaryomyces hansenii and Lactobacillus sakeii to determine if starter culture will contribute positively to dry-aged beef characteristics. This research is important to the meat and food preparation industry, as dry-aging is normally only a processing step performed by large-scale food service operations with dedicated dry-aging facilities and a high customer demand for dry-aged beef. Previous research has suggested that there is no apparent difference between dry aging in bags as compared to traditionally dry-aged beef. Additional research has shown that the use of starter cultures is effective in dry-aging beef and developing more intense flavors and aromas. No research has evaluated the effectiveness of starter cultures, such as Debaryomyces hansenii (yeast) and Lactobacillus sakei, (bacteria) when using dry-aging bags. If the starter cultures and dry-aging bags work, smaller retail and food service outlets or at-home cooks can dry-age beef without the need for dedicated dry-aging facilities.

Poster #16

Natural Language Translation utilizing LLMs

Anjali Kumar, Harshitha Dhulipala, Ashrita Vadlapatla

Faculty Advisor(s): Dr. Jeeeun Kim

Our research tackles the challenge of language barriers by developing a practical solutionâ€”a live translator that goes beyond traditional language conversion. We aim to create a tool that not only translates spoken language but also captures cultural nuances through facial expressions, tone analysis, and live transcription. This tool is crucial for scenarios like healthcare, where language proficiency is essential. Led by a three-person team, the project leverages advanced language models like GPT-3 and BERT. Anjali focuses on facial recognition, analyzing expressions in Western languages, particularly Spanish. Ashrita explores tonality, emphasizing vocal emotions, especially in Eastern languages. Harshitha works on live transcription and translation, ensuring seamless language processing. Our approach is rooted in practical insights from studies on American-Japanese cultural differences. We aim to tailor the tool to diverse cultural contexts, addressing challenges associated with variations in facial expressions and tonality. The end goal is a tool that not only translates but also enriches communication with real-time descriptions of facial expressions and tones. We envision its integration into video call platforms, facilitating direct communication between people speaking different languages, supplemented by live translations and cultural cues. Our timeline aims to achieve three key tasks: live translation and transcription, facial expression analysis, and tone of voice analysis. The model aims to bridge linguistic gaps, capturing cultural intricacies for more inclusive and accessible communication. The implications extend beyond language barriers, offering a practical solution for individuals worldwide.

Poster #17

X-Band Phased-Array Transmitter Design for Space Solar Power System

Mitchell Clark, Thomas Raguso, James Alexander

Faculty Advisor(s): Dr. Aydin Karsilayan, Dr. Jose Silva-Martinez

Amidst a global energy crisis, organizations are investigating innovative ways of producing renewable energy. Current methods of scalable renewable energy have significant drawbacks, preventing energy providers from making a complete conversion to more sustainable methods. Recent research discusses the economic and technical viability of space-based solar power generation that aims to negate the primary issues plaguing solar energy's capabilities. This novel method of solar power generation is where solar power collection satellites wirelessly distribute solar energy to earth, eliminating losses from atmospheric reflections and inconsistent sun exposure. The enticing prospect of efficient, continuous, renewable energy justifies further investigation to see if the concept is technologically achievable. This paper describes the phased-array microwave transmitter for wirelessly beaming the energy to a target on earth. The transmitter is composed of a 900 million patch antenna grid and control integrated circuit. Each 400 antenna tile group is equipped with a phase-locked loop to generate the X-band signal, programmable phase shifters to modify beam direction, and power amplifiers to drive antennas, all designed in TSMC 40 nm CMOS. The control integrated circuit deploys a specialized calibration algorithm that utilizes power transmission data to continuously calibrate tiles for correcting beam aim and minimizing beam width. This results in a transmitter capable of distributing over 1 GW of power to a 2 km diameter rectenna array. Once reviewed, the findings of this paper will encourage further research in this field to accurately determine the economic and technical viability of space-based solar power with a goal to innovate the design with more modern technologies.

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

Room: MSC 2300 C

Poster #1

Investigation of Virtual Memory Aware Memory Structures

Connor Nicholls

Faculty Advisor(s): Dr. Roger Pearce

Virtual Memory Aware toolkit is a library of data structures with specific purposes, allowing for significant speedups to be found through the elimination of assumptions. This toolkit is designed to be flexible within its specific purposes, and allows for complete customizability of parameters for each project. While the library will be continuously updated as more structures are added, the primary focus is that of the bag and the static index set. Bags are vectors that do not guarantee sequentiality, and as such are enabled to provide faster removals in cases where the order does not matter. Static index sets are linear probed hash tables that perform resize operations by allocating levels of ever-increasing user-defined size to add new information to, allowing for quicker resize functions and static access of members via a returned handle. This is supported by a fingerprinting algorithm, by which a selection of the hash is kept alongside each inserted object in order to allow for more efficient duplicate checking. While these algorithmic improvements allow for stronger use cases, they are not solely responsible for this. Following the theme of elimination of assumptions, instead of using malloc for memory allocation, VMA toolkit utilizes mmap, handling the memory allocation directly. By skipping over malloc, which contains much logic to allow for generalized use cases, VMA toolkit is designed for high performance and large data set use cases, meaning that the memory allocation can be optimized for the specific use cases and create quicker allocation times throughout. Notably, handling allocation directly also means that the program can direct the kernel on how to handle the pages it has received, once again allowing for significant speedups.

Poster #2

IV Assist: A stand-alone Mechanical Device for Assisting Ultrasound-guided Intravenous Cannulation

Moza Alsubaiei

Faculty Advisor(s): Dr. Reza Sadr

Intravenous cannulation is one of the most crucial medical processes that facilitates the delivery of nutrition, blood products, and medications. A child's arm can be one of the most delicate and difficult parts of medical treatment to insert a needle into. A special set of abilities is needed for pediatric intravenous (IV) cannulation since kids may be more apprehensive, have smaller veins, and find the process upsetting. However, the procedure still depends on the person performing it and demands a

high degree of proficiency. Effective peripheral intravenous cannulation requires a specially designed needle placement guidance device. Comparable items will perform worse than those that differ somewhat in terms of fine functionality. By using 3D printers feature an "IV Assist," a standalone mechanical device was printed that works to improve the accuracy of insertion of IV cannulation, in response to this difficulty. However, the prototype was printed using SolidWorks features and tested by using someone's arm. The prototype shows a working mechanism that follows the criteria of inserting the needle, yet adjustments need to be made to ensure stability, assign the right angle for inserting the needle, and design a location for Ultrasound. The Ultrasound-guided intravenous cannulation device has the opportunity to visualize the veins and provides information about the vein's characteristics. In summary, IV Assist is a cutting-edge development in the ultrasound-guided IV cannulation sector that provides a useful tool for medical professionals of many specializations. The design of the device will be improved and its incorporation into medical practice will be maximized through future research concentrating on larger clinical trials and user input.

Poster #3

The Effects of Repeated Contingent Footshock Punishment on Punishment Resistance for Cocaine Seeking in Male Rats

Katherine Jaffe

Faculty Advisor(s): Dr. R.J. Smith

A defining characteristic of addiction is compulsive drug-seeking, despite aversive consequences. In a rodent model, rats continue to self-administer cocaine despite footshock, indicating punishment resistance. Preliminary data from the lab found that a history of exposure to noncontingent footshock did not change the response to subsequent contingent footshock in male rats, although it caused enhanced punishment resistance in female rats. Here, we investigated whether the contingency of the footshock is crucial to how male rats respond to subsequent contingent footshock. In particular, we wanted to compare our previous data to rats with a history of contingent footshock. We trained 11 male Sprague Dawley rats to self-administer intravenous cocaine on a seeking-taking chained schedule of reinforcement for 2 hours daily. Once reaching the final schedule, rats were given contingent footshock punishment (delivered randomly ⅓ of trials after completion of seeking). All rats were given 4 days of contingent footshock punishment (0.4 mA, 0.3 sec), up to 5 days of ramped punishment (increasing the intensity and/or duration), and then 4 more days of the contingent footshock (0.4 mA, 0.3 sec). We observed that male rats with a history of noncontingent punishment were more sensitive to later footshock than those with a history of contingent footshock. This might indicate that different histories of footshock affect behavior to later punishment.

Poster #4

Vehicle Navigation Resilience with Post-GPS Spoofing Recovery Algorithms

Isabel Moore

Faculty Advisor(s): Dr. Swaminathan Gopalswamy

The integration of unmanned air systems and autonomous vehicles in various industries has led to a heightened focus on cybersecurity, particularly regarding Global Positioning System (GPS) spoofing attacks. This research pivots from traditional approaches that primarily emphasize spoofing attack detection, directing attention instead to the post-spoofing recovery phase, proposing a recovery algorithm designed to reestablish accurate GPS navigation and positioning swiftly and effectively. Leveraging simulation environments such as Gazebo, RVIZ, and ROS within Docker containers, this research conducts extensive testing to validate the resilience of the proposed solution. By integrating data from GPS, Inertial Measurement Units (IMUs), and odometry, the research develops a Sensor-Health Aware Resilient Fusion (SHARF) algorithm that maintains positional accuracy despite compromised GPS data. The algorithm's health monitoring component continuously evaluates sensor integrity, applying Kalman filters and Covariance Intersection methods to ensure unbiased and consistent estimates of the vehicle's state. Through a methodological exploration within a simulated framework, this thesis demonstrates the potential of the proposed algorithms to enhance the reliability and security of navigation systems, thereby contributing significantly to the field of autonomous vehicle navigation.

Poster #5

Evaluating Malware Robustness against Inspections by Security Analysts

Svettlira Van Jakovich

Faculty Advisor(s): Dr. John Drew Hamilton, Dr. Marcus Botacin

Malware is defined as malicious software that can damage or allow unauthorized access to a computer system. Malware is a worldwide problem that can affect individuals, companies, and government entities by threatening data security. The challenge is that malware creators actively find ways to evade detection by security analysts using increasingly creative techniques. Ideally, security analysts should be able to inspect and reverse engineer malware. The issue is that malware utilizes concepts such as encryption, code obfuscation, trojan horse techniques, and more to avoid detection by analysts. Our proposed solution to this issue is to explore the resilience of malware against attacks against it. We are effectively aiming to evaluate malware robustness from a man-in-the-middle point of view. Current research focuses on how malware behaves from a host perspective to the connection to its command-and-control server. We aim to build on top of past and current malware dynamic analysis techniques but from an intercepted viewpoint. Our motivation is to better understand how malware would look and behave if inspected by a security analyst using common security tools. Progressive malware research is essential to advance analyst tools at the same rate that attackers are advancing malware. The results of this research could reveal potential flaws in current analysts' tools and techniques and improve the progress toward future tools.

Poster #6

Physician-Assisted Euthanasia for Physical vs. Psychiatric Illnesses

Grace MaGee

Faculty Advisor(s): Dr. Rebecca Schlegel

Euthanasia, often known as "killing on request," refers to the intentional giving of drugs to a patient by a medical practitioner at that patient's competent and willing request. According to earlier studies, most wealthy countries have seen strong public support for euthanasia over the past 30 years, but medical endorsement has been less universal. This study examined support for access to physician-assisted euthanasia for physical and psychiatric illnesses to identify differences based on the illness type, and how one's belief in free will is associated with physician-assisted euthanasia support. We obtained a sample of undergraduate students from Texas A&M University who answered a questionnaire that assessed the extent to which they believe in free will and their reactions to several vignettes about different physical-assisted euthanasia scenarios. They also completed a number of other relevant measures including fear of personal death, spiritual transcendence, and willingness to help. These items were examined along with items like religiosity and political orientation. It was hypothesized that those who had a high belief in free will would be more in favor of the administration of euthanasia to a patient by a doctor for both psychiatric and physical illnesses. A repeated measures ANOVA found that individuals were more in favor of physician-assisted euthanasia being granted for physical rather than psychiatric illnesses. Additionally, a Pearson correlation found that free will beliefs were negatively related to support for physician-assisted euthanasia.

Poster #7

Performance of Geometry-Based Functionally-Graded Additive Manufactured Interfaces

Meredith K. McNichols

Faculty Advisor(s): Dr. Mathew Kuttolamadom

This project focuses on designing, manufacturing, and testing functionally graded interfaces through interlocking graded geometric patterns at the contact regions between metal and polymer faces. Functionally graded materials (FGMs) essentially provide the “best of both worlds” by maximizing strength-based material properties while reducing crack initiation/propagation by eliminating harsh transition areas that would otherwise exist between materials having significant property differentials. Typical exploration in this field involves pore-fraction, microstructure, or chemical composition gradation to create gradient property changes through material interfaces. In contrast, this will be accomplished in this project by using selective laser melting (SLM) to manufacture a metallic part with specific process parameters and geometric designs, then using fused deposition modeling (FDM) to print a polymer part directly atop this structure. Finally, various mechanical tests, including tensile, shear, and hardness tests, will be performed to determine the properties and performance of the resulting assembly. Repeating similar tests with variable surface patterns, i.e., altering the sizing and spacing of

the interlocking design features, and changing process parameters, including laser power and scan speed, will provide knowledge regarding the influence of design type on the performance under different loading conditions, which will in turn help define viable FGM design and manufacturing processes.

Poster #8

An Analysis of Osteological Variation Between Gopher Genera at Hall's Cave, Texas

Patrick Brannen, Macayla Sauser

Faculty Advisor(s): Dr. Michael Waters

From Hall's Cave, Texas, many microfaunal remains were excavated. Among the kinds of rodents found in the Hall's Cave archaeological material, there are two different genera of gopher: Geomys and Thomomys. Although there are clear distinctions between the mandibles of these two groups, differences in other bones are much more subtle. This project aims to determine whether or not gopher genera can be determined from osteological measurements using the mandibles, humeri, and femurs. To do this, 27 different osteological measurements were taken across 1,485 gopher mandibles, femurs, and humeri using digital calipers. T-tests and Principal Component Analyses will be used to determine whether there are enough osteological differences between the Geomys and Thomomys populations to base future estimations of genera membership for other bones using these measurements. Although the statistical analysis has not been completed, the data may support the idea that genera membership can be estimated by measuring certain features of the specimen's mandible, femur, and/or humerus. If this is the case, further research may be done in a similar capacity with other members of the family Geomyidae, or perhaps even with the order Rodentia, to better understand the metrics most important to the determination of genera, their reliability, and how they relate to other nearby taxa. This research will contribute to the understanding of Geomyidae by pinpointing specific elements of their bones, which can aid future researchers in determining to what genera a given specimen belongs.

Poster #9

Autonomous Guide Star Catalog Screening using Machine Learning

Snigdha Palamari, Anu Poudyal

Faculty Advisor(s): Dr. Jacques Richard

Advanced space telescopes such as the James Webb Space Telescope (JWST) and the Hub- ble Space Telescope (HST) utilize a Fine Guidance Sensor (FGS) in order to accurately point the telescope in the appropriate direction depending on the data required. These sensors rely on guide stars, which the FGS lock onto to ensure that the telescope is aimed properly and does not change positions throughout data collection. However, the quality of the selected guide star catalog can significantly impact the abilities of the FGS to complete guide star acquisition. Failure to acquire the desired guide star can delay research and cause drift in the roll of the space telescope. Ac- cording to the JWST Guide Star User Documentation, the current failure rate of these guide stars is approximately 0.6%. A part of the causes

includes guide star catalog errors such as surprise double binaries, faint stars, and compact galaxies. In order to effectively filter the existing guide star catalogs to eliminate stars that can potentially cause errors, the k-clustering machine learning algorithm was selected. In general, the algorithm works by randomly choosing a set number of “cluster centers.” Once these centers are chosen, all of the surrounding points are assigned a clus- ter dependent on the distance from the cluster center. Next the center of each cluster is recalculated with consideration of all the points in said cluster. Finally the previous two steps are repeated until there is no longer a significant change in the location of the cluster center between iterations. By utilizing the algorithm on several guide star catalogs, the optimal guide star catalogs are found.

Poster #10

Predicting Adherence to Remote Patient Monitoring for Hypertension using Machine Learning

Suhu Lavu

Faculty Advisor(s): Dr. Bobak Mortazavi, Dr. Hye-Chung Kum

Hypertension is a prominent health issue that is a leading risk factor for cardiovascular disease and has the potential to cause premature mortality. Remote patient monitoring or telemonitoring systems have been determined to be effective in reducing patient blood pressure and provide an effective communication medium for patients and physicians, enabling earlier interventions and diagnosis of hypertension. However, the effectiveness of these systems is highly dependent on a patient's adherence to the system, with adherent patients achieving much higher levels of blood pressure control than non-adherent patients. Therefore, developing an algorithmic method for identifying non-adherent patients would improve the efficacy and scalability of telemonitoring systems as physicians would be able to send reminder calls, check-ins, etc. to these patients without significant additional stress on healthcare resources. We present a predictive model that can accurately identify whether a patient will take a blood pressure reading on a given day based on their past behavior. We first model the data as a sequence of binary states using Markov chains to serve as a statistical baseline. We then test tree based models, such as random forest and XGBoost, and compare their performance to our baseline results before training more complex deep learning models, such as a multi-layer perceptron and long short-term memory network. For every model, we also test window sizes between one and fourteen days to determine the optimal amount of data necessary to successfully predict a patient's adherence. Taking into account computational expense and practical application within a real world system, the optimal model, XGBoost, achieved an AUCROC score of 0.94 at a window size of ten days.

Poster #11

Characterization of Novel Nora Viruses Infecting the Araneae Order

Aldair Monsivais Collazo

Faculty Advisor(s): Dr. Benjamin Neuman

Picornaviruses are characterized for having a genome composed of a single open reading frame (ORF). However, viral evolution shows genome organization is non-conserved between viral families. Noraviridae is an ancestral viral family of picornaviruses, however these viruses are unique for being the only picorna-like virus with four ORFs. Picornaviruses and coronaviruses show protein homology and have common ancestors, but the genome organization of coronaviruses is present in multiple ORFs that are transcribed as part of a segmented genome. Our research believed that due to the genome organization of Nora viruses, segmented genome transcription was also used, yet we have not seen this case. We have identified novel nora-like viruses in a spider silk transcriptome, but their genome characterization remains unknown. Previously, Nora viruses were initially only found in fruit flies and other invertebrates, and our research suggests their presence in spiders. We find that while not all viruses in our transcriptome belong in Noraviridae, five viruses do show the evolution of Nora virus genome organization. We argue that Nora viruses do not undergo segmented genome transcription due to the presence of IRES elements and ribosomal frameshifting in Nora virus genomes. Rather, Noraviridae fragmentation into multiple ORFs may be an example of convergent evolution. To our surprise, remote homology has predicted the ORF3 protein of our Nora viruses to be an incomplete fusion motor protein. Past research has shown ORF3 as essential but unreliable, thus we argue that Noraviridae fragmentation seeks to lose this protein gene. These results build on the research that Nora viruses can infect other invertebrates, while providing new insight into ORF3's function and picornaviral evolution.

Poster #12

Calibration Measurements of Two Scientific Grade Astronomical Cameras

Jared Bull

Faculty Advisor(s): Dr. Jennifer Marshall

We present the results of a calibration analysis of two scientific grade cameras: an SBIG ST-8300 CCD and an APOGEE-ALTA F16M CCD. Calibration measurements and analyses are being conducted to identify and address potential issues or defects that could impact future experiments. Key parameters such as gain conversion factor, readout noise, linearity, and dark current are determined through the acquisition of bias, flat field, and dark images. Twenty bias frames at zero exposure time are generated for each camera, while sets of flat field frames are captured at varying exposure times, with the sets subtracted from each other to create flat-field corrected frames. Dark frames, taken at similar exposure time ranges with the shutter closed, reveal typical dark currents of 0.0222 electrons/s and 0.0805 electrons/s for the SBIG and APOGEE cameras, respectively. Transfer curves and linearity curves, plotted for both cameras, indicate a nonlinear response. Utilizing a Python implementation of least squares minimization, the gain conversion factor and readout noise are calculated, resulting in values for the

SBIG (0.407 electrons/ADU, 53.9 ADU) and APOGEE (1.58 electrons/ADU, 28.1 ADU). The study also identifies the presence of a nonlinear response in both cameras through residuals of linear fit analysis. Future testing aims to adjust the experimental setup to understand the cause of these nonlinear responses. Observations of a Landolt standard star field will be conducted later to determine photometric zero points and V-band color-correction terms. Completion of these calibration measurements ensures the readiness of the cameras for deployment in future Munnerlyn Instrumentation Lab projects.

Poster #13

Sea of Change: A Mixed Reality Approach to Addressing Psychological Distancing in the Context of Rising Sea Levels

Robert Eads

Faculty Advisor(s): Dr. Ann McNamara

While a great majority of the population in countries around the world are aware of the phenomenon known as climate change and often feel responsible for taking steps to slow its effects, the level of personal engagement related to this subject in those countries is far below that of its awareness. For the parts of climate change that do not affect certain communities, those people often naturally feel removed from it to some degree. This feeling, known as psychological distancing, is a common hurdle when addressing rising sea levels in communities physically distant from coastlines. With this in mind, can psychological distancing's effect on inaction related to rising sea levels be combated in a person's local environment? Using mixed reality, I propose taking the first steps toward answering this question by creating an experience that brings simulated water, at levels based on historical and predictive data, to the user's local environment. With the help of popular digital creation tools, realistic water simulations are combined with an environment made of both physical and digital elements to emotionally impact users by exploiting their connection to their own locale and peer group. If successful, this application of mixed reality technology will help reduce the tendency towards inaction due to physiological distancing in those populations unlikely to be at immediate risk of rising sea levels. With the creation of this experience, further research can be done to answer the question of whether or not this technology can help combat psychological distancing and make progress toward a more sustainable world not just for our generation, but for future generations yet to come.

Poster #14

Explanted Vessel Perfusion with BriteVu Using a Flow Loop with Customizable Adapters

Alyssa A. Chrietzberg

Faculty Advisor(s): Dr. Staci J. Horn, Dr. Anne-Marie Ginn-Hedman

Previous research has shown that addition of contrast can enhance the micro-CT assessment of various tissues associated with medical device implants. Contrast-enhanced micro-CT of vessels with intravascular devices often produce better results when compared to imaging without contrast. Current methods for vessel perfusion with contrast often result in air bubbles trapped within the vessel that interfere with image interpretation and damage to the vessel, such as tearing. BriteVu is a low-density contrast agent that can penetrate the microvasculature of vessels. Data suggest that BriteVu is a preferable contrast agent for explanted specimens because it does not damage formalin-fixed tissues and has long working times ideal for large specimen scans. In this study, we developed an improved method for perfusing explanted vessels with contrast. Vessel damage is minimized by varying flow rate according to vessel size using custom 3D printed adapters. The adapters were printed with flexible TPU to provide a rubber-like seal. The perfusion method started with a saline flush and then a contrast agent flush. Once the contrast agent was flushed, the distal end of the vessel was ligated and the contrast was gently introduced to reduce formation of air bubbles. The vessel was ligated and imaging was performed. The 3D printed adapter and the methods for introduction of the contrast agent provided better infiltration of the contrast and reduction of the air bubbles present and damage to the vessel. Better infiltration of the contrast is achieved by using a vessel size-specific adapter that limits the flow rate of the contrast. With a working flow loop, adapters of different sizes can be manufactured to perfuse vessels of all sizes and ultimately produce enhanced imaging analyses.

Poster #15

3D-Printed Synthetic Tissues for Cardiac Surgical Training

Aliana Hagen

Faculty Advisor(s): Dr. Anne-Marie Ginn-Hedman

Congenital heart defects pose distinctive treatment challenges due to their rarity. Surgeons presented with such complex cases often possess limited hands-on experience, increasing the risk of errors during operation. While imaging and 3D virtual visualization techniques can aid preoperative planning, they cannot replicate the tactile sensation of performing surgery on a heart. Current synthetic heart models made with molding techniques offer limited tactility, but often lack mechanical and anatomical accuracy. Additionally, their production is expensive and time-consuming. This study aims to address these limitations by investigating the development of a cost-effective 3D-printed heart model created from patient-specific CT or MRI scans. The primary focus of this study is developing resins for stereolithography printing that closely mimic the mechanical properties and tactile qualities of cardiac tissue once printed. Silicone, soft polymer resins, hydrogel resins, and hydrogel resin blends were

compared against fresh cardiac tissue for puncture resistance, suture resistance, and tensile strength. Certain hydrogel resin blends exhibited mechanical properties closely mirroring those of fresh cardiac tissue. A neonatal heart with hypoplastic left heart syndrome (HLHS) was printed for feasibility. Pursuing additional modifications and fine-tuning is recommended to advance the creation of synthetic heart models that more closely align with the properties of cardiac tissue while also reducing printing time.

Poster #16

Parallel Non-Counting In-Place Radix Sort

Rushil Udani

Faculty Advisor(s): Dr. Dmitri Loguinov

Explosive growth of the Internet, cluster computing, and storage technology has led to the generation of enormous volumes of information. Many common data processing tasks require this data to be sorted. The particular case of MSD Radix Sort has been investigated using transparent streaming abstractions like Vortex, which create the illusion of a larger than RAM buffer that is backed by remappable "blocks" of memory. Such abstractions are indispensable for simple algorithms, but limit their speed. In this paper, we propose a high-performance sorting algorithm based on "slices" of memory, which are managed explicitly by the programmer. This is more complicated than using a transparent solution, but eliminates the overhead from transparent streaming paradigms. This algorithm takes advantage of the multiple cores and other microarchitectural details found in modern processors to fully saturate the RAM bandwidth of a modern Intel Coffee Lake System. This technique can be applied to develop other specific high-performance and memory-efficient algorithms.

Poster #17

Investigation into Lysis Inhibition in N4 Bacteriophage

Kaylyn Niemiec

Faculty Advisor(s): Dr. Jolene Ramsey

Annually in the U.S., antibiotic-resistant microbial infections account for nearly 36,000 deaths and cost approximately $4.6 billion in treatment expenditures. One approach to treat antibiotic-resistant bacterial infections is using their natural predators, bacteriophages or phages, as a therapy. One challenge to applying phage therapy is large scale phage production. Some phages normally produce more progeny than others using a process called lysis inhibition (LIN). Past studies have studied LIN proteins in phage T4. The induction of LIN in T4 occurs through superinfection, where new phages attempt to infect an already infected cell. This triggers inhibition of lysis proteins and allows further accumulation of phage progeny. However, the T4 proteins involved are not conserved. Therefore, studying LIN in other phages is necessary for its broad application in phage production. Using phage N4, this study will characterize new proteins and their involvement in LIN signaling. The primary approaches will be infection assays combined with genetics. Overall, this study will help us understand the conservation of superinfection in LIN across different phages. In the future, knowledge of conservation,

or lack thereof, in LIN among diverse phages can be used to quickly identify LIN signals in phages we need to overproduce for therapy.

Poster #18

The Impact of Static Physical Arousal on Attentional Networks

Jenna Glotfelty

Faculty Advisor(s): Dr. Brian Anderson

Humans tend to perform better cognitively when physically aroused. For instance, studies have found that physical arousal can lead to improvements in executive functioning. One common approach is to use the attentional network task (ANT) after physical arousal. This task is often used to measure the executive control of attention by assessing how people allocate their limited resources to relevant visual stimuli. The task uses the flanker paradigm, where participants try and maintain focus on a centrally presented target while ignoring distracting ("flanking") stimuli on either side. Typically, participants cannot help but attend to the flanking items, impairing their response to the target. Physical arousal can help to alleviate the influence of distracting information in the flanker paradigm. However, dynamic arousal (e.g., cycling, running, swimming) is difficult to measure in the lab and might not be generalizable. These types of aerobic arousal are less conducive to everyday settings like the classroom or office. Thus, whether static arousal improves executive functioning similar to dynamic arousal remains an open question. To test this question, our participants gripped a hand dynamometer for 18 seconds at maximum strength to simulate physical arousal, Then, participants completed the ANT. Participants were tasked with reporting the direction of a centrally presented target arrow (left or right) via a keyboard press. The target was flanked by distractors that were either congruent with, incongruent with, or neutral with respect to the target response. Prior to the search array, nonpredictive cues were presented. If static arousal improves executive functioning, we expect participants to perform better on the ANT in the grip condition than the no-grip condition.

Poster #19

Investigating the Elemental Geochemistry of Deep-Sea Corals Using LA-ICPMS

Nichole Mendez

Faculty Advisor(s): Dr. Brendan Roark

Deep-sea corals (DSC) are a relatively new and unique archive that can be used to better understand past and future climate change. The trace element geochemistry of DSC can be used as proxies to reconstruct past environmental parameters of ambient ocean conditions on decadal to millennial scales. These reconstructions can be used to explore the impacts of anthropogenic activities on DSC and the ocean. Proxy development work has only been done on a limited number of DSC species and regions of the world's oceans. This work will focus on analyzing bamboo corals collected from the North Pacific and Atlantic Seaboard. Additionally, the modern environment in the areas from which specimens were collected has been well characterized. Data available includes water column chemistry from sample

sites, which enables us to use a multiple of different DSC species and compare the modern environmental conditions to the trace element proxies. The elemental data was obtained utilizing Laser Ablation Inductively Coupled Plasma Mass Spectrometry from the Australian National University to characterize the elemental composition within the coral structure. The goal of this project is to assess the reproducibility, heterogeneity, and controls of elemental measurements to assess environmental proxy development opportunities to further our understanding of past ocean and climate environments.

Poster #20

Enhancing Brain Cognitive Deterioration Analysis Using Machine Learning

Nihar Shah

Faculty Advisor(s): Dr. Tracy Hammond

The multidisciplinary research project integrates genetics and machine learning to advance our understanding of Alzheimer's disease (AD), the sixth leading cause of death in the United States. Timely detection of AD is crucial for effective disease management. To achieve early detection, it is crucial to distinguish individuals in the early stages of mild cognitive impairment (EMCI) from those with normal cognitive (NC) function. This research is centered on refining this differentiation process to enhance AD detection. Utilizing genetic data collected from ADNIGO/2 dataset and processed with tools like PLINK and Python libraries, the study explores genetic factors contributing to early AD diagnosis. We would also investigate the impact of some brain measures including MRI available in TADPOLE dataset, as well as APOE on AD risk since it has been associated with increased susceptibility to the disease. By integrating genetic insights and neuroimaging data, this research strives to unveil a comprehensive understanding of the intricate interplay between genetic factors, brain measures, and Alzheimer's risk, ultimately paving the way for more accurate and early diagnoses, and potentially opening avenues for targeted therapeutic interventions. In the realm of classification problems, machine learning approaches play a pivotal role in deriving meaningful insights and predictions. In addition to detection, the study aims to elucidate the rationale behind identified features using Explainable AI techniques such as Local Interpretable Model-Agnostic Explanations (LIME). This comprehensive understanding of genetic factors will contribute to future Alzheimer's research and potentially inform the development of targeted treatments.

Poster #21

Synthesis and Characterization on PLLA-PEG-PLLA triblock polymers into PCL-based SMP Bone Scaffolds

Caitlyn M. Prejean

Faculty Advisor(s): Dr. Melissa A. Grunlan

Thermoresponsive shape memory polymers (SMPs) were developed as self-fitting scaffolds to heal cranial bone defects and present a promising alternative to the limitations of allografts. Exposure to

temperatures above the melt transition temperature (Tm) causes scaffolds to undergo shape recovery, driving its expansion to the tissue perimeter for improved osseointegration and healing. Scaffolds prepared from star-poly(Ɛ-caprolactone)-tetraacrylate (★PCL-TA, Mn ~ 10 kg mol-1) have been studied and found to exhibit desirable characteristics such as shape memory properties, mechanical properties suitable for synthetic bone and a tissue-safe melt transition temperature (Tm) ~45 °C. However, a major limitation of scaffolds based on ★PCL-TA is the slow degradation time (~2 years). To facilitate proper bone tissue healing, it would be advantageous to increase the rate of degradation of the scaffold to match that of tissue growth. Herein, two triblock polymers consisting of poly(L-lactide) (PLLA) and poly(ethylene glycol) (PEG) were synthesized (PLA_87-PEG_35-PLA_87 and PLA_70-PEG_70-PLA_70) to be incorporated into a crosslinked ★PCL-TA network at two different weight percents (10% or 25%), resulting in four semi-interpenetrating network (semi-IPN) compositions: PEG_35_10, PEG_35_25, PEG_70_10, and PEG_70_25. ★PLLA_10 and ★PLLA_25 (10 and 25 wt% PLLA respectively), were used as controls as these compositions have been previously studied within the lab. Due to the hydrophilicity of PEG, the semi-IPN triblocks are expected to exhibit increased degradation rates compared to the PLLA compositions. On top of this, scaffolds with the PLLA-PEG-PLLA triblock are also expected to maintain mechanical properties desirable for bone tissue, as well as shape memory and a Tm profile ~45 °C.

Poster #22

Dynamic Graph Visualization Techniques

Octavio Almanza

Faculty Advisor(s): Dr. Nate Veldt

Graphs are amongst the most important and common data structures found throughout the field of computer science. Thoroughly understanding graph operations and algorithms is crucial for students in the discipline. Unfortunately, graph algorithms can be very challenging to follow by hand, and this can be attributed to their abstract nature, long subroutines, and many variables to keep track of. Although it is common for students in university algorithm courses to code graph algorithms using some high-level programming language, students are only able to see their program's output rather than the steps the program took to produce it. On top of that, a graph's topology can greatly influence the behavior of an algorithm. Instructors may choose to trace an algorithm's steps within a lecture, but their examples are usually limited by the aforementioned difficulties. Like instructors, researchers in the field of graph theory often necessitate a way of illustrating dynamic processes on graphs. These types of visualizations are useful when presenting research work and new algorithms to audiences in academic conferences and forums. The goal of this project is to create a tool that can assist students in analyzing the behavior of common graph algorithms through interactive visualizations, and also provide instructors and researchers the ability to create, load, and save graphs and visualizations that could then be incorporated in lectures or research presentations.

Poster #23

Unraveling Nutrient Exchange: The Influence of Symbionts on Cassiopea Jellyfish Regeneration

Lauren Bothwell

Faculty Advisor(s): Dr. Sheila Kitchen

The charming upside-down jellyfish, Cassiopea xamachana, can regenerate bell tissue, vesicular appendages, and oral arms. The species often serves as a model system for complex or endangered cnidarians that rely on similar symbiotic relationships with dinoflagellate algae. While previous studies demonstrated enhanced appendage regeneration in the moon jellyfish Aurelia when given supplements of the amino acid L-leucine, limited research exists on the impact of dietary supplements on the regeneration of Cassiopea. This project explores the effects of amino acids, namely L-leucine, L-alanine, and L-arginine, on the regeneration process in Cassiopea during the polyp stage. These amino acids span from essential to non-essential classifications and two play a prominent role in the mTOR pathway, providing a framework to test how essentiality or mTOR regulation of a given amino acid affects regeneration. Prior to immersion in the amino acid solutions, the animals were amputated at the top of the stem of the polyps. We scored phenotypic categories of regeneration for each group every 2-3 days, with polyp regeneration being measured by mortality, no growth, tentacle bud growth, or significant tentacle regrowth. Higher concentrations that induced regeneration in Aurelia resulted in mortality of Cassiopea. An additional facet of this project is determining the most effective method of creating aposymbiotic Cassiopea polyps. This is a necessary step in ensuring an ample population of symbiont-free animals for the reproduction of this, or similarly related, experiments. This investigation of Cassiopea contributes to our understanding of the underlying mechanisms governing cnidarian regenerative potential and can serve as a model for more complex species.

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

Room: MSC 2300 C

Poster #1

*Trophic Ecology of Swordfish (*Xiphias gladius*) between Marginal Seas in the Atlantic Ocean*

Carly Farley

Faculty Advisor(s): Dr. Jay Rooker

Pelagic predators influence marine ecosystems via top-down control of prey abundance and biomass. Changes in predator populations and trophic dynamics can have long-term effects on ecosystem structure, functioning, and resilience. Trophic ecology studies of these predators can elucidate their feeding ecology and food web structure, which can then inform management of these species. A popular method used to conduct trophic ecology studies is stable isotope analysis (SIA) of carbon and nitrogen (δ13C, δ15N). These dietary tracers can be used to identify source(s) of organic matter supporting pelagic food webs and the trophic position of consumers. The purpose of this study is to investigate the trophic ecology of swordfish (*Xiphias gladius*) using SIA to compare trophic relationships across two marginal seas in the Atlantic Ocean (Gulf of Mexico, Mediterranean Sea). Muscle biopsies were taken from juvenile and adult swordfish from both the Gulf of Mexico (n = 20) and the Mediterranean Sea (n = 20). Muscle samples will be freeze dried, powdered, and tinned for SIA of δ13C and δ15N at the University of California-Davis using an elemental analyzer interfaced with a continuous flow isotope ratio mass spectrometer (EA-IRMS). Results of this study will fill critical data gaps in the feeding ecology and trophic position of swordfish to better inform management of swordfish fisheries in two primary spawning sites for the species.

Poster #2

Reflective Proprties of Dust: Impact of Dust on Light Absorption

Asmaa Al-Qahtani

Faculty Advisor(s): Dr. Bing Guo

Photovoltaic cells are subjected to dust accumulation which reduces the power generation output, also known as soiling loss. This experimental study investigates the reflective characteristics of dust particles, focusing on how the dust particles brightness appear at different camera angles, as this is an important factor in soiling loss quantification using the image contrast method. The apparent dust brightness is a function of both camera distance and camera angle. In this study a correction factor for the distance is to be calculated and to isolate the angle dependency effect. The approach is to use two surfaces, one being a dust pellet and the other a reflectance standard that is assumed to be a matte surface exhibiting Lambertian behavior, i.e., constant brightness regardless of the camera angle. The range of the angles

that is going to be studied is between 30 to 60 degrees with an increment of 5 degrees, an average pixel value will be found at each angle using digital imaging techniques. This study contributes to understand how dust particles reflect, which can be helpful in photovoltaic cells in areas subjected to high dust accumulation. A key finding is dust act as a matte surface, thus it is a Lambertian reflector, and dust accumulation on photovoltaic cells reflects sunlight and hence reduce the energy generated by the PV cells.

Poster #3

Self-Healing and Stretchable Next-Generation Enthused Conjugated Polymers For Electronic Skin Application

Wala Abdelhalim

Faculty Advisor(s): Dr. Mohammed Al-Hashimi

In the dynamic field of electronic materials, our research explores the development of conjugated polymers tailored for electronic skin applications, drawing inspiration from the remarkable properties of human skin. Focused on crafting the next generation of polymers, we employ advanced coupling reactions and meticulous synthesis, introducing deliberate variations in sidechains and supramolecular crosslinks. Urea side chains, emphasizing the uniqueness of hydrogen bonding, optimize self-healing capabilities and tailor the material's attributes, marking a distinctive contribution. The urea side chains induce hydrogen bonding between molecules, facilitating self-assembly into a more ordered and planar structure in the solid state, thereby enhancing intermolecular charge transfer. This unique hydrogen bonding also enables self-healing capabilities within the conjugated polymer, exhibiting tensile strength without compromising electrical performance in transistors. Ensuring finely tuned chemical and physical properties, our study showcases key attributes such as self-healing, stretchability, biocompatibility, and high electrical conductivity. This versatility positions our polymers as ideal candidates for applications in organic field effect transistors (OFETs) and electronic skin, where the seamless integration of these attributes is crucial for optimal performance and user comfort. Our work presents a versatile semiconductor polymer film with distinct attributes, emphasizing the transformative potential of electronic skin applications. This research encapsulates a vision where electronic materials, specifically conjugated polymers, mimic the resilience of human skin, pushing the boundaries of innovation in the realm of electronic integration with biological systems.

Poster #4

Efficient Partial Discharge Detection in Online Gas Insulated Switchgear Monitoring: Characterization Insights

Al-Anoud M. Al-Emadi

Faculty Advisor(s): Dr. Ali Ghrayeb

This posterfocuses on investigating the detection of partial discharge (PD) in gas insulated switchgears (GIS) through the use of advanced deep learning models and signal processing methods. The aim is to effectively differentiate PD-induced noise from other noises in high-voltage environments using these sophisticated techniques. The collaboration with Qatar General Water and Electricity Corporation (KAHRAMAA) enriches our research by providing valuable insights into real-world applications and specific considerations in GIS systems. This study includes a comprehensive overview of GIS systems, highlighting the complexities of their operations and the vital role of PD detection in ensuring their reliability. Furthermore, the study extensively explores various machine learning techniques, examining their effectiveness in identifying unique patterns in PD noise, thereby enabling quick and accurate detection of potential faults in the system. Moreover, the study discusses several designs in the field of deep learning, including convolutional neural networks (CNNs). This model is taught to identify the distinctive features of noise caused by PD, setting it apart from other kinds of noise that are prevalent in high-voltage situations. The study also explores the useful uses of PD detection in preserving the integrity of GIS systems. It emphasizes how early detection of PD can save system failures, lower maintenance expenses, and increase equipment longevity. KAHRAMAA's real-world case studies demonstrate how successful these deep learning models are in practical environments.

Poster #5

Effects of Duration of Bupivacaine Treatment on Secondary injury after SCI

Natsuka Kobayashi

Faculty Advisor(s): Dr. James Grau

After a spinal cord injury (SCI), peripheral tissues are often damaged, engaging pain (nociceptive) fibers. Prior research has shown that pain input after SCI impairs locomotor recovery and increases hemorrhage around the site of injury due to the breakdown of the blood-spinal cord barrier (BSCB). This breakage allows infiltration of neurotoxic components of the blood to come in contact with neural tissue and expand tissue loss, which may account for chronic pain after SCI. Chronic pain, in addition to the physical effects of SCI, can be debilitating for patients. Prior work has shown that application of pentobarbital anesthesia immediately after injury for 12 hours attenuated hemorrhage. Locally inhibiting cellular activity at the site of injury, by slowly infusing bupivacaine, also has a protective effect. Therefore, there is indication that local anesthetics may block the adverse effects of secondary tissue loss and improve recovery after injury. To translate prior research to a clinical setting, the present study will focus on understanding the conditions under which treatment of bupivacaine after SCI can reduce hemorrhage and improve locomotion. The project will explore how efficacy varies with the duration of

treatment by treating moderate spinally contused rats at the T11-12 level with bupivacaine or vehicle for 1.5, 3, 6, or 12 hrs. Acute locomotor recovery of subjects and hemoglobin levels around the site of injury will be examined. We hypothesize that 6 hours of treatment will be sufficient to reduce the secondary effects of SCI.

Poster #6

Religious Belief in Space: The Significance of Land in the Development of Belief and Tradition

Aryn A. Bagley

Faculty Advisor(s): Prof. Wendi Kaspar

This thesis will explore the connection between a natural environment and the society it hosts. It will begin by broadly examining the way in which an environment influences religion, then the way a religion can affect a peoples' attitudes and interactions with their environment. Three facets of these effects will be looked into more deeply with specific examples of the social, political, and economic aspects of these interactions. Finally, the paper will explore examples of these themes in indigenous communities from across the globe. Discussions will be brought in as to why this is an important topic to explore in lieu of such factors as the current climate crisis; as well as a brief illustration on why culture shaking events like colonialism can be so detrimental.

Poster #7

Always Watching: Studying Surveillance through Facial Recognition Technology in the United Arab Emirates and Saudi Arabia

Claire Campbell

Faculty Advisor(s): Prof. Wendi Kaspar, Dr. Maddalena Cerrato

Understanding the surveillance environment of any given country can be very difficult as both the political and economic must be taken into consideration. This paper seeks to analyze said environment in the United Arab Emirates and Saudi Arabia, through the study of facial recognition technology (FRT). Two theoretical surveillance frameworks are used in which to help frame the material presented: the panopticon and the surveillant assemblage. Both frameworks are seen in FRT's implementation. The political and economic environment of the UAE and the KSA are examined respectively, then FRT's implementation at the public and private levels. As examined, these two countries share a similar history as both have authoritarian regimes that have heavily relied on surveillance in the past. In addition, both of these countries are extremely rich yet are also seeking to diversify their economies. It has been well documented that in the UAE, FRT has been used in law enforcement, banking, and retail. Meanwhile, in the KSA, FRT has been implemented throughout the Hajj experience, at both the private and public levels. Thus, FRT has allowed for these two countries to simultaneously surveil and expand economically, giving reason to its continued technological implementation as a mode of surveillance.

Poster #8

The Role and Mechanism of METTL14 in Angiogenesis

Reed Rivera

Faculty Advisor(s): Dr. Xu Peng

Angiogenesis, the process of blood vessel formation from preexisting vessels, plays a vital role in embryogenesis, organogenesis, and pathological conditions. Recent studies have shown the impact of mRNA modifications on the stability, degradation, alternative splicing, and translation efficiency of mRNA molecules. The most common mRNA modification, N6-methyladenosine (m6a), is conserved, reversible, and site specific. The modification is installed on mRNA molecules by methyltransferases known as “writers”. Among these â€œwritersâ€, methyltransferase-like 14 (METTL14) is a component of the complex, aiding in the recognition of sequences where the m6a modification is often installed. In the landscape of angiogenesis, vascular endothelial cells (ECs), serving as effectors and transducers of angiogenic stimulation, play a role in coordinating cell migration, proliferation, and apoptosis. METTL14 influences the installation of m6a and potentially impacts the mRNA molecules involved in the necessary processes of migration, proliferation, and apoptosis during angiogenesis. This positions METTL14 as a potential upstream regulator of various angiogenic processes. To understand METTL14's role, a vascular endothelial cell-specific knockout mouse line was generated. Preliminary data from this knockout revealed embryonic lethality before embryonic day 12.5, highlighting the nature of METTL14 in embryonic development. Subsequent whole mount staining of embryos from this cross unveiled disrupted blood vessel formation, indicating the role METTL14 plays in angiogenesis. To further explore METTL14's impact in angiogenesis, embryos from the knockout will be stained with proliferation and apoptotic markers and imaged with confocal microscopy.

Poster #9

Co-Design of Novel Electronic-Photonic Systems for Energy-Efficient Coherent Optical Interconnects

Heather Chang

Faculty Advisor(s): Dr. Samuel Palermo

Advancements in machine learning, artificial intelligence, and 5G are pushing the performance metrics in high-performance computing systems and data centers, making improvements in these systems' interconnect bandwidth density and energy efficiency essential. One potential solution is coherent optical interconnects that enable spectrally efficient quadrature modulation. This project develops a novel interconnect architecture with energy efficiency improvements by co-designing high-bandwidth CMOS front-end electronics and photonic devices. This poster will study the characterization of the high-bandwidth quadrature Mach Zehnder Modulators. This includes how they were simulated and characterized in the optical laboratory. Following the design of the optical component, the transmission electronic integrated circuit will be discussed. Specifically, this poster will focus on the design of the clocking unit and the injection-locked oscillator. Finally, the electrical and optical systems will be co-

simulated to ensure that the design works together and that the electrical system can properly adjust to different optical inputs. Overall, these contributions will be a part of a prototype that can support DP-QAM 16 modulation to allow 224 Gb/s at 28 Gbaud while designing with energy efficiency in mind.

Poster #10

Vascularized Ovarian Tumor Microenvironment-Chip: Modeling Cancer Resistance Against Anti-VEGF Therapy

Ashley Chuong

Faculty Advisor(s): Dr. Abhishek Jain

Angiogenesis is a complex process involving the formation of new blood vessels from existing ones driven by proliferation, migration, and differentiation of endothelial cells. Researchers have been studying the components that regulate angiogenesis under different pathological conditions to identify specific angiogenic modulators for targeted treatments. For instance, many cancer therapies aim to arrest angiogenesis to reduce the growth of tumor microvasculature and subsequently stifle metastasis. In this study, we have engineered an angiogenesis-enabled tumor microenvironment-on-chip (aTME-Chip) model to recapitulate the convergence of angiogenesis physiology in the absence and presence of ovarian cancer. The model was used to observe the effect of an anti-angiogenic cancer therapy, Bevacizumab, and the consequences of drug removal post-treatment. Our results showed in an aTME-chip, angiogenic sprouting was observed with and without ovarian cancer in the system. The presence of ovarian cancer in the chip resulted in an increased amount of angiogenic sprouting when compared to chips without. Upon exposing the aTME-Chip to Bevacizumab treatment, we observed retrogression of angiogenic sprouts in the aTME-Chip. Upon removal of the drug from the system after 48 hours, a relapse in angiogenesis was noted in devices with ovarian cancer. We have quantified angiogenesis using sprout vessel area as the quantification metric and made three distinct observations with our platform. First, when ovarian tumor spheroids are introduced, they increase the proangiogenic activity of the aTME-chip. Second, the presence of Bevacizumab within the aTME-chip negatively impacts the existing angiogenesis. Third, the removal of Bevacizumab results in the resumption of angiogenesis in the chip.

Poster #11

Machine Learning for Muon Reconstruction at CERN

Jessica Williams

Faculty Advisor(s): Dr. Alexei Safonov

The Large Hadron Collider (LHC) at CERN is undergoing increases in luminosity, meaning more data will have to be processed at high speed. At the Compact Muon Solenoid (CMS), triggering algorithms discard much of the data as not all of it can be kept. Machine learning has been used for higher level reconstruction and analysis of sets of particles, but on the level of individual tracks of particles classical algorithms are used. The necessity of real-time computing and ability to implement machine learning models in FPGAs presents the opportunity to use machine learning for improved muon detection and classification. We investigate machine learning for muon segment and transverse momentum assignment in ME0 as part of the Level One Trigger. A small, simply connected network discriminates between background and muon sets of detector hits with 99% accuracy. We also investigate assignment of momentum to muons, as high transverse momentum can be a sign of interesting physics and a useful parameter for higher level decisions. We then analyze considerations for performing quantum machine learning on a similar dataset.

Poster #12

LIDAR Measurement of Atmospheric Profiles with an Atomic Cesium Vapor Cell

Rahul Ayanampudi

Faculty Advisor(s): Dr. Richard Miles

The main objective of the project is to identify novel approaches to the measurement of atmospheric properties. The intention is to explore the possibility of using advanced injection locked laser technology and atomic vapor filters to measure atmospheric profiles. This project is a follow on to the NASA University Leadership Initiative (ULI) and will establish capabilities for flight testing of our LIDAR system on a pod carried by a modified NASA F-15 jet. The research challenge is to determine methods to separate spectral properties of the LIDAR scattered return from air molecules in the presence of background scattering from particles and clouds. To accomplish this, the team will develop new atomic prism techniques. A particular interest is the use of cesium atomic vapor together with a laser operating in the ultraviolet spectrum, close to a cesium resonant transition. By using a prism cell with a dispersion augmented by the cesium resonance, very significant spectral selectivity is expected. Since the injection locked laser operates with very small spectral line width, the spectrum of the light scattered from the air molecules can be analyzed to determine the spectral broadening, which is associated with the thermal motion of the molecules themselves. Therefore, the prism is expected to enable the measurement of the spectral broadening as a function of the temperature of the atmosphere. This information will be used to determine the feasibility of using dispersion filters to measure atmospheric profiles and predict the perceived level of the sonic boom on the ground created by the F-15.

Poster #13

SigmaShortcuts: Using Keyboard Shortcuts for Efficient Digital Notetaking

Caleb M Oliphant

Faculty Advisor(s): Dr. Tracy Hammond

One of the many challenges surrounding Engineering Education is integrating digital tools and resources with mathematics. For students who struggle with producing legibly handwritten work, the option to take notes and assessments using only digital tools may be a preferred option. The challenge for these students is that the contexts where such tools are needed, such as in exams and lectures, are heavily time constrained, and require time efficient note taking. Many existing solutions for generating mathematical text without handwriting suffer from slow notetaking experiences because of needing to use a mouse or having to type verbose and complex syntax. To address these problems, a math notetaking web application designed with speed in mind was developed. The approach to prioritizing speed without sacrificing intuition was an interface with many keyboard shortcuts that are clearly communicated to the user. The speed at which expressions could be typed for this application will be tested alongside other digital math notetaking applications, and user feedback on the experience will be collected.

Poster #14

A Magnet Tracking Platform Optimized for Stylus Movement

Kevin Champagne

Faculty Advisor(s): Dr. Tracy Hammond

Magnet tracking is a fast and accurate method of tracking an object without relying on visual information or sight of the object. In this study, we create a platform that performs magnet tracking specifically for a stylus, estimating its position and orientation over time. The platform is composed of a grid of magnetometer sensors, and the stylus has a cylindrical permanent magnet embedded in its center. We apply optimizations specific to stylus movement over a platform, such as determining the best way to represent the orientation of the stylus, and using the earth's magnetic field to track the platform's rotation in case it is moved (thus, it needs no calibration). We measure the speed and accuracy of the system by tracing objects with known measurements. We observe how various factors affect the speed and accuracy, such as the number of sensors used, the positions of the sensors, and the distance of the stylus from the sensors. We further show the potential application of our platform as an educational tool. Visualization and 3D imagination abilities are essential within the fields of science and engineering, and our technology could help strengthen those skills. We created a program that displays the stylus within a virtual 3D scene once its position and orientation are calculated. Furthermore, we calculate the position of the tip of the stylus, and provide the user with a button that enables a "pen tool" in the program. The user can choose to either "paint" the scene with lines or voxels (small cubes). Further studies are needed to show how this program could help teach visualization skills to its users.

Poster #15

Gravitational Lumen Patterning of Complex Vascular Architectures: Fabricating Collagen Embedded Lumen for Modeling Spatially Intricate Blood Vessels

Jennifer Lee

Faculty Advisor(s): Dr. Abhishek Jain, Dr. Tanmay Mathur

The human vascular system exhibits significant diversity and heterogeneity of lumen shapes and sizes. Within the vasculature, blood vessels display a range of diameters as well as variations in vessel architecture, for example, aneurysms, stenosis, tortuosity, branching etc. The complex architectures of these vessels result in altered hemodynamics and subsequently endothelial cell phenotype, which cannot be recapitulated with uniform blood vessels. Hence it is important to incorporate the spatial variations that exist in vivo and fabricate physiologically relevant, complex embedded lumen. Gravitational Lumen Patterning (GLP) is a surface tension and pressure driven biofabrication technique that has been employed in vascular organ-chip research to create simple, uniform cylindrical vessels that are embedded in collagen. The hypothesis was that the shape of the patterned collagen lumen is dictated by the shape and size of the external microfluidic channel. It was observed that using GLP in different external microfluidic channels, it is possible to generate vessels with aneurisms, stenosis, branches, tortuosity, and varying widths. This study demonstrates a simple yet powerful application of the GLP biofabrication technique to create vessels with spatially complex architectures. These vessels closely mimic the structural variations that are observed in vivo and can eventually be used to investigate vascular complications like aortic aneurysm, atherosclerosis, and carotid artery etc., where vessel architecture plays a crucial role in disease onset and progression.

Poster #16

Engineering Synthetic Protein Binders to Hepatitis C Virus Core Antigen

Sam Vrana

Faculty Advisor(s): Dr. Zhilei Chen

While the current state of Hepatitis C virus (HCV) testing includes reliable antibody and viral RNA tests, it lacks a valuable tool — a rapid, single-step viral antigen test. Previous work conducted by a collaborating laboratory involved the design and validation of a rapid, low-cost, and portable diagnostic tool that uses synthetic nanobody-functionalized gold nanoparticles for the detection of other relevant viral antigens. To build on this work toward a goal of specializing it for a potential HCV antigen test, I attempted to discover novel Designed Ankyrin Repeat Protein (DARPin) binders of HCV core antigen by using directed evolution. DARPins, which are stable antibody-like proteins, can recognize targets with high specificity and have affinity to targets equal to or surpassing that of antibodies. By starting with a vast library of DARPin variants and successive rounds of biopanning that specifically select DARPins targeting HCV core antigen, I hoped to produce a set of high affinity binders. To be able to conduct these biopanning rounds, a sufficient supply of HCV core antigen was required. This demand was met by developing an efficient method for the recombinant expression and purification of the antigen. The novel DARPin

binders produced in this process could then be used in conjunction with the nanoparticles and the readout system for the development of an effective, inexpensive, and rapid HCV core antigen test.

Poster #17

Guardians of Prosperity and Development: Unraveling the Nexus Between Constitutional Property Rights and Foreign Direct Investment

Joshua Hillman

Faculty Advisor(s): Dr. Chelsea Strickland, Dr. Natalia Pakhotina

This research explores the impact of constitutional property rights on foreign direct investment inflows in 160 countries over the period from 1995 to 2022 by implementing econometric regression analysis. Foreign direct investment benefits a country's economy by providing stable investment into human and other capital inputs and by spreading the best corporate governance practices, accounting rules, and legal traditions. These listed advantages have increased its popularity across countries in previous decades, motivating countries to pursue policies to attract such investment. This study aims to derive the significance of an efficient legal system in attracting foreign investment. A property rights index serves as a proxy for a country's legal system efficiency and effectiveness, as the clear allocation of property rights is a critical component to achieving economic efficiency. The analysis derives a statistically significant positive relationship between constitutional property rights and foreign direct investment when controlling for macroeconomic conditions, infrastructure quality, and openness to trade. The relationship is impacted by the geographic region of the country; notably, Europe produces the largest magnitude of coefficients relative to other geographic regions. Moreover, the national income level of the country affects the nexus of interest, as the developed, wealthiest countries yield the largest coefficients relative to less wealthy countries. Given these findings, this study offers empirical evidence for countries to adjust their legal framework to offer stronger protection for property rights; such action will theoretically enhance the country's ability to attract international resources and stimulate domestic economic development.

Poster #18

Cricket Song Analysis using Deep Learning Techniques for Species Clasification

Varun Somarouthu

Faculty Advisor(s): Dr. Yoonsuck Choe

The situational singing of the Gryllus genus species can produce different songs. The primary objective of this research includes developing precise species classification methods based on songs and creating visualizations in low-dimensional space to uncover connections between species and their defining song patterns, ultimately contributing to our knowledge of cricket behavior and providing tools for conservation efforts. In this research, I will use deep learning techniques for cricket species classification based on their songs and visualize their relationships within a high-dimensional feature

space, aiming to better understand distinct cricket species' distribution patterns, where each song corresponds to a point in this multidimensional space. Feature space refers to the space in which data is represented by their features or attributes. Each feature corresponds to a dimension in this space. The "high-dimensional feature space" refers to a space where each dimension represents specific attributes extracted from cricket songs, such as pitch, frequency, and duration. Conversely, the "low-dimensional space" involves reducing the complexity of the feature space to make data more manageable for visualization and analysis while retaining essential information. My research will be focused specifically on species-level categorization, which builds upon previous genus classification and provides precise differences between the Gryllus species. While crickets of the same species typically share common characteristics in their songs, there can be variations in the songs produced by individual crickets, making it a much more intricate task to analyze species than genus. This study is significant for biodiversity monitoring and monitoring individual cricket species.

Poster #19

Reinforcement-Learning-Based Controls for UAS Gust Disturbance Rejection in Realistic Ship-Based Environments

Akshaj Kumar

Faculty Advisor(s): Dr. Benedict Moble

With the development and growth of autonomous Unmanned Aerial Systems (UAS), it is essential that their use in naval applications is created to be as safe as possible in their interactions with personnel-laden ships. This paper investigates the creation of a model machine-learning-based control system for a real UAS to safely land on a realistic ship platform. This precision landing will be presented with an algorithm using a completely vision-based system to land on a pitching, rolling, and heaving on a model ship platform utilizing solely a heaving, horizon-fixed bar as a visual reference. The horizon bar is based on and resembles actual bars that Navy pilots use to land VTOL aircraft by sight. First, the machine-learning algorithm is presented for distances at which the horizon-fixed bar may be unable to be distinguished. Then, the computer-vision algorithm is presented for distances at which the horizon-fixed bar is indeed able to be distinguished. Special consideration is given to correcting for the heaving motion of the platform and horizon bar. Finally, a Parrot ANAFI drone equipped with only a single gimbaled camera is used to conduct flight tests to validate the efficacy of the algorithms in both controlled and uncontrolled flight environments.

Poster #20

Impact of Circadian Rhythm Dysregulation on the Brain-Gut-Immune Axis

Ella Barnum

Faculty Advisor(s): Dr. Karienn A. Souza, Dr. David Earnest

Circadian clocks in the body coordinate biochemical, physiological and behavioral processes. Circadian synchronization to 24-hour solar cycles ensure events occur at proper times. Desynchronization via shift work, jet lag and other factors has been tied to various pathologies (stroke, cognitive aging). The mechanism by which circadian dysregulation affects human health is currently unknown. Recent studies suggest immune cell activation and inflammation may be important in mediating pathophysiological dysregulation effects. We hypothesize that gut permeability and microbiota shifts are key agents by which shift work-induced circadian dysregulation promotes inflammation and pathological outcomes. Using a shift work-like light-dark schedule, we aimed to find if rodent desynchronization alters gut microbiome and barrier integrity. Long-term dysregulation effects were tested in mice and rats exposed to either a regular “fixed” or “shifted” LD 12:12 cycle (12hr advance/5d) for 80d before both groups were kept on the regular cycle for 7 further months. Circadian rhythm entrainment was analyzed, and upon conclusion animals were euthanized with tissue/fecal samples collected. Ileum gut architecture rapidly changed after desynchronization. Gut morphology in shifted LD animals appeared “injured”, with shorter/wider villi than in fixed controls. Combined with gut barrier integrity effects, circadian dysregulation altered gut microflora composition; shifted animals had greater Firmicutes/Bacteroidetes ratios, a gut dysbiosis marker, and reduced microbial diversity, a gut health measure. These results advance understandings of how gut barrier permeability and dysbiosis interact with other factors to impair stroke outcomes and accelerate cognitive aging via circadian dysregulation.

Poster #21

Analyzing Novel Therapeutic Agents for Treatment of Mycobacterium tuberculosis Infection

Michael Lord

Faculty Advisor(s): Dr. Junjie Zhang

An estimated 10.6 million people fell ill from tuberculosis (TB), and of that number, 1.6 million died in 2021. TB infection is the leading cause of infectious disease conferred by one pathogen known as Mycobacterium tuberculosis (Mtb) which has the tendency to evolve into multidrug-resistant TB (MDR TB) and extensively drug-resistant TB (XDR TB) after treatment failure. Treatment of TB infection usually requires a strict drug regimen which starts with a two-month intensive phase of four first-line drugs (isoniazid, ethambutol, rifampicin, and pyrazinamide), followed by a four-month continuation phase (isoniazid and rifampicin). With these emerging points in mind, there is a need for a new class of antibiotics that can target pathways essential for Mtb cell survivability. One such vulnerability lies within a subclass of ABC transporters known as ABC-F (ATP-binding cassette F) proteins. Several ABC-F proteins bind to the Mtb ribosome using ATP and resume translation by facilitating the removal of ribosome-

targeting antibiotics, which are termed antibiotic resistance (ARE) ABC-F proteins. However, there exists a non-ARE ABC-F protein within Mtb that has been shown to play a role in regulating translation elongation and is essential for Mtb survival. This protein is homologous to the previously characterized EttA (elongation-throttle protein A) in *E. coli* which will be termed MtbEttA for simplicity. By using molecular docking studies, several drugs have been designed that represent a new class of antibiotics that can occlude the ATP-binding site of MtbEttA to compete with its ribosomal-binding activity. The activity of these antibiotics was analyzed against planktonic cell growth, biofilm growth, and dormant cell growth of the surrogate Mycobacterium smegmatis (Msm).

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

Room: MSC 2300 C

Poster #1

Medication Abortion Access in the United States

Yilin Li

Faculty Advisor(s): Dr. Chelsea Strickland, Dr. George Naufal

The abortion access landscape has changed drastically in the last five years. There are competing forces: increased access to modern medicine with telemedicine and restrictive state legislation and the overturning of Roe v. Wade. This paper analyzes the nuances of the complicated landscape to understand how telemedicine has proliferated and reduced trips taken to an abortion clinic. We conduct a difference in difference model using monthly U.S. county data that estimates the distance from nearest abortion data and trips taken in each U.S. county.

Poster #2

RFID PC Passkey System

Colton Rhoades

Faculty Advisor(s): Dr. Oscar Moreira

Many Radio Frequency Identification (RFID) systems in use today are insecure since they function in a way that the tag sends the same signal to the reader every time it is read. This means that someone could easily copy the tag and use it to beat the system. This research attempts to design an RFID system that cannot be easily copied. This system will implement two-way communication so that the reader will send a test signal to the tag this ensures that the tag will not always respond in the same way. The tag will then respond with it's own unique response to the test signal. All communications will be encrypted to prevent anyone listening in on the communications from gathering any useful information. The communication from reader to tag will use frequency modulation and the tag to reader will use load modulation. The system will operate on a 13.65 MHz frequency. So far, I have finished designing most of the signal transmission subsystem which includes the oscillators, modulators, amplifiers, and demodulators for the reader and tag. I have also designed some of the power supplies. What's left of the design is the microcontroller subsystem, the rest of the power supplies, and the software.

Poster #3

Portrayal of Hispanics' Health in the Media

Yulissa Rodriguez

Faculty Advisor(s): Dr. Stephanie Kirkland

This project will examine how different health disparities within the Latino community are viewed from the perspective of the media. The media has played an integral role in providing information to the nation over the last several decades. Thus, it is vital to understand what true role media plays in presenting public health issues specific to the Latino community. This media can be in the form of popular news outlets, social media applications, and television programs. The purpose of this project is to determine how the health of Hispanics is portrayed in modern society. Upon accomplishing this, we will be able to understand how to address some health concerns in this population of individuals. This will also help influence the passing of laws that will help this group of people obtain better health resources to improve their overall well-being of life for both themselves and their families. We will also be able to understand which specific barriers impede the communication that is given about Hispanic health. By having a deeper knowledge of these additional problems, we can work towards addressing them at the local, state, and national levels while simultaneously learning how to accurately inform the public on health issues in the Latino community.

Poster #4

Computational Fluid Dynamics Analysis of Pulmonary Hypoplasia for Greater Risk Stratification

Jackson Roberson

Faculty Advisor(s): Dr. John D. Horn

Hypoplastic lung syndrome, or pulmonary hypoplasia, is a congenital abnormality in which the lung does not fully develop. Given the critical importance of lung function, this is usually a significant threat to the newborn once they begin to breathe on their own. Currently, a metric known as the lung-to-head ratio (LHR) is used to assess the severity of lung hypoplasia. While the LHR metric is useful, it falls short when distinguishing outcomes for a wide range of cases between the highest and lowest severity of the condition. Given the accessibility of non-invasive and non-ionizing imaging modalities, we investigated how a computational approach using pulmonary geometry derived from the fetal patient could yield a more precise risk stratification. Since lung function is tied directly to gas exchange in the bloodstream, we isolated the pulmonary arteries to simulate blood flow. Real patient imaging and anatomical structures were obtained from open source repositories and from fetal and neonate MRIs provided by Texas Children's Hospital. Computational fluid dynamics was then utilized to simulate blood flow within the pulmonary arteries. The inlet boundary conditions were determined based on patient-derived flow profiles, and the distal vasculature was approximated by using a lumped parameter model. We anticipate the results indicating that the resolution of the imaging modality will make it difficult to accurately and properly segment the fetal vascular geometries. Despite this, we hope that simulations

done on the geometries of one day old neonates will yield outputs that allow for better stratification of outcomes, and justify obtaining higher resolution medical imaging in utero for analysis before birth.

Poster #5

Emotional Upregulation in High and Low Stress Environments: An ERP Study

Tara M. Driskill

Faculty Advisor(s): Dr. Annmarie MacNamara

Savoring is an emotion regulation technique focused on experiential and perceptual awareness, in which individuals focus on and try to increase positive emotion elicited by stimuli. Evidence from controlled laboratory settings indicates that savoring is effective at increasing and sustaining positive emotion. Nonetheless, the real world is more chaotic, distracting and stressful than these controlled settings. Therefore, the present study aimed to create a higher stress experience that challenged the ability to savor positive and neutral pictures. We used the late positive potential (LPP), an electroencephalographic event-related potential that is larger for emotional compared to neutral stimuli, as well as self-reported valence and arousal to measure emotional response to pictures. Participants were English speaking students at Texas A&M 18 years and older (N = 78) who were randomly assigned to one of two groups. In one group (high stress, n = 39), participants performed a difficult math task prior to savoring positive and neutral pictures. In the other group (low stress, n = 39), participants performed a simple math task before savoring pictures. Results showed that participants were able to savor neutral (LPP) and positive (LPP and ratings) pictures, but that this was not compromised by the difficult math task (i.e., there were no interactions involving group and condition). There was, however, a significant effect of group, where overall LPP was smaller in the hard math group versus the low math group. Results suggest that savoring may be effective even in high stress environments. Nonetheless, stress may lead to overall reductions in individuals' ability to attend to salient, external stimuli.

Poster #6

An Analysis of Bone Tools from Hall's Cave, Texas

Willow Grote

Faculty Advisor(s): Dr. Michael Waters

The Hall's Cave, Texas site (41KR474) has had an episodic history of human occupation for over 10,000 years. The site has been extensively studied by archaeologists as the absolute dates provided by the cave's preserved soil record have bridged many gaps in lithic tool typologies for the Central Texas region. However, the bone tools found during the excavation have not been analyzed in any way. This research intends to glean as much information from the tools as possible from non-destructive analysis. Through quantitative and qualitative analyses, the use and origin of the bone tools found at Hall's Cave will help give archaeologists a deeper understanding of the activities Native Peoples engaged in at this site.

Poster #7

Investigating the Influence of Surface Roughness on Corrosion Behavior in 3D-Printed Metals in Seawater Environments

Hemayan Mohamed A M Al-Malki

Faculty Advisor(s): Dr. Marwa AbdelGawad

This research explores the intricate relationship between microstructural defects, specifically focusing on the surface roughness defects, and the corrosion behavior of additively manufactured (AM) stainless steel 316L (SS 316L). SS 316L material is renowned for its exceptional properties, highlighting its contribution to various industry applications. However, defects introduced during the AM process of the SS 316L part can compromise its corrosion resistance. This study investigates the corrosion behavior of selective laser melting (SLM) AM SS 316L components with varying surface roughness levels in a 3.5 wt.% NaCl solution, representing a corrosive seawater environment condition. The corrosion behavior of the sample was tested quantitatively and qualitatively, using a weight loss experiment, and by examining the microstructure of the sample using both optical microscopy (OM) and scanning electron microscopy (SEM). The surface roughness was varied by changing various parameters within the printing process of the tested samples. By systematically examining the corrosion behavior of the SS 316L samples under different surface roughness conditions, the study aspires to enhance the understanding of how microstructural defects influence the durability and reliability of 3D-printed metal applications. This research contributes valuable insights that have the potential to drive advancements in the production of corrosion-resistant AM SS 316L components.

Poster #8

Assessing Impact of Recycling Cycles on Pet Plastics Manufactured in Qatar

Ahmed Ahmed, Jad Abi Almona

Faculty Advisor(s): Dr. Marwan Khraisheh

This experiment focus is environmental and industrial implications of recycling Polyethylene Terephthalate (PET) in Qatar, a critical step in addressing plastic pollution and global warming. The research hypothesized that repeated recycling cycles degrade PET's mechanical properties. In the primary phase, a two-by-two factorial design was used with the two factors being Temperature profile and Number of recycling cycles. The secondary phase was a two-by-three factorial design which was used to evaluate mold temperature (30, 40, 50°C), the added % of Virgin PET (0%, 15%, 30%), and the number of recycling cycles (1-3). The procedure of this experiment consisted of cleaning, shredding, mixing vPET, injection molding, and tensile testing the PET specimen. Tensile tests corresponding to the ASTM standard D638 which assessed the Yield Strength and Young's modulus of PET specimens. The primary phase results showed that the highest yield strength, 0.026GPa, was at temperature profile 1 for PET recycled once. The lowest yield strength, 0.007GPa, was at temperature profile 1 for PET recycled twice. The Young's modulus highest value, 3.334Gpa, was at temperature profile 2 for PET recycled twice. The secondary phase results showed that the highest yield strength, 0.041GPa, was at a

mold temperature of 30°C, with 30% added virgin PET, recycled once. Conversely, the lowest yield strength of 0.008GPa was observed at a mold temperature of 30°C with no Virgin PET added and after three recycling cycles. The highest Young's Modulus recorded was 4.272GPa under conditions of a 50°C mold temperature with no virgin PET added after three recycling cycles. These findings highlight the significant impact of recycling cycles on PET's mechanical properties.

Poster #9

Impact of Mito-PstI Tool on Surrounding Neurons in the Hippocampus

Alan Ta

Faculty Advisor(s): Dr. Mendell Rimer

In the context of Alzheimer's Disease, the role of astrocytes is not yet fully understood. Astrocytes can become reactive in the response to neurodegeneration or injury, a phenotype which leads to the release of growth factors and other molecules. Astrocyte dysfunction greatly impacts neurons in the brain as astrocytes transfer mitochondria to neurons and supply the building blocks of neurotransmitters. In this study, a novel adeno-associated virus (AAV) tool is used to specifically ablate astrocytic mitochondria and impair their function in a mouse model. To do so, the mouse hippocampus will be injected with the tool, and after an incubation period, will subsequently be sectioned and immuno-stained. Fluorescent images will be taken on a slide-scanner confocal microscope and analyzed in the program QuPath. By characterizing the effects of the tool on astrocytic mitochondria and the surrounding neurons, we can gain more knowledge on the effects of mitochondrial and astrocytic dysfunction with regards to Alzheimer's Disease. At 8 weeks old, male and female mice were given a stereotaxic injection of either the control GFP tool or both the Pst1 restriction enzyme and control tools. Following a 3 week (or 6-week for a hold study) incubation period, the animals were sacrificed and perfused. Once extracted, the brains were placed in formalin and later submerged in a sucrose solution. The brains were then cryosectioned to retrieve 40 micron-thin slices of the Dentate Gyrus (DG) region of the Hippocampus. Immunohistochemistry antibody staining was then performed. The antibodies used stained DAPI, or cell nuclei, NeuN, a neuronal marker, and DCX, a neurogenesis marker. Fluorescent images were taken on a slide-scanner confocal microscope and analyzed in the program QuPath.

Poster #10

Assessing the Efficiency and Accuracy of Large Language Models in Reverse Engineering

Jonathan Peng

Faculty Advisor(s): Dr. Guofei Gu

The rapid evolution of cyber threats necessitates advanced techniques for the analysis and understanding of binary malware. Traditional methods, such as static and dynamic analysis, have proven valuable but face inherent limitations. This research investigates the accuracy of Language Models

(LLMs) in the context of reverse engineering binary malware. The primary objective is to assess the extent to which LLMs can contribute to the efficacy of malware analysis. Building on a foundation of existing research in malware analysis and the application of Language Models in cybersecurity, this study employs a carefully curated dataset of binary malware samples. A rigorous experimental setup, utilizing state-of-the-art tools for reverse engineering and LLMs, is designed to evaluate the performance of these models. Evaluation metrics, including precision, recall, and F1 score, provide a quantitative basis for assessing the accuracy of LLMs in comparison to traditional analysis methods. The results reveal insights into the capabilities and limitations of LLMs in reverse engineering binary malware. Comparative analysis with traditional methods highlights the potential strengths and weaknesses of LLMs in this domain. Interpretation of the findings, encompassing unexpected outcomes and potential influencing factors, adds depth to the understanding of the research. As the cybersecurity landscape continues to evolve, this research contributes to the ongoing discourse on leveraging advanced language models in the fight against malicious software.

Poster #11

Exploring large Language Models in Zero-Shot Recommendation Systems

Michael Norman

Faculty Advisor(s): Dr. James Caverlee

Recommendation systems are crucial in allowing users to discover relevant content for their queries with an ever-expanding number of options available. As the volume and diversity of items to recommend continues to grow, traditional recommendation systems face challenges in keeping pace with the demand of users. Because of the general knowledge these models are trained on, large language models require less user-specific data than traditional recommendation systems to personalize the recommendations to the user. Also, the inherent natural language processing abilities in large language models, enabling models to make unforeseen connections and better understand the user's information needs without explicit training. One challenge in combining large language models and recommendation systems includes attempting to recommend items the large language models have not been trained on such as a new movie and using a model trained prior to its release. Another challenge is dealing with the slow inference times in large language models, leading to wait times when attempting to run in real-time with user data. These difficulties can be addressed by supplementing the model with data from external sources to allow the model to make informed recommendations on items released after the date the model was trained. This thesis proposes a new approach to integrate large language models into recommendation systems in a live setting utilizing strategic prompting methods. The proposed method aims to increase the accuracy and personalization of recommendations while requiring less historical data from users. An empirical testing framework was developed to compare different recommendation methods using live data from users' Netflix pages against the recommendations made by Netflix itself.

Poster #12

Optimization of Process Parameters for Additive Manufacturing of Polymers

Hala Samir Al-Mughanni, Jodi Jarrar, Ghalya Al-Emadi

Faculty Advisor(s): Dr. Eyad Masad, Dr. Marwan Khraisheh

Polyethylene (PE), known for its desirable mechanical properties, faces challenges in additive manufacturing (AM) due to issues like excessive shrinkage and poor adhesion. This research presents a framework to upcycle PE waste into valuable feedstock for fused deposition modeling (FDM), addressing sustainability in materials and manufacturing processes. Low-density PE (LDPE) and high-density PE (HDPE) pellets, categorized as industrial waste, were sourced from Qatar Petrochemical Company (QAPCO). To improve PE's printability, we blended Pre-puff Polystyrene (PS) beads with varying ratios of LDPE and HDPE. A 5 wt% addition of styrenic block copolymer (SEBS) was used to ensure blend compatibility and homogeneity. After blending the constituents in a twin-screw extruder, the blends were granulated, dried, and extruded into standard 1.75 mm filaments using a 3DEVO Composer 350. Filament quality was evaluated using tensile strength tests, filament roundness, and printing trials, which involved printing a single perimeter cube with a 0.6 mm nozzle at various temperatures. This helped identify the optimal blend for FDM before examining the effect of FDM process parameters. We varied two FDM process parameters, specifically nozzle diameter (0.4 to 0.6 mm) and nozzle temperature (240 ℃ to 260 ℃), on the printed object's dimensional accuracy, shrinkage, warpage, and mechanical properties. Our findings illuminate the significant role of AM in promoting sustainable manufacturing practices and enhancing material properties, marking a step forward in the utilization of recycled materials in advanced manufacturing processes.

Poster #13

Investigating Users' Engagement with a Digital Coaching Tool for Mental Health Self-Management

Abby Somich

Faculty Advisor(s): Dr. Farzan Sasangohar

Mobile health apps are increasingly being used to self-manage various health conditions. However, retaining high levels of user engagement with these technologies remains a challenge. This research aims to investigate the magnitude of college students' engagement with a mental health self-management mobile health app. The data from a previous study meant to assess the efficacy of the app was used. Statistical modeling and machine learning techniques were used to determine relationships between engagement behavior, mental health outcomes, and health beliefs. First, the best predictors of engagement were determined using random forest feature selection. Then, the top predictors were used as inputs for a generalized linear model, random forest, and support vector machine model to predict engagement with the app's features throughout the study. From preliminary analysis, top predictors of engagement include academic departments, pre-intervention scores from the General Anxiety Disorder – 7 diagnostic test, self-efficacy, pre-intervention scores from a modified version of the

Patient Health Questionnaire – 9, and students' academic class level. After optimizing the models, the expected results will reflect minimized root mean squared error metrics. By understanding variables that predict engagement with a mental health self-management tool, such mobile health apps can be designed accordingly to maximize user engagement.

Poster #14

Changes Over Time in Benthic Foraminiferal Assemblages in Carancahua Bay

Anna Marie Mozisek

Faculty Advisor(s): Dr. Christina Belanger

Changes in foraminifera assemblages observed in sediment cores, including changes in diversity and the relative abundance of species, can indicate overall health of the estuaries. Additionally, these changes can be compared to mercury content, a proxy for human influences, in the core to test whether ecological changes occur with this increasing stress. In my research, I will examine a total of 14 samples from a core from Carancahua Bay (CAR-1), creating a time series of ecological change throughout the core. I will examine the relative abundance of three foraminifera taxa, Ammonia, Elphidium, and Quinqueloculina, as well as ostracods, to determine the diversity in the assemblage. Morphological differences in taxa throughout the core may also give indications of the health of the area, given larger specimens are expected when individuals are better able to thrive. As human influences have increased in the bay, I expect diversity will decrease towards the top of the core as well as smaller specimen size.

Poster #15

CARS or the Cognitive and Affective Reinforcement Study

Griffith Greenwood

Faculty Advisor(s): Dr. Albanese Brian

The purpose of this study is to understand the neural processing of differential reward content to include (monetary, relief of an aversive stimulus). With this information, we are trying to determine how this may influence and in turn be influenced by other neurobehavioral mechanisms. This includes cognitive control, sustained attention towards both rewarding and threating stimuli and negative reinforcement learning. With the thought process that relief of an aversive stimulus is an understudied form of reward that has broad implications for PTSD, depression, substance use disorders and anxiety. This in turn can provide a more in-depth understanding by collecting and calibrating the measurement of relief responses in healthy controls. The data collected within this study is gathered through several different means, with our initial four tasks Doors, Go/no-go, Flankers and Pictures. While these are reactions tests where the lab is monitoring the participants movements, seniors, heart rate, eye tracking movements and depth survey to be completed before moving forward. Each task is presented from a predetermined list the tasks are given in a controlled/ random order. Implications Anxiety-related disorders, including PTSD, are amongst the most common psychological disorders and yield considerable burden among those affected. The CARS study has the potential to bring light to the underlying

mechanisms driving negative reinforcement learning among healthy individuals. This information will in turn inform why some people engage in maladaptive, negatively reinforced behaviors more frequently and try to provide critical insights into risk for multiple anxiety-related forms of psychopathology and ultimately inform the development of targeted interventions.

Poster #16

Periodate Oxidation of High Amylose Starch for Biomedical Application

Jacob Aragon

Faculty Advisor(s): Dr. Akhilesh Gaharwar

The purpose of this project is to investigate how high amylose content in starch affects the properties of starch biomaterials. Starch is a natural polymer that is made of chains of both amylose and amylopectin. High amylose starch (HAS) is an eco-friendly, biodegradable, biocompatible, abundant biopolymer that can be utilized in various biomedical applications. High amylose content reduces the ability of starch to swell, which in turn reduces solubility in atmospheric conditions. The objective of this study was to create a process to functionalize the HAS through periodate oxidation, which requires the solvation of HAS. To achieve this goal, several methods were compared, ultimately landing on the use of a pressure reactor to maintain the conditions required to complete the oxidation. Oxidation modifies the starch by converting the hydroxyl groups to aldehyde groups. Through varying the amount of oxidizing agent added, a range of aldehyde percentages were determined through acid base titration. Understanding how the ratio of oxidizing agent to HAS monomer units affects the extent of aldehyde conversion will allow for better control and understanding of polymer properties. The functionalized HAS can ultimately be used to create a scaffold for regeneration, drug delivery, and bioprinting.

Poster #17

Hurricane Harvey and its Differential Market Effects Across Industry and Region

Shreyush Shankar, Emily Lightfoot

Faculty Advisor(s): Dr. Chelsea Strickland, Dr. Fernando Luco

Hurricanes have become stronger, more dangerous, and more common in recent years. This has harsh economic impacts on afflicted places; we analyze one of these channels. We research how Hurricane Harvey impacted business dynamism in multiple urban centers in the affected regions of Texas on a time horizon from 2013 through 2019. We do so using extremely detailed water level data from FEMA and a panel dataset containing firms and important benchmark characteristics regarding these firms. By tracking when these firms closed from 2013 until 2017, we establish a baseline rate of exit, which we compare to the rate of exit from 2017 to 2019 to determine how Hurricane Harvey impacted firm decision-making. We also analyze how this changes based on a firm's industry, type of business, region, and the amount of water they were subjected to during Hurricane Harvey. This allows us to determine which industries are more resilient and which fail quickly when faced with dangerous natural disasters. We find that water level strongly impacts a firm's decision to exit the market. However, this effect is

limited to certain industries - we found that restaurants are extremely sensitive to water levels, while grocery stores exhibited some resilience, and gas stations virtually remained the same. We believe that gas stations' lack of responsiveness is both a function of their product being stored in a way that mitigates flooding damage and consumers' inelasticity with regard to consuming gas.

Poster #18

Development of a Microfluidic Testbed Array for Impedance Measurement

Hasan A. Dhanji

Faculty Advisor(s): Dr. Arum Han

The present study includes the development of a corrosion-based interdigitated electrode microfluidic impedance sensor for detection microbiologically induced corrosion causing bacteria, as well as subsequent stages that allow for live cell filtration and cell counting and single cell analysis in a microfluidic medium. The interdigitated electrodes on the corrosion-based impedance sensor are tested with various designs including the electrode arrangement as well as the deposited material. A microfluidic device is microfabricated and corrosive chemicals are tested on corresponding electrode materials, such as hydrogen sulfide on stainless steel. The impedance change over time is documented by an impedance analyzer. Another microfluidic device is then developed and fabricated to filter out live bacteria cells marked cells from cell debris or dead cells. The mechanism consists of interdigitated electrodes that apply an electric field to a microchannel. The live cells are identified by their bio marker as they are passing the electrodes, and the electrode power is turned on. By dielectrophoresis, a force is applied to the cells, moving them into the correct channel for live cells. Additionally, a flow cytometer is developed and microfabricated to allow for live cell counting and other single cell analyses after the live cell filtration. The cytometer is composed of a working, counter, and reference electrode that are under a microchannel. As a cell passes over the electrodes, the impedance of the system changes and two peaks are seen in the signal. An amplifier and a low pass filter are used to extract a signal from the noisy environment and the number of cells passing over the electrodes are counted.

Poster #19

Reversing the Narrative: How Asian Americans Shaped Affirmative Action Debates

Miriam Chen

Faculty Advisor(s): Dr. Sarah McNamara

My thesis examines the role that conservative Asian Americans played in the overturning of affirmative action. I will use the litigation of Students for Fair Admission v. Harvard and UNC to explore the history of conservative Asian American politics and to analyze the arguments made regarding affirmative action, both within the Supreme Court and in the larger context of American politics and race relations. Affirmative action has been challenged since its conception in 1961, with arguments largely centering around white university applicants complaining of “reverse discrimination” policies that benefited black applicants. While the policy has continuously been narrowed, its overturning was only made possible by

introducing Asian plaintiffs. Coupled with a conservative Supreme Court majority, a myriad of reasons made Asian American complaints compelling enough to overturn affirmative action. My thesis will explore such factors, including the emphasis that Asian Americans place on higher education, exposure to right-wing media and politicians, and American racial stereotypes, all of which has led to the collaboration of Asians with white conservatives to overturn affirmative action. I believe that this narrative undermines histories of racial exclusion and multiracial coalition-building, particularly during the civil rights era, and the arguments made by anti-affirmative action Asian Americans turn a blind eye to broader diversity efforts and ignore American racial history. Using a legal analysis with historical methodology, I will research how debates over affirmative action have contributed to discussions about Asian American belonging, stereotyping, conservatism's impact on diversity in higher education, and its larger impacts on American race relations.

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

Room: MSC 2300 C

Poster #1

Bubble Aid: Assistive AI to Improve the Robustness and Security of Reading Hand-Marked Ballots

Maya Shah

Faculty Advisor(s): Dr. Nitesh Saxena

The right to vote is one of the most critical and notable factors of a democratic process. Within the United States, a sizable amount of the population continues to vote using hand-marked ballots. Despite the availability of modern voting methods, the way election systems scan and process hand-marked ballots is still rudimentary, only looking at the average darkness of marks within a defined target area. As a result, current ballot scanners are unable to tabulate ballots that are filled incorrectly or incompletely. Additionally, miscategorization of a stray mark or scanner noise as an intended vote for a particular candidate is also possible. Current scanners also have no fraud detection capabilities. However, artificial intelligence and machine learning techniques have changed the way computers can see, perceive, and process image data. The proposed work aims to use these developments to alleviate issues faced with current election scanners through Bubble Aid, an AI System that will be an assistive tool in tabulating hand-marked ballots and detecting potential fraudulent cases of “same-hand voting”. This study builds upon previous works in artificial intelligence, machine and deep learning, and image processing, but in a context that works to improve speed, accuracy, and security for future elections.

Poster #2

Genomic Evolution of Antibiotic Resistance Under Selective Pressure in Treated Cancer Patients

Megan Mahon

Faculty Advisor(s): Dr. Jessica Galloway-Pena

The development of antibiotic resistance by opportunistic pathogens is a growing concern in healthcare. Although resistance is naturally occurring, the overuse of antibiotics has affected the efficacy and reliability of antibiotics to treat infections and is accelerating resistance rates. This project investigates the genomic evolution of antibiotic resistance under selective pressure among strains of bacteria collected during antibiotic and chemotherapy administration for Acute Myeloid Leukemia (AML). Stool samples and infection isolates were longitudinally collected from treated AML patients. 16S amplicon-sequencing was used to identify stool samples that could be colonized with antibiotic resistant pathogens. Selective and differential media along with MALDI-TOF and VITEK2 were used to extract and

identify antibiotic resistant pathogens. DNA was extracted from the bacterial isolates, and whole genome sequencing analysis was performed to understand genetic mutations leading to antibiotic resistance or virulence within patient longitudinal isolates. A species and antibiotic frequently seen to cause a specific genetic change across multiple patients was selected for in vitro analysis. The in vitro genetic changes were compared to that of the in vivo patient data. Understanding the genetic changes that lead to antibiotic resistance in bacteria under antibiotic selective pressure may help inform antimicrobial stewardship practices and improve the outcomes of cancer patients.

Poster #3

Binding-Induced DNA Assembly for Detection of SARS-CoV-2

Caitlyn Mutchler

Faculty Advisor(s): Dr. Zhilei Chen

The ongoing global pandemic caused by SARS-CoV-2, a novel coronavirus, has highlighted the urgent need for robust and efficient diagnostic tools. As of September 21st, 2023 there have been 770,778,396 confirmed cases of COVID-19 (caused by SARS-CoV-2) and 6,958,499 deaths have been reported to the World Health Organization (WHO). False positives and false negatives remain a challenge for current methods of SARS-CoV-2 diagnostics posing further challenges regarding disease management and prevention of infection spread. To address this critical demand, we took advantage of biologics specific to SARS-CoV-2 and developed a protein-DNA circuit for point-of-care (POC) diagnosis of SARS-CoV-2. By utilizing a phenomenon known as Binding-Induced DNA Assembly (BINDA) phenomenon, we designed a rapid (<2 hour) proximity ligation assay that uses SARS-CoV-2-specific DARPins covalently linked to single-stranded DNA oligonucleotides that form an amplifiable product upon recognition of SARS-CoV-2.

Poster #5

Designing and Improving Software Accessibility of AccessLens

Saikavya Kotra

Faculty Advisor(s): Dr. Jeeeun Kim

AccessLens is an innovative application that detects inaccessible objects in indoor spaces and provides users with 3D printed solutions that can be easily installed, specifically focusing on individuals with motor and physical impairments. Without proper accessibility, individuals with various types of impairments may encounter barriers that hinder their ability to navigate and benefit from digital applications. The current AccessLens prototype does not have many software accessibility features, the purpose of this project is to identify, design, and develop methods to improve the accessibility of AccessLens and better the user experience with navigating the application. To improve the accessibility of AccessLens, heuristic evaluations and user studies were conducted to understand user needs. This method was chosen for evaluating AccessLens since it is efficient, cost effective, and provides quick insightful observation regarding the current accessibility features and areas to focus on for the project. Based on these findings, new software designs and customized accessibility features were developed on

AccessLens. The accessibility features created include voiceover audio descriptions on images, navigation highlighting for users to follow, and improvements in user interface design.

Poster #6

Self-Perception and the Dark Triad

Mia N. Vasquez

Faculty Advisor(s): Dr. Matthew Vess

The "true" self is defined as the essential characteristics that people believe define who they are. The good true self bias is a bias in which people generally tend to view their true selves as more morally good than bad. This bias shows up in both the judgments that people make about their own true selves and the judgments people make about others' true selves. Recent research indicates that people high in narcissism, Machiavellianism, and psychopathy show a diminished true self-bias in self-judgments relative to people low in those traits. Whether or not this diminished bias exists for judgments of others' true selves remains unknown. The aim of the current study is to answer that question. We recruited 308 participants from Texas A&M University Introductory Psychology courses. We measured narcissism, Machiavellianism, and psychopathy using validated measures. All participants then judged whether a series of moral and immoral traits are central to who they are (i.e., their own true selves) and are central to other people's true selves. We used Linear mixed regression analyses to address our research hypotheses. Replicating earlier research, narcissism, Machiavellianism, and psychopathy all moderated the size of the good true self bias in self-perceptions. People high in those traits showed a smaller bias in self-judgments relative to people low in those traits. In addition, narcissism, Machiavellianism, and psychopathy moderated the good true self bias in perceptions of other's true selves but did so more weakly than it did for self judgments. Thus, while these traits affect how people view true selves for both self and other, the ways they do so are different depending on whether they are thinking about their own true self or the true self of other people.

Poster #9

User Interaction Design in Assisted Reality Systems for EMTs

Aarthi Srinivasan

Faculty Advisor(s): Dr. Jeeeun Kim

Emergency Medical Services (EMS) play a critical role in emergent medical scenarios and have been shown to have a significant impact on the outcome of emergent patients. When arriving on the scene of a medical emergency, Emergency Medical Technicians (EMTs) must analyze the emergent patient's symptoms and choose the appropriate treatment protocol. While the method of protocol selection and EMT training may differ per EMS agency, protocol selection remains an universal and integral part of emergency medical care. The time-sensitive and high-pressure nature of protocol selection can be difficult for EMTs; as such, EMSAssist – a mobile voice assistant for EMS protocol selection – was developed to aid EMTs with protocol selection. User interfaces (UIs), information displays, and human-

computer interaction all play an important role in the way that users interact with technology. While the content and functionality of EMSAssist have been analyzed, how does EMSAssist's current user interface impact users' understanding of the information presented? Do users prefer certain modalities of information display over others? To address these questions, we introduce a study that analyzes users' interaction with the mobile app, EMSAssist. This study analyzes the existing UI, presents alternate information displays, and collects views on EMSAssist integration with alternative IoT devices. Participants range widely and include (but are not limited to): the general population, those with experience in the medical field, and EMTs. In response to the study, we propose modifications to the UI and suggest further methods of presentation display that would improve user interaction with and understanding of EMSAssist.

Poster #10

Electrostatically Adhesive Double Network Membrane for a Cargo-Carrying Adhesive Biosensor

Theodore Ferrell

Faculty Advisor(s): Dr. Melissa Grunlan

Continuous glucose monitors (CGMs) have emerged as improved glucose management systems by providing real-time, continuous glycemic values. Two major issues in the development of subcutaneous (subQ) injectable glucose biosensors are biofouling and assay retention . To overcome this, the Grunlan lab developed a self-cleaning, thermoresponsive double network (DN) hydrogel membrane that cyclically swells and deswells , minimizing biofouling and increasing the lifespan of the biosensor. The DN hydrogel membrane consists of a tightly crosslinked first network of N-isopropylacrylamide (NIPAAm), [-] 2-Acrylamido-2-methylpropane sulfonic acid (AMPS) and [-] PAMPS-methacrylate (PAMPS-MA) comb macromer. The second network is comprised of loosely crosslinked NIPAAm and N-vinylpyrrolidone (NVP). These antibiofouling membranes may be fabricated as hollow rods which can be used to house new, optical glucose-sensing assays . However, a challenge remains: the liquid assay must be contained within the central cavity of the hydrogel membrane. Thus, the ends of the hydrogel hollow rod must be sealed while allowing for simultaneous assay retention and glucose diffusion. In this work [-] PAMPS-MA is added to the second network of the hydrogel for a two-fold benefit: controlled mesh size for assay retention and increase the negative charge density present at the surface to promote adhesion towards a positively charged â€œcapâ€. This work will quantify the effects on mechanical properties, adhesivity, glucose diffusivity, mesh size, and volume phase transition temperature (VPTT) to ensure longevity of the biosensor. DN hydrogels were prepared with different concentrations of [-] PAMPS-MA comb macromers, as well as varying size of comb macromer (n=10, n=20) between the networks.

Poster #13

Evaluating ZenSketch: Arcade Game for Practicing Drawing Skills

Rishi Chandnani, Mason Jiao

Faculty Advisor(s): Dr. Tracy Hammond

Sketching, a commonly undervalued skill by most STEM students is a difficult craft to learn, let alone practice. In an attempt to increase familiarity with this skill, many types of software, intelligent tutoring systems (ITS), have been developed to teach students of all ages how to draw. SketchTivity, the main focus of our research, is an example of one of these. ZenSketch is a simple game built into SketchTivity, an intelligent tutoring system (ITS), designed to encourage learners to practice their sketching skills through playing games. We wanted to see if using these intelligent tutoring systems provides any benefit to users immediately, as compared to traditional teaching styles, to determine their value for new users. The reason why we have focused on this software specifically is because of its gamification of the learning process of drawing which is a modern concept that has shown great potential in enhancing the average person's learning experiences. The purpose of our study is to gauge the effectiveness of using ZenSketch as a warmup tool for drawing and evaluating the participant's drawing in both accuracy and creativity. We will conduct a study with 20 students and compare the results of warming up with pen-and-paper to that of warming up with ZenSketch. Through our study, we hope to determine that ZenSketch is a viable method of warming up for drawing, for both new and old participants. Furthermore, if it proves to be a valuable warmup technique, it will further prove the efficacy of gamification in a learning environment.

Poster #14

Development of the Optical Communications for the TMB-2025 Board for CMS Muon Trigger Improvement Project at the LHC

Wenzhe Xu

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

The Large Hadron Collider (LHC) is a high-energy particle accelerator designed to help physicists solve the mystery of unexplained phenomena by Standard Model (SM). The Compact Muon Solenoid (CMS) is one of the largest general-purpose detectors used in LHC. The CMS consists of several different sensors which generate a vast amount of data during each event. A trigger system is designed to quickly decide whether an event is interesting or background noise. The Trigger Mother Board (TMB) was designed to be a part of the trigger system. The primary objective of the TMB-2025 upgrade project is the substitution of the TMB-2005 with an updated FPGA characterized by better logical capabilities and support for optical functionalities. Within the Trigger system, it is important to ensure the compatibility of the new TMB board with the pre-existing system. Additionally, it is crucial to verify that the optical signal strength transmitted aligns with the requirements of the data acquisition system, at the same time maintains a high level of link reliability. The optical transceiver is set in a external far-end loopback configuration.A custom firmware is designed and loaded to the board. The transmitter sends

PRBS(Pseudorandom binary sequence) test patterns. Simultaneously, a pattern checker logic is intricately linked to the receiver, functioning to identify errors within the received data patterns. To control the transceiver and to access the data, a virtual FPGA interface is used.

Poster #17

An Experimental Test Bed for Resolving Observation-Grounded Queries

XiMing Zhang

Faculty Advisor(s): Dr. Jason O'Kane

This research aims to create a robotic system capable of resolving boolean observation-based queries using a physical robot operating in a static controlled environment. The system comprises a robot for sensing the environment and a base station for analyzing sensed data and controlling the robot. The robot used in this research has a differential drive chassis with two incremental encoders and a front-facing camera. The base station is a powerful computer capable of running You Only Look Once (YOLO), a machine-learning-based object detector. The system is given a boolean observation-based query, a pre-generated plan, and a weighted-directed graph representing the environment (vertices represent known locations, and edges represent feasible paths). The goal is to answer the query quickly while minimizing the distance traveled. Fiducial markers were placed at known locations in the environment to facilitate localization, which is achieved using a particle filter that combines marker estimation and encoder measurements. Dijkstra's algorithm has been applied to find the shortest path from a localized pose to a given target pose. A proportional-integral controller has been used for controlling motor outputs, which enables precise turning. Finally, a YOLO object detector was trained using custom data, enabling the system to detect objects of interest and their properties. The system is still under development, and we will evaluate its performance after major components are implemented.

Poster #18

Development and Freeze-thaw Cycle Implementation of an Edible Scaffold Formulated from Curdlan and Brewer's Spent Grain Protein Extract for Cellular Agriculture Applications

Julia Felder

Faculty Advisor(s): Dr. Reza Ovissipour

As demand for meat products continues to grow, cellular meat has the potential to significantly improve many aspects of our food production system by decreasing carbon emissions, decreasing antibiotic use, and increasing food security. However, cellular agriculture solutions currently lack scalability. Edible scaffold development may help achieve cellular agriculture scale-up. In this study, edible scaffolds were formulated from curdlan hydrogel and protein isolates extracted from brewer's spent grain (BSG) via alkaline extraction. Curdlan is a good candidate for edible scaffold development as it forms a high-set gel without additional reagents and is widely used as a texture modifier in the food industry. BSG is a food

waste produced in large volumes during beer production and has a beneficial nutritional profile. Hydrogels were analyzed for their protein content and chemical composition to determine formulation implications. The hydrogels underwent three freeze-thaw cycles and then freeze-dried. Material properties were analyzed for samples pulled from each freeze-thaw cycle. To correlate these material properties to their effects on cell growth, hydrogels pulled from each freeze-thaw cycle were rehydrated with cell media and seeded with either bovine-induced pluripotent stem cells (iBSCs) or zebrafish embryo fibroblast cells (ZEMs). The results of this study will indicate whether curdlan gel supplemented with BSG protein is a viable edible scaffold solution. Additionally, the effect of freeze-thaw cycles on the hydrogel material properties and their subsequent effect on cell growth will allow the identification of material properties beneficial to specific cell growth characteristics.

Poster #21

Anthropogenic Effects on Fusconaia mitchelli

Will Flack-Robinson

Faculty Advisor(s): Dr. William E. Grant, Dr. Hsaio-Hsuan Wang

Background: The rapid expansion of agriculture and urban development along the Guadalupe River basin has caused detrimental changes to the natural terrain that once existed, resulting in disrupted water flow and increased runoff. Such changes have affected the critically endangered freshwater muscle, Fusconaia mitchelli (Bivalvia: Unionida) or False Spike. F. mitchelli are aquatic invertebrates that contribute important ecological benefits to freshwater environments such as stabilizing benthic habitat and improving water quality via filtration. Thought to be extinct, F. mitchelli was discovered in the Guadalupe River in 2011 during a survey and has since been classified as critically endangered as it is endemic to the river. Like other mussels, F. mitchelli is sensitive to anthropogenic changes to the natural flow of streams as well as pollution from differing sources. Aim: To determine the effects of urban and agricultural runoff on F. mitchelli, both live and dead samples were collected and counted over a three-year period, with most of the samples coming from less populated areas downstream in Gonzales and DeWitt counties. Methods: We will use these samples along with their associated environmental variables to develop a species distribution model. We hope the information gained from the model will aid in identifying the best conservation action to implement for this species.

Poster #22

Comparing Efficacy of Peroxyacetic Acid from Different Manufacturers on Chilled Beef Carcasses

Brittley Bowers

Faculty Advisor(s): Dr. Kerri B. Gehring, Dr. Jeff Savell

As *E. coli* O157:H7 has caused several different food outbreaks, there have been practices in commercial facilities implemented to aid in the reduction of this foodborne pathogen. Peroxyacetic acid has been a

commonly used application method on chilled beef carcasses within these commercial facilities for the reduction of *E. coli* O157:H7. While this is a commonly used method within the industry, the source of peroxyacetic acid could impact the overall efficacy of the product. Chilled beef carcasses were inoculated with surrogate *E. coli* and 120 samples were collected during five separate treatments at a commercial facility using fast and slow chain speeds and set concentration parameters as the beef surfaces passed through the spray cabinet. On one chilled beef surface, two samples were collected prior to moving through the cabinet and three samples were collected post spray cabinet. Samples were then taken to the food microbiology lab and each sample was diluted seven times onto *E. coli*/Coliform Count Plates and Aerobic Count Plates to determine the growth and log reduction of surrogate *E. coli*. Upon collection of results, reduction on chilled beef carcasses was increased on slower chain speeds with higher concentrations. However, there were still log reductions with faster chain speeds and lower concentrations. Results varied depending on the source of the acid and the preferred concentration parameters chosen. Each of these concentration parameters can impact commercial facilities decision when applying peroxyacetic acid to chilled beef surfaces.