



Honors Program
COLLEGE OF LETTERS & SCIENCE
UNIVERSITY OF WISCONSIN-MADISON

2025 Senior Honors Thesis Symposium Abstracts

Friday, April 11, 2025

1:00 PM - 5:00 PM

Union South

LIST OF PRESENTERS

BAKAYAT, Rohit.....	3
BAXTER, Joshua.....	3
BOES, Sophie.....	4
BOHACHEK, Ian.....	4
BOOMER, Axell.....	5
CRNKOVICH, Taylor.....	5
CULVER, Aiden.....	6
DUNBAR, Emma.....	6
DURHAM, Honor.....	7
FANDRICH, Brooke.....	7
FOONG, Han Yu.....	8
GENTILE, Bradyn.....	8
HA, Yunju.....	9
HUG, Shanti.....	9
JACOBSON, Raphael.....	10
JAIN, Sania.....	10
KESIREDDY, Tanvi Reddy.....	11
KING, Isaac.....	11
LASH, Jaidynne.....	12
LIETZ, Hazel.....	12
LIN, Ethan.....	13
LIU, Ziqi.....	13
LOCKWOOD, Emmett.....	14

LYP, Audrey.....	14
MARTELL, Ella.....	15
MELENDEZ, Sonya.....	15
MILLS, Jakob.....	16
MODI, Shrey.....	16
MORRIS, Jonathan.....	17
MUHAMMAD IDRESS, Ahmad Danial Bin.....	17
NAGAR, Tanay.....	18
NAMRU, Ngawang.....	18
RODERICK, Megan.....	19
RUDYKH, Daria.....	19
SHAH, Saira.....	20
SIMON, Abby.....	20
SLOAN, Tyler.....	21
SNOBERGER, Courtney.....	21
SUKUMAR, Srinandini.....	22
SURI, Natalie.....	22
WALSH, Patrick.....	22
WANG, Justina.....	23
WANG, Jessica.....	23
WU, Sherrie.....	24
ZHAO, Yalei.....	24
ZOU, Bocheng.....	25

BAKAYAT, Rohit***Determining the Spatial Scale of Balanced Direction Signals for Segmentation Perception***Major(s):
Neurobiology**Advisor(s):** Xin Huang and Bikalpa Ghimire**Thesis department(s):** Neurobiology

A common stimulus used in motion segmentation experiments consists of two random, spatially overlapping dot fields moving in different directions. These overlapping fields are typically perceived as separate directional surfaces, a phenomenon known as motion transparency. However, previous psychophysics studies suggest that “locally balanced” motion signals- created by spatially pairing two dots moving in two different directions- disrupt the perception of motion transparency. When dots are locally paired, observers perceive a single vector-average of two motion directions rather than perception of two transparent motion surfaces when unpaired. It remains unclear at which stage in motion processing pathway this distinction in segmentation and integration occurs, given that higher-order visual areas, with larger receptive fields (RF), are ideal for integration multiple features across broader spatial extents, whereas lower visual areas, with smaller RFs, are more susceptible to local manipulation. We hypothesize that the unique perceptual change observed with “locally balanced” stimuli is predominantly driven by lower visual areas operating at finer spatial scales. In this experiment, we aim to systematically manipulate the spatial limit of dot pairing to narrow down visual area primarily responsible for dictating the perception of motion transparency.

BAXTER, Joshua***Cognitive and sensory performance in a rhesus model of frontotemporal dementia***Major(s):
Neurobiology**Advisor(s):** Marina Emborg**Thesis department(s)s:** Neurobiology

Frontotemporal dementia (FTD) is a group of neurodegenerative disorders affecting the frontal and temporal lobes of the brain. FTD is highly hereditary and is the most common dementia in patients under 60 years old. Dr. Emborg’s team at the Wisconsin National Primate Research Center has identified a family of macaques carrying an exact replica of a mutation in the gene that encodes for the neuronal protein tau, which has been linked to FTD. My interest in neurodegenerative disorders led me to joining the Emborg lab in September 2023; since then, I have evaluated primate behavior and sensory skills using an array of behavioral tests, such as task reversal learning, sensory tactile, and puzzle feeder tests. For this thesis, I will employ these evaluations to examine the relationship between cognitive and sensory impairments in rhesus carriers of a mutation linked to FTD before comparing this relationship to current data on FTD patients.

BOES, Sophie

Major(s): English
and Political
Science

“Seeing (with -dl) is believing”: The acquisition of evidentiality by English-Turkish bilinguals

Advisor(s): Jacee Cho

Thesis department(s): English

According to Slobin’s thinking-for-speaking hypothesis, the attentional biases that speakers acquire from their first language (L1) influence their linguistic processing in a second language (L2). This is especially true for grammatical categories that are not obligatory in a learner’s L1. For L1 English speakers, one such category is evidentiality, which refers to an utterance’s source of information and is obligatorily encoded in one-fourth of the world’s languages, including Turkish. Previous research shows that evidentiality is susceptible to incomplete acquisition by heritage and L2 Turkish speakers, particularly those whose L1 does not grammatically encode evidential distinctions. This study employs an acceptability judgment task to further investigate these results among L1 English speakers, asking: How do adult L1 English L2 Turkish learners’ acceptability judgements compare to those of Turkish native speakers regarding the (in)appropriate uses of Turkish evidentiality? The results demonstrate that L1 English L2 Turkish learners judge evidentiality in a relatively target-like manner. However, they also suggest that evidentiality is a grammatical category particularly prone to attrition for L1 Turkish speakers residing in English-dominated environments. The findings will be discussed in terms of their conceptual implications for second language acquisition research and, more broadly, the relationship between language and thought.

BOHACHEK, Ian

Major(s):
Geography,
Cartography and
Geographic
Information
Systems, and
Environmental
Studies

Certificate(s):
Integrative Design
of Built and Natural
Environments,
German

Transitions to Sustainable Energy Systems: Evaluating Renewable Energy Policies in U.S. Cities

Advisor(s): Asligul Gocmen

Thesis department(s): Geography

Climate change has driven governments to develop renewable energy and decarbonization policies for reducing greenhouse gas emissions. Previous research has primarily focused on policies at the state and national level, with limited attention to municipal policies. My thesis evaluates municipal policies of 39 mid-sized American cities in eight states with high renewable energy potential, according to sixteen relevant measures of municipal energy policy. Preliminary findings suggest that while many cities have adopted renewable energy and decarbonization policies, these policies vary significantly in strength and extent, even in places with similar capacity to generate renewable energy. Energy efficiency and transportation policies lead the way, with renewable energy transmission and market-based energy transition policies rarely implemented by municipalities. In addition, policies more recently adopted tend to be stronger, and those found in planning documents specific to climate change, such as climate action plans, are often more developed than policies found in a municipality’s comprehensive plan. Municipal policies tend to reflect their respective state’s, but in some cases, local policies are stronger. This research highlights the interaction between state and local policy in powering renewable energy and decarbonization efforts at the municipal level in a time of accelerated climate policy growth.

BOOMER, Axell

Major(s):
History and
Religious Studies

The Saint and Soil of Democracy: Idolatry of Abraham Lincoln as an Intersection of Christian Nationalist and Settler Nationalist Identities

Advisor(s): Jennifer Ratner-Rosenhagen

Thesis department(s): History

"The Saint and Soil of Democracy" explores Protestant perceptions of Abraham Lincoln in late nineteenth- and twentieth-century America. Employing an archive of sermons, poems, newspaper articles, scrapbooks, and the Gutzon Borglum papers, the project marks the role memories of Lincoln played in marrying settler and Christian identities into one American identity. While today Lincoln is venerated as the "Great Emancipator," or preserver of the Union, many Christian Americans first found glory in Lincoln as a frontiersman or settler. Indeed, sermons and eulogies produced immediately after Lincoln's assassination, posited Lincoln as the "First American," associating his glory both to his faith in God and origin in the frontier. These sermons, church bulletins, and poems celebrate Lincoln's participation in the Black Hawk War as an early mark of his leadership. Moreover, these works canonize Lincoln as a martyr, with one poem asserting that "His blood is freedom's eucharist." After analyzing church writings, my thesis moves to analyze Lincoln shrines—Lincoln's Tomb and Mount Rushmore. Speeches at dedications for the respective monuments reveal how Americans believed they could reaccess the frontier through the memory and celebration of Lincoln at these sites and often paralleled the death of Lincoln with Jesus of Nazareth.

**CRNKOVICH,
Taylor**

Major(s):
Neurobiology

Certificate(s):
Global Health and
Gender and
Women's Studies

Glioblastoma Multiforme Immunotherapy: Investigating the Role of Dendritic Cells in GIFT7-Induced TH17 Differentiation

Advisor(s): Jack Shireman and Mahua Dey

Thesis department(s): Neurobiology

Glioblastoma multiforme (GBM) remains a highly aggressive and incurable brain tumor with limited treatment options. Immunotherapy, particularly tumor vaccines, has shown promise in other cancers but remains ineffective in GBM. Our lab developed a novel fusokine, GIFT7—a fusion of GM-CSF and IL-7—that has demonstrated anti-tumor effects and increased survival in a GBM tumor vaccine model. Notably, GIFT7 promotes TH17 cell differentiation, yet its direct administration to naïve CD4⁺ T cells fails to induce TH17 polarization, suggesting the involvement of additional cellular components. We hypothesize that dendritic cells (DCs) play a pivotal role in this process by priming CD4⁺ T cells towards a TH17 phenotype.

To investigate this, we created an in vitro co-culture system where bone marrow-derived DCs, naïve CD4⁺ T cells, and tumor cells are incubated with GIFT7. Flow cytometry will assess TH17 differentiation, with secondary gating for CD4⁺ subsets. We anticipate that DC-CD4 interactions within the tumor microenvironment will be critical for TH17 differentiation and subsequent anti-tumor immunity. If in vitro conditions fail to recapitulate TH17 induction, we will utilize a syngeneic murine GBM model to evaluate GIFT7's efficacy in vivo. Understanding these mechanisms could lead to improved GBM immunotherapies by leveraging TH17-mediated responses.

CULVER, Aiden***Hog Heaven: The Ethics of Farmed Animal Welfare and Death***

Major(s):
Philosophy and
Political Science

Advisor(s): James Goodrich

Thesis department(s): Philosophy

Certificate(s):
Public Policy and
History

The treatment and killing of non-human animals on farms raises many ethical questions about how we ought to consider well-being and death. In acknowledging that what happens to non-human animals can be of moral weight, we must inquire about how exactly well-being, death, and moral weight correlate. In what follows, I aim to provide an account of non-human animal well-being, and argue that non-human animal death is something distinct from this. I will do so by exploring the arguments for and against two main assertions. First, that death necessarily involves a complete lack of any state of well-being, that is, an individual can neither benefit nor suffer from not being alive. Second, there are no relevant moral differences between deaths in human and non-human animals. To facilitate this exploration, I use two parallel case studies involving human and non-human animal deaths. My findings are consequential to our moral understanding of the suffering and death of non-human animals in agriculture, and are instrumental to the development of policy interventions in the field of animal welfare advocacy.

DUNBAR, Emma***RecA and Topoisomerase III in Post Replication Gap Repair***

Major(s):
Biochemistry

Advisor(s): Michael Cox and James Keck

Thesis department(s): Biochemistry

Certificate(s):
Physics

Post replication gaps occur when a DNA polymerase skips a section of damaged DNA during replication. These gaps of single stranded DNA must be repaired for the cell to survive. In *E. coli* the repair pathway proceeds with homologous recombination, involving the protein RecA. Due to the nature of bacterial genomes, this strand invasion creates immense topological stress, which can be resolved by topoisomerase proteins, such as Topoisomerase III. The recombinational repair pathway can be well modeled by strand exchange assays. When RecA and Topoisomerase III are used in strand exchange, with circular single and double stranded homologous DNA, the formation of large intermediates are observed. These large intermediates are likely the crossing over of multiple pieces of circular DNA to form many interlinked rings. These then appear to be resolved into smaller products. The RecA ATPase has been a long studied, but poorly understood component of the RecA protein. When the ability to hydrolyze ATP is removed from RecA, the large intermediates and final products are no longer observed. We hypothesize that the motor function of the RecA ATPase is involved in post replication gap repair, modeled by strand exchange.

DURHAM, Honor

Major(s):
Political Science
and Data Science

Safeguarding Democracy in Elections: Analyzing State Preparedness Against Deliberate Efforts to Undermine U.S. Election Administration

Advisor(s): Barry C. Burden

Thesis department(s): Political Science

Intentional threats to election administration have intensified as more Americans fear the consequences of their political party losing. As threats continue to escalate and affect various branches of election administration, it is crucial to assess whether states are prepared to handle these threats. It is equally important to explore potential differences between the states that can readily counter threats and those that cannot. In this study, a sample of 12 states was chosen and their ability to handle intentional threats to election administration was evaluated through existing state laws and court practices. The seven threats highlighted in this work include candidates refusing to concede elections, election officials refusing to certify elections, disinformation about the electoral process and election fraud, foreign interference, cybersecurity threats and hacking, voter intimidation, and election official intimidation. Through the use of K-means clustering techniques, this thesis presents preliminary findings on state preparedness by grouping states into clusters based on their existing ability to counter these threats. These results offer insight into the factors that determine how and why different states are better prepared than others to face intentional threats to election administration.

**FANDRICH,
Brooke**

Major(s):
Strategic
Communications
and Anthropology

Certificate(s):
Digital Media
Analytics

The Call of Illegal Prescription Drugs: what the search engine history and content analysis of illegal pharmaceutical websites can tell us about the health media consumption of fringe consumer audiences

Advisor(s): Dhavan Shah

Thesis department(s): Strategic Communications

This exploration of the National Association of Boards of Pharmacy's Unsafe Online Pharmacy list utilizes web content analysis and search engine data to investigate how illegal online pharmacies advertise, maintain clientele, spread medical misinformation, and attract fringe internet audiences. As internet content increasingly replaces institutional information in people's everyday lives, the information infrastructure surrounding essential goods and services has shifted to for-profit media networks. With the NABP finding that 96% of reviewed online pharmacies sell prescriptions illegally, uncredited groups have created their own health and wellness media online, developing an information ecosystem that prioritizes their business interests over consumer well-being. Research into this decades-old illegal market, which provides significant funding to organized crime syndicates, suggests that their popularity stems primarily from consumers' desire for self-medication and pharmaceutical experimentation. Some of these websites attract millions of visitors annually, encouraged by the consumption of content within the internet's largely unmoderated health media ecosystem.

FOONG, Han Yu***Leveraging LLM-Vectorized Semantic Representations for Email Phishing Detection***Major(s):
Computer Science**Advisor(s):** Rahul Chatterjee**Thesis department(s):** Computer Sciences

Previous studies have used vectorized data to interpret emails as a decision factor for phishing. However, the nature of their methods did not directly test on a real-world dataset for email phishing detection. Here this paper proposes both a new method and an analysis of email phishing detection for real-world applications. By utilizing a preprocessed Large Language Model (LLM) to identify acts of persuasion, the semantic meaning of texts and the context of the sender, the LLM could answer a list of criteria regarding an email's content. The list of criteria consists of 12 carefully formulated questions, each tackling a different aspect of the sender's context, to be vectorized as a tensor dataset to achieve a confident decision by the Machine Learning (ML) model associated with the LLM. The preprocessing conditioning given to the LLM allows the ability to answer with a relatively low false positive and false negative rate when tested over a small series of questions. Testing with the LLM over a real-world dataset displayed a remarkable >90% area under curve (AUC) score on the receiver operating characteristic (ROC) curve. Applying this method to existing email filters will project to provide improved security and better privacy to the general user.

GENTILE, Bradyn***Addressing Disparities in Healthcare Access for Unaccompanied Youth Experiencing Homelessness***Major(s):
Political Science,
Spanish, and
Environmental
Studies**Advisor(s):** David Weimer and Amy Gangl**Thesis department(s):** Political Science

This thesis addresses the barriers faced by unaccompanied youth experiencing homelessness (UYEH). Many social factors deter UYEH from seeking medical treatment; however, due to their transient and consequently elusive nature, studies addressing UYEH healthcare experiences have been limited. Nevertheless, understanding UYEH and ensuring their access to healthcare must continue to be explored in hopes of ensuring every U.S. citizen receives the care they need. To do so, this thesis focuses on the statutory ability of UYEH to consent to primary medical services before reaching the age of the majority. Policies regarding minor consent are codified into every state's laws and allow varying degrees of freedom for UYEH to consent to primary healthcare. A cross comparison of state laws relating to minor consent was conducted across all 50 states. Analysis of the statutes demonstrates that states passed laws at different times for several different reasons. Many legislatures have now passed legislation specifically regarding UYEH and consent due to recognition that not all homeless youth have parents capable of providing consent. However, some states still remain silent on the issue. Through the analysis and synthesis of the statute data, this thesis serves to provide policy suggestions that will increase UYEH access to healthcare in states with restrictive laws or provide UYEH with healthcare access in states with no law on the books.

HA, Yunju***Predicting cancer risk using biomarkers from value-added abdominal CT scans in individuals with Alzheimer's disease***Major(s):
Statistics and
Computer Science**Advisor(s):** Richard Chappell and John Garrett**Thesis department(s):** Statistics

Prior research has suggested a potential inverse relationship between Alzheimer's disease and some types of cancers, highlighting unique pathophysiological interactions worthy of further research. Through opportunistic screening, this study aims to utilize existing AI-derived abdominal biomarkers to predict cancer risk without requiring additional imaging or invasive procedures. This early risk stratification in Alzheimer's patients is crucial, as it may enable targeted interventions aimed at improving patient health by identifying risk factors for diseases like cancer, cardiovascular disease, and more.

In this retrospective, cross-sectional study, data from 136,136 adult patients were analyzed. Patient abdominal computed tomography (CT) scans collected between January 2000 and February 2021 at UW Health were analyzed using fully automated artificial intelligence tools to quantify body composition biomarkers. Patient demographic data and outcomes were collected from the electronic medical records (EMR) and correlated with imaging exams. We specifically evaluated these biomarkers within a subgroup of patients diagnosed with Alzheimer's disease to investigate their utility in risk stratification using Kaplan-Meier curves and logistic regression.

By leveraging already available clinical data, the application of abdominal biomarkers offers a valuable and effective approach to improving clinical outcomes and quality of life for individuals with Alzheimer's disease.

HUG, Shanti***Catecholamines and β 3-Adrenergic Receptor Regulate Hematopoietic Stem Cell Development***Major(s):
Cellular and
Molecular Biology**Advisor(s):** Catherine Auger**Thesis department(s):** Cellular and Molecular BiologyCertificate(s):
Biology Core
Curriculum and
Classics

Hematopoietic stem cells (HSPCs) interact with different niches throughout their development. Interactions between these stem cells and their microenvironment, or niche, are very important for proper development of HSPCs but not very well understood. Signals produced by niche cells include catecholamine neurotransmitters that are detected by β -3 adrenergic receptors (adrb3) on the HSCs. These catecholamines have been shown to regulate both the number of stem cells present in early hematopoiesis, as well as a role in HSPC differentiation. In zebrafish adrb3 knockouts display a greater number of HSPCs than wild types in the second niche, but the mechanism behind the phenotype is still unknown. In this project we will attempt to determine if mutant adrb3 results in expansion of the zebrafish HSPCs population by 1) increasing HSPC emergence from the first niche, or 2) increasing HSPC proliferation within the second niche. Additionally we want to look if there's premature differentiation of the HSPCs within the niche that could be contributing to the greater observed HSPC expansion.

**JACOBSON,
Raphael**

Major(s):
Sociology

Certificate(s):
Jewish Studies and
History

Leaving Its Mark: Space and the Collective Memory

Advisor(s): Chad Goldberg

Thesis department(s): Sociology

Memories are a universal part of life and while they might seem deeply personal, some memories are collective, or shared by a group of people with a common thread. One of these common threads can be space, a constant that shapes how people experience the world around them. But multiple different communities can occupy a space, both at the same time or at different times, and theory on collective memory does not take into account how demographics affect the formation of space based collective memories. The Grand Concourse, a neighborhood in the Bronx borough of New York City, offers a perfect ground to explore these questions. Having once held the highest concentration of Jews in the city to now being prominently African American and Latino, the neighborhood and its changing demographics allow us to look at how collective memories span across demographics and time. Utilizing interviews conducted with both Jewish and non Jewish residents, this thesis seeks to establish the collective memory of the neighborhood and see if and how it changes as the neighborhood changes.

JAIN, Sania

Major(s):
Neurobiology and
Psychology

Experience-Dependent Selection of Purkinje Cell Targets

Advisor(s): David Ehrlich

Thesis department(s): Neurobiology

Neuroplasticity refers to the formation of new neuronal connections and the reorganization of existing ones based on experiences and environmental demands. While plasticity in the visual cortex is well studied, its role in the cerebellum remains unclear. Our study investigates how sensory experience influences Purkinje cell target selection in the cerebellum, a key brain region responsible for motor coordination and learning. Purkinje cells, which generate cerebellar output, selectively innervate targets, but its dependence on sensory experience was previously unclear. Using larval zebrafish, an ideal model due to their transparent exterior and ease of genetic manipulability, we examined how developmental conditions influence Purkinje cell innervation. We chemogenetically activated Purkinje cells and exposed zebrafish to either constant flow or a static water environment early during development. Light sheet microscopy and image analysis revealed that both flow exposure and Purkinje cell activation promoted preferential innervation of a putative brainstem flow center at the expense of other targets. Furthermore, we identified a developmental critical period during which sensory experience strongly influences Purkinje cell target selection. This research provides novel insights into experience-dependent plasticity in the cerebellum and may inform predictions about behavioral and neuronal outcomes based on the timing of developmental disruptions.

**KESIREDDY,
Tanvi Reddy**

Major(s):
Computer Science
and Data Science

Cross-platform compatibility and performance of JDBC

Advisor(s): Shivaram Venkataraman

Thesis department(s): Computer Science

This thesis explores the cross-compatibility of different database management systems (DBMS) using Java Database Connectivity (JDBC) and evaluates its impact on performance. JDBC serves as an abstraction layer, facilitating seamless interaction between applications and various databases. However, this abstraction introduces constraints, particularly in handling transactions, execution performance, and in-out parameter operations. This study systematically implements and analyzes single-statement execution in Oracle and MySQL, assessing their compatibility and performance through a series of trials. Additionally, it examines the limitations imposed by JDBC when retrieving outputs in real-time and managing bidirectional parameters across different DBMS. Performance metrics such as execution speed and resource consumption are evaluated to determine the trade-offs between convenience and efficiency. By identifying compatibility issues and performance variations, this research aims to provide insights into optimizing database interactions via JDBC while mitigating its inherent limitations.

KING, Isaac

Major(s):
Neurobiology and
Global Health

The Impact of CAR T-cell Target Antigens on IFN γ Dependence in AML vs. B-ALL

Advisor(s): Rebecca Richards and Nat Murren

Thesis department(s): Neurobiology

Chimeric antigen receptor (CAR) T-cell therapy has revolutionized treatment of B-cell acute lymphoblastic leukemia (B-ALL) but has not been successful in acute myeloid leukemia (AML), likely in part due to differences in the cytokine response. IFN γ is a pro-inflammatory cytokine produced by T-cells that is measured as a benchmark of CAR T cell activity, but it is also the most prominent cytokine differentially elevated in the serum of patients who develop both cytokine release syndrome (CRS) and/or Immune Effector Cell-Associated Neurotoxicity Syndrome (ICANS). Recent literature has found that disrupting the IFN γ axis in B-ALL CAR T-cell therapy can reduce toxicity without reducing anti tumor efficacy. However, preliminary data show that AML is dependent on IFN γ for optimal activity. I hypothesize that this differential IFN γ dependence in AML and B-ALL will be consistent across multiple CARs and target antigens. I will engineer B-ALL cell lines to express AML antigens CD33 and CD93 and AML to express B-ALL antigen CD19, and compare target-specific CAR activity in each cell type. This will better inform development of novel AML CAR T-cell therapies that can modulate the CAR T/AML milieu in order to improve clinical efficacy and reduce toxicities to improve patient outcomes.

LASH, Jaidynne***Ponatinib suppresses NLRP3 inflammasome activation in primary microglia***

Major(s):

Advisor(s): Tyler Ulland and Anthony AugerNeurobiology and
Psychology**Thesis department(s):** Neurobiology and Psychology

Alzheimer's Disease (AD) is a neurodegenerative disease affecting 6.9 million people in the United States. AD pathology is characterized by extracellular amyloid-beta (A β) plaques and intracellular neurofibrillary tau tangles (NFTs) in the brain. Although some amyloid-targeting therapies have been FDA-approved, clinical trial results remain inconsistent, leaving novel treatment approaches necessary. The nod-like receptor family pyrin domain-containing (NLRP3) inflammasome in microglia, the brain's immune cell, contributes to neuroinflammation and drives AD pathology. Using an enzyme-linked immunosorbent assay (ELISA) based screen, we found that Ponatinib, an FDA-approved tyrosine kinase inhibitor, decreases NLRP3 activation in bone marrow-derived macrophages (BMDMs) and primary microglia. We utilized dose curves and cytotoxicity assays to further characterize Ponatinib's NLRP3 inhibitory activity in microglia. This work positions Ponatinib as a promising, potential therapeutic for AD.

LIETZ, Hazel***Oxygen as a Determinant of Bacteriophage Infection in Escherichia coli.***

Major(s):

Advisor(s): Andrew Hryckowian

Biology

Thesis department(s): Biology

Certificate(s):

German and
Biology Core
Curriculum

This study investigates the infectivity and adaptability of bacteriophages isolated from wastewater in targeting *Escherichia coli* under varying oxygen conditions—anaerobic, aerobic, and hypoxic. Bacteriophages, viruses that specifically infect bacteria, are emerging as promising tools in alternative therapies, particularly in the face of rising antibiotic resistance. However, their effectiveness in diverse physiological environments – such as within the digestive tract – remains underexplored. Wastewater, a complex microbial ecosystem, serves as a rich reservoir for diverse phage populations potentially adapted to fluctuating oxygen levels. In this project, phages were isolated and purified from wastewater samples and screened for lytic activity against *E. coli* under the three distinct oxygen conditions. The fitness of each phage was assessed based on parameters such as plaque formation and countable plaque forming units.

LIN, Ethan

Major(s):
Microbiology and
Biology

Certificate(s):
Disability Rights
and Services

Molecular Alterations and Therapeutic Outcomes of Cholangiocarcinoma in the Veterans Health Administration: A Comprehensive Analysis Using Real-World Data

Advisor(s): Jeremy Kratz

Thesis department(s): Microbiology

Cholangiocarcinoma (CCA) is a rare form of liver cancer associated with poor prognosis and limited treatment options. Leveraging data from the Veterans Health Administration's (VHA) National Precision Oncology Programs (NPOP) comprehensive genomic profiling (CGP) efforts, rates and overall survival across different molecular alterations present in veterans with CCA were analyzed. Actionable alterations were defined as IDH1mut, FGFR2fus, ERBB2amp, BRAFmut (V600E), and MSI-H collectively represented 19.8% of all Veteran CCA. The largest population was intrahepatic CCA (n=355) with actionable alterations including IDH1mut (12.1%), ERBB2amp (5.3%), and FGFR2fus (4.2%). Data suggested improved overall survival (OS) in IDH1mut Intrahepatic CCA. Homologous recombination deficiency were defined by pathogenic variant mutations (MT) in ARID1A, ATM, ATR, BAP1, BRCA1, BRCA2, CDK12, CHEK2, FANC, NBN, PALB2, and RAD51. Mutations associated with HRD were found to be common, however alone they were not prognostic in OS across a diverse patient population of CCA. Data suggested platinum-exposure improved overall survival in HRD(+) tumors relative to non HRD(+). By integrating CGP and real-world clinical data, this research seeks to stratify predictive biomarkers to guide future personalized treatment strategies.

LIU, Ziqi

Major(s):
Computer Sciences

AskNow: An LLM-powered Interactive System for Real-Time Question Answering in Large-Scale Classrooms

Advisor(s): Bilge Mutlu and Yuhang Zhao

Thesis department(s): Computer Sciences

In large-scale classrooms, students often struggle to ask questions due to limited instructor attention and social pressure. Based on findings from a formative study with 24 students and 12 instructors, we present AskNow, an LLM-powered system that enables students to ask questions and receive real-time, context-aware responses grounded in the ongoing lecture and that allows instructors to view students' questions collectively. We deployed AskNow in three university courses for a week and tested with over 150 students. To evaluate AskNow responses, each instructor rated the perceived correctness and satisfaction of 100 randomly sampled AskNow-generated responses. In addition, we conducted interviews with 24 students and all three instructors to understand their experience with AskNow. We found that instructors generally found AskNow responses to be accurate and satisfactory. Students showed various use patterns depending on when and why they use AskNow. Instructor feedback provided insights into the potential role of such systems in supporting real-time learning in large lecture settings.

**LOCKWOOD,
Emmett**

Major(s):
Political Science
and Gender and
Women's Studies

Certificate(s):
American Indian
Indigenous Studies
and Integrated
Studies of Science,
Engineering and
Society

Ballots for Business, Barriers for Bodies: The Economic Test of Political Participation

Advisor(s): Keisha Lindsay

Thesis department(s): Political Science

While it is taken as a core assumption that the right of political participation in the United States is afforded based on personhood court developments in the cases *Citizens United v. Federal Elections Commission (FEC)* and *Doe v. Rowe* bring this assumption into question. This study examines the throughline between the expansive rights to political participation adopted by *Citizens United v. FEC* and the limited rights to political participation adopted by *Doe v. Rowe*. This study analyzes through legal discourse analysis how the permission of corporations to engage in electioneering communication and the denial of suffrage to disabled citizens under state guardianship on the basis of employment is discussed in court opinions. Findings suggest that political participation rights are being afforded based on whether an entity is deemed to be economically productive rather than if they are a person. Disability is a broad category not tied together by a single diagnosis or culture. Similarly, corporations and non-profits range in size-structure and fervor for political participation. Thus, vast potential exists for further study; future researchers may include court cases from other states that limit voting rights to those under guardianship, or lawsuits around other rights afforded to corporations.

LYP, Audrey

Major(s):
Chemistry

Measurement of Reactive Ozone Loss to Lake Surfaces

Advisor(s): Timothy Bertram

Thesis department(s): Chemistry

The reaction of ozone with iodide and dissolved organic carbon (DOC) in the sea surface microlayer is a major pathway of ozone loss from the troposphere but remains poorly constrained. However, the reaction of ozone with freshwater surfaces (e.g., inland lakes) remains significantly overlooked, with current climate models approximating ozone loss to these surfaces as zero. Since iodide concentration in lake water is typically below 10 nM, the uptake of ozone to these surfaces is likely controlled solely the reaction of DOC with ozone. This study aims to better understand the reactive loss of ozone to inland waters by measuring the uptake of ozone to samples collected from Lake Michigan, Lake Mendota, Lake Monona, and Lake Wingra. We find that the uptake of ozone to lake water is on the same order of magnitude as the uptake of ozone to iodide concentrations observed in the surface ocean.

MARTELL, Ella

Major(s):
Biochemistry

Certificate(s):
Data Science and
Biology Core
Curriculum

Investigating Tregs and the Use of CRX-Exosomes as a Novel Treatment for GVHD

Advisor(s): Christian Capitini

Thesis department(s): Biochemistry

The development of graft-vs-host disease (GVHD) and relapse of the patient's primary disease following allogeneic hematopoietic cell transplantation (allo-HCT) are two major complications for patients. The primary challenge in developing a treatment for GVHD is to establish a treatment that prevents GVHD while maintaining graft-vs-leukemia (GVL) activity. Previously, our lab has identified a T regulatory cell (Treg) population that is correlated with the prevention of GVHD. We have also developed a novel treatment involving exosomes collected from mesenchymal stromal cells stimulated with the lipid A analog CRX-527 to form immunosuppressive CRX-extracellular vesicles (CRX-EVs) that limit GVHD without inhibiting the GVL activity of T cells. We hypothesized that Tregs, induced and activated by CRX-EV expression of IL-6, are required for the prevention of xeno-GVHD. We tested this hypothesis by blocking IL-6 receptors in our in-vitro and in-vivo model, then quantifying the Tregs and their cytokine expression.

MELENDEZ, Sonya

Major(s):
Data Science,
Information
Science, and
Political Science

Economic Sanctions and the Burden of Compliance: Effectiveness, Enforcement, and Evasion in a Global Economy

Advisor(s): Amy Gangl and Lisa Martin

Thesis department(s): Political Science

Economic sanctions are a key instrument of international policy, used to influence a nation's behavior through economic pressure. However, their effectiveness varies, especially as nations increasingly develop new mechanisms to mitigate their impact. This thesis examines the economic impacts of sanctions by analyzing economic indicators like GDP, inflation and trade patterns in Iran, Cuba, and Russia. Using historical sanction timelines, this research identifies key economic shifts and contextualizes their causes and assess whether sanctions achieved their intended objectives. Findings suggest that comprehensive sanctions often disrupt economies but fail to force long-term policy shifts, whereas targeted sanctions rely on multilateral enforcement and financial tools like SWIFT restrictions to remain effective. However, global financial systems, like Russia's pivot to alternative payment networks, challenge the efficacy of traditional enforcement strategies. This study evaluates the conditions under which sanctions succeed, highlighting the need for adaptive enforcement mechanisms to maintain their strategic impact. As nations increasingly sidestep restrictions, this research explores how policymakers can design sanctions that remain effective in an evolving global economy.

MILLS, Jakob

Major(s):
Physics and
Astronomy-Physics

Certificate(s):
Criminal Justice

Utilizing Simulation-Based Inference to Study the Structure of the Milky Way

Advisor(s): Trey Wenger

Thesis department(s): Physics

The structure of the Milky Way galaxy remains poorly constrained. We have long known the Milky Way is a spiral galaxy, but many parameters, such as the location and number of spiral arms are still unknown. We seek to better constrain and understand these structural parameters of the Milky Way. First, we utilize observational data consisting of the position and velocity of ionized hydrogen regions of space throughout the galaxy. These regions are key tracers of star formation and the Milky Way's spiral structure. Next, we will develop a model of the Milky Way galaxy in which we can control for various parameters dictating the shape and position of its spiral arms. Then, we will train a machine learning algorithm using simulation-based inference (SBI) to be able to extract these parameters from our model without having previous knowledge of them. Next, we employ Markov Chain Monte Carlo (MCMC) fitting to test which model parameters selected from actual data by the machine learning algorithm are the most likely to be true. Preliminary results show we can successfully use SBI and MCMC techniques to train a neural network to extract the model parameters of a synthetic dataset. Our next step is to train a neural network to extract the model parameters from the observational dataset. After completing this task, we will be able to construct the most accurate map of the Milky Way galaxy to date.

MODI, Shrey

Major(s):
Computer Science
and Data Science

Layer-Guided Latent Reasoning: Exploring Targeted Manipulation of Processing Regions in LLMs

Advisor(s): Sharon Li

Thesis department(s): Computer Science

Large language models (LLMs) have demonstrated impressive reasoning capabilities through techniques like chain-of-thought (CoT), but remain constrained by the limitations of reasoning in language space. Recent approaches like Coconut (Chain of Continuous Thought) suggest potential benefits of enabling models to reason in latent space rather than through discrete tokens. However, these latent reasoning methods face significant training challenges that limit their practical implementation. This paper proposes Layer-Guided Latent Reasoning (LGRL), an approach that builds on empirical evidence regarding the functional specialization of different layers within transformer architectures. Drawing on findings that early decoder blocks in LLMs extract task representations while later blocks apply them, we present a framework for targeted interventions that may enhance information bandwidth during reasoning processes. We hypothesize that by modulating specific processing regions, models can more effectively maintain and leverage complex reasoning states. Our preliminary investigations explore whether LGRL can address limitations in both traditional CoT and existing latent reasoning methods, particularly for tasks requiring backtracking and exploration of alternative paths. This work contributes to our understanding of how the localization of different cognitive functions within LLM architectures might be exploited to advance artificial reasoning capabilities.

**MORRIS,
Jonathan**

Major(s):
Statistics and
Psychology

The Time Course of Negative Emotion and Associations With Time Spent on Work

Advisor(s): Stacey Schaefer

Thesis department(s): Psychology

This study investigates the relationship between recovery from negative emotion and work participation. Using data from the Midlife in the United States Study (MIDUS: <https://midus.wisc.edu>), linear mixed effects models tested whether faster emotional recovery measured via facial electromyography in response to negative images and stress reactivity (self-reported negative affect on days with stress compared to days without stress) predict greater time spent on work. Lower stress reactivity at baseline was associated with greater time spent on work ten years later and a slower decline in time spent on work across a decade (N = 900). Faster emotional recovery from negative images was associated with greater time spent on work at baseline (N = 160). Findings suggest that individual differences in the time course of recovery of negative emotional may be related to time spent on work, but follow-up research within different samples is needed.

**MUHAMMAD
IDRESS, Ahmad
Danial Bin**

Major(s):
Chemical
Engineering and
Chemistry

Certificate(s):
Engineering for
Energy
Sustainability

Techno-economic Analysis: Industrial-scale Simulation of Oxidative Dehydrogenation of Propane over Supported Vanadium Catalysts

Advisor(s): Unni Kurumbail

Thesis department(s): Chemistry

The conventional direct dehydrogenation of propane is industrially well-established to synthesize propylene, a crucial commodity chemical. However, this high-temperature reaction is highly energy-consuming. Alternatively, oxidative dehydrogenation of propane (ODHP) over a supported vanadium oxide catalyst is an energy-producing reaction that can run at a lower temperature. Here, a techno-economic analysis of an industrial-scale ODHP was developed to determine the minimum selling price of propylene for a profitable process. Lab-scale ODHP reactions were performed to evaluate kinetic data, which was then inserted into an industrial-scale ODHP process simulation developed on Aspen Plus to generate results for the techno-economic model. Hence, the generated results could be compared to the conventional process for possible future commercialization.

NAGAR, Tanay***Decoding Bias in Letters of Recommendation: A Word Embeddings Approach***

Major(s):

Advisor(s): Fred Sala, Sarah JungComputer Science
and Philosophy**Thesis department(s):** Computer Science

The integrity of medical residency selection is paramount in cultivating competent physicians. With recent changes to the selection process, the weight of the letter of recommendation has increased, bringing potential gender and ethnic biases to the forefront. This study proposes a novel computational approach in applicant assessment research, to quantify, interpret, and visualize the root cause of implicit gender and racial biases. Using advanced natural language processing techniques, including word embeddings through word2Vec and other custom transformer-based models, and a suite of bias-detection algorithms, this study not only seeks to influence policy, fostering a fairer and equitable selection process but also hopes to lay the groundwork for a broader application of bias examination in various qualitative assessment records across multiple languages.

**NAMRU,
Ngawang*****Investigating RhoA Signaling Defects in Tuberous Sclerosis Complex***

Major(s):

Advisor(s): Timothy GomezMolecular and Cell
Biology; and Asian
Languages and
Cultures**Thesis department(s):** Molecular and Cell Biology

Tuberous Sclerosis Complex (TSC) is an autosomal dominant neurodevelopmental disorder caused by the monoallelic inactivation of TSC1 or TSC2, often resulting in intellectual disabilities, autism, and seizures. The TSC1-TSC2 complex is known to negatively regulate mTORC1-mediated protein synthesis and activate mTORC2-mediated cytoskeletal rearrangements, both essential for proper neural development. Previous research from the Gomez lab has found that human forebrain neurons differentiated from patient-derived TSC2+/- induced pluripotent stem cells (iPSCs) displayed axon outgrowth and guidance cue sensitivity defects independent of mTORC but attributed to diminished RhoA signaling. To explore this further, we examined TSC2+/- and TSC2-/- iPSCs and found reduced RhoA activity in TSC2-/- iPSCs at the early stem cell stage, indicated by decreased myosin light chain phosphorylation compared to TSC2+/- iPSCs. We are now characterizing RhoA defects in TSC2-/- stem cells and neurons to identify new phenotypes for rescue experiments using a Tet-inducible, Halo-tagged TSC2 lentivirus to restore normal TSC2 expression. Future experiments will investigate TSC2 activity and localization in live cells during repulsive guidance cue stimulation, assess whether LV-mediated TSC2 expression rescues RhoA activity and axon guidance defects, and identify key TSC2 domains regulating RhoA. Understanding these mechanisms may reveal therapeutic targets for TSC-related neurodevelopmental defects.

**RODERICK,
Megan**

Exploring interactions between PP2A-PR70 and BRD4 in triple-negative breast cancer

Major(s):
Molecular and cell
biology

Advisor(s): Yongna Xing

Thesis department(s): Molecular and cell biology

Certificate(s):
Data Science

BRD4 is a bromodomain-containing protein that regulates transcription associated with carcinogenesis and cancer progression. In triple-negative breast cancer (TNBC), the BET inhibitor JQ1 has potential to decrease tumor growth by blocking BRD4 function. However, a problem currently facing JQ1 treatment in TNBC is the development of resistance. Hyperphosphorylation of BRD4 has been implicated in the mechanism of JQ1 resistance, which was attributed to reduced activity of protein phosphatase 2A (PP2A). The specific PP2A regulatory subunit responsible for BRD4 dephosphorylation remains unexplored. We identified a short linear motif (SLiM) sequence for the PP2A regulatory subunit PR70 in the BRD4 amino acid sequence as a possible site of recruiting the PP2A-PR70 holoenzyme. Expression of this SLiM sequence alone can serve as an inhibitor of PR70-BRD4 interactions. Mutations in the SLiM sequence on BRD4 were designed to inhibit interaction with PR70. These expression constructs will be introduced into TNBC cell lines and the impact on BRD4-PR70 interactions, BRD4 phosphorylation, and JQ1 resistance will be assessed. Results may provide insights into the dephosphorylation of BRD4 by the PP2A-PR70 holoenzyme and inform the development of therapeutic strategies to overcome JQ1 resistance in TNBC.

RUDYKH, Daria

Harnessing Nature's Design: Investigation of Proteins as Sustainable Build Materials

Major(s):
Chemistry and
Computer Science

Advisor(s): AJ Boydston

Thesis department(s): Chemistry

The evolution of 3D printing technologies, especially Direct Ink Writing (DIW), presents a novel opportunity to harness the properties of various shear-thinning materials. Among these materials, proteins stand out due to their immunocompatible and biodegradable properties, making them highly suitable for medical and environmental applications. Although several studies have looked into protein 3D printing, many have relied on the use of additional synthetic additives (such as PEGDA) for the improvement of mechanical properties. This research proposes the use of native proteins with DIW without the addition of synthetic cross-linking agents, relying instead on the unique entanglement properties of protein structures. The goal of this project is to develop a method that ensures the structural integrity of printed objects while maintaining their environmental compatibility.

SHAH, Saira

Major(s):
Molecular and Cell
Biology

Mapping Human Immune Cell Development in Humanized Mouse Models for Hypoimmune Cell Therapy Studies

Advisor(s): Matthew Brown

Thesis department(s): Molecular & Cell Biology

The development of effective therapies for cancer and infectious diseases such as SARS-CoV-2 remains a priority in biomedical research. Advances in humanized mouse models—engineered to replicate the human immune system—have opened new avenues for studying immune responses in vivo. However, these models vary in their ability to support human immune cell development, particularly natural killer (NK) cells and T cells, which play crucial roles in transplant rejection. This study investigates immune development across three humanized mouse strains: NSG-IL15 (NeoThy), NSBSW, and NOG-IL6, with a particular focus on NSG-IL15 mice due to their robust NK cell chimerism. The primary goals are to (1) evaluate the development of human T cells and NK cells, and (2) assess responses to hypoimmune pluripotent stem cell (PSC)-derived therapies, including grafts lacking major histocompatibility complex (MHC) class I and II expression. Since the absence of MHC molecules can trigger NK cell-mediated rejection through missing-self recognition, the NSG-IL15 model provides a critical platform for studying immune evasion strategies. These findings will support the development of cell therapies designed to minimize immune rejection and promote graft tolerance.

SIMON, Abby

Major(s):
Psychology and
Neurobiology

Preschoolers' Use of Expertise in Word Learning

Advisor(s): Jenny Saffran and Jess Mankewitz

Thesis department(s): Psychology

As adults, we know it is impossible for everyone to know everything but at what age do we begin to understand that people can be experts? The present study investigated whether preschoolers are able to understand expertise and whether they consider that knowledge when learning new words. Three-year-olds participated in a tablet task in which they were taught the names of novel toys by two speakers, each with a color-specific domain of expertise. We then tested how well they learned these words. We expected participants to remember labels better when the color of the object matches the demonstrated expertise of the speaker. Preliminary findings with a small sample size indicate that three-year-olds are equally as accurate in recalling words taught by an expert or non-expert. Data collection of a full sample of forty participants is currently ongoing and findings will expand our knowledge of the strategies children are using to learn language.

SLOAN, Tyler

Major(s):
Molecular and
Cellular Biology;
and Global Health

Certificate: Biology
Core Curriculum

Determining the synergistic properties of Natural Extracts in combination with Vancomycin against Clostridioides difficile

Advisor(s): Nasia Safdar and Jonah Dixon

Thesis department(s): Molecular and Cellular Biology

Clostridioides difficile infection (CDI) is the most common colon bacterial infection in first world countries, with an estimated half a million infections in the United States each year. The CDC estimates that one in six patients diagnosed with CDI will see recurrence of the infection within two months of treatment. Natural compounds have been widely looked at as a potential alternative therapy for CDI. This study will look at combinations of six natural compounds with the antibiotic vancomycin and determine if they exhibit a synergistic relationship against C. difficile. We can identify this through a checkerboard broth microdilution assay to determine a minimum inhibitory concentration, a time-kill assay to determine if the combinations are able to kill all bacteria (bactericidal) or only inhibit cell growth (bacteriostatic), and finally a spore inhibition assay to see if they can inhibit spore germination. Through these experiments, I aim to find an in vitro treatment against C. difficile that can lead to a novel mechanism to treat recurrent CDI.

**SNOBERGER,
Courtney**

Major(s):
Psychology and
Spanish

Certificate(s):
Social Justice and
Education

The impacts of peer behavior and classroom environment on preschoolers' word learning outcomes

Advisor(s): Jenny Saffran, Ellie Breitfeld

Thesis department(s): Psychology

Learning outcomes for young children are closely related to their social experiences. While we know a great deal about the ways in which children's social interactions with teachers and parents influence learning, few lab-based studies have investigated the impact of peer interaction on children's learning outcomes. We hypothesized that supportive peers and positive classroom environments would improve preschoolers' acquisition of novel words. To test this hypothesis 3- to 5-year-olds viewed a short, animated video of kids participating in an art activity in either a positive or negative classroom. Participants then watched a supportive and unsupportive peer interact before each peer labeled two novel objects. We then tested word learning accuracy. We will determine how well children learned novel objects from the supportive peer and unsupportive peer and in either the positive or negative classroom environment.

Once full data completion and analysis is collected, the results will inform possible implications for the role of positive learning environments in improving children's academic success.

**SUKUMAR,
Srinandini**

Major(s):
Political Science,
Economics, and
French

Do terrorist organizations join government?

Advisor(s): Jon Pevehouse

Thesis department(s): Political Science

In the 21st century, Violent Non-State Actors (VNSAs), or terrorist organizations, have often been written off as negative externalities of failed governance, consequences of an imperialist past, or reactions to interventionism. However, there is a notable lack of investigation into whether VNSAs could serve as conduits for inducing political activity and whether this could be extrapolated to suggest that they might enter governance in a forthright manner. This paper investigates the trade-offs between remaining non-state actors and entering politics for VNSAs, with the aim of understanding the failure to fully democratize the Middle East.

SURI, Natalie

Major(s):
History

The Story of Desegregation Policy Implementation in Austin, Texas: How Brown v. Board Made Educational Equality Improbable

Advisor(s): Walter Stern

Thesis department(s): History

Seventy years ago Brown v. The Board of Education was hailed as the solution to educational inequality yet there is still a large racial opportunity gap in American schools. I detail how desegregation policy impacted the minority groups in Austin, Texas that it intended to help. My analysis shows how the interpersonal rather than structural understanding of inequality that Brown promoted hindered its potential to mold a more equitable educational landscape.

**WALSH,
Patrick**

Major(s):
Applied
Mathematics,
Engineering, and
Physics; Physics;
and Data Science

Certificate(s):
Computer Science

A Simulation Backend for Autotuning Quantum Dot Qubit Devices

Advisor(s): Mark Eriksson

Thesis department(s): Physics

Gate-defined quantum dot (QD) devices confine individual electrons for use as quantum bits for quantum computation. Their operation requires experimentalists to tune a variety of voltages across the device. Thus, to scale up the number of dots, autonomous methods of selecting these voltages (i.e. device tuning) are required. Here, we present a current-flow simulation of a QD device designed to enable the testing and development of such autotuning software. It simulates the gate-voltage response of a gate-defined QD qubit device, and it is built using a Schrodinger-Poisson solver. We demonstrate how the output of this solver was made interpretable for an autotuner and how this was then used to aid autotuner development. This simulation backend provides a powerful platform for further autotuning development.

WANG, Justina***Adaptive Reading Interfaces for Bilingual and Immigrant Families***

Major(s):

Advisor(s): Bilge Mutlu and Hui-Ru (Irene) Ho

Computer Science

Thesis department(s): Computer Science

Certificate(s):

Education and
Educational
Services

This study develops and evaluates a web-based reading tool designed to support immigrant parents in co-reading with their children. Many immigrant parents face difficulties maintaining reading flow due to language barriers, unfamiliar cultural references, and limited access to relevant materials. To address these challenges, this research explores adaptive interfaces that offer varying levels of language support, culturally responsive content, and AI-generated prompts using ChatGPT.

The intervention is a web tool intended to be used alongside physical books, combining traditional reading with digital support. The study consists of two phases: Phase 1 identified key design elements through a series of interviews, generating evidence-based guidelines for inclusive reading interfaces. Phase 2 assesses the tool's usability and effectiveness through user testing with bilingual/immigrant parent-child pairs (children aged 4-6). By analyzing engagement, confidence, and interaction patterns, this study evaluates whether AI-enhanced reading tools improve co-reading experiences. Findings will inform the design of culturally responsive literacy tools, fostering stronger parent-child engagement in multilingual households.

WANG, Jessica***LearnMate: Enhancing Online Education with LLM-Powered Personalized Learning Plans and Support***

Major(s):

Advisor(s): Bilge Mutlu

Computer Science

Thesis department(s): Computer Science

With the increasing prevalence of online learning, adapting education to diverse learner needs remains a persistent challenge. Recent advancements in artificial intelligence (AI), particularly LLMs, have introduced powerful tools and capabilities to enhance personalized learning in online educational environments. In this work, we explore how large language models (LLMs) can improve personalized learning experiences by catering to individual user needs and enhancing the overall quality of online education. First, we design a personalization guideline based on personalized learning theory to ground LLMs in generating tailored learning plans. Next, operationalizing these guidelines, we implement LeanMate, an LLM-based system that generates personalized learning plans and provides real-time learning support to users. Finally, we discuss the implications and future directions of this work, aiming to move beyond the traditional one-size-fits-all approach by leveraging LLMs to integrate personalized support in online learning environments.

WU, SherrieMajor(s):
BiochemistryCertificate(s):
Chinese
Professional
Communication***Breaking the biofilm barrier: CRISPRi-guided investigation of Pseudomonas aeruginosa susceptibility to a novel natural product*****Advisor(s):** Tim Bugni**Thesis department(s):** Pharmacy

Antibiotic resistance is a growing concern, with pathogens such as *Pseudomonas aeruginosa* evolving resistance to clinical treatments. Furthermore, our race against antibiotic resistance is worsened by a slowdown in novel antibiotic discovery. The Gram-negative bacterium *P. aeruginosa* often causes infections in patients with cystic fibrosis and poses a particular threat due to its ability to form biofilms, which are stable supercellular structures that adhere to surfaces and enhance resistance to antibiotics. However, natural products are promising sources for discovering new antimicrobial compounds. This project investigates the mechanism by which a recently discovered antibacterial natural product and a semi-synthetic derivative inhibit *P. aeruginosa* biofilm formation. Based on preliminary studies, it was hypothesized that the natural product and its derivatives interfere with pigment production and/or signaling, which is important for biofilm development. Full genome CRISPR-interference (CRISPRi) knockdown strains of *P. aeruginosa* were utilized to identify the genetic and biochemical targets of the natural product and its analog. By elucidating the mechanism of how biofilm formation is inhibited, this research aims to reveal vulnerable genes and pathways that can be targeted for future antibiotic development, with implications for treating *P. aeruginosa* and potentially other comparable pathogens.

ZHAO, YaleiMajor(s):
Statistics and
Mathematics***Sensitivity Analyses for Missing Not at Random Data in Body Donor Program Studies*****Advisor(s):** Richard Chappell**Thesis department(s):** Statistics

Missing data on socioeconomic variables, such as education and occupation, is a common issue in survey studies and can be Missing Not at Random (MNAR), where the likelihood of missingness depends on unobserved factors. Even small amounts of MNAR can introduce bias, compromising the validity of model outcomes. This study examines potential MNAR issues in the UW-Madison Body Donation Program's Life Course Research, which predicted whole-body acceptance rates using registrants' demographic data, including incomplete education and occupation variables.

To evaluate the robustness of the acceptance prediction model, a three-stage sensitivity analysis framework was developed. The framework consists of (1) assigning ranks to categorical covariates based on model coefficients, (2) imputing missing data under the Missing at Random (MAR) assumption, and (3) simulating MNAR scenarios by introducing deviations from MAR using a sensitivity parameter. Bootstrapping was applied to generate mean outcomes and confidence intervals to assess MNAR's impact. The results indicated that the missingness in the dataset had minimal influence on the robustness of the model. This framework is practical and interpretable for assessing model robustness with categorical MNAR covariates and can be applied to enhance decision-making in other studies.

ZOU, Bocheng***A Simple Yet Surprisingly Effective Baseline for One-Class Defect Detection***

Major(s):

Advisor(s): Yong Jae Lee

Computer Sciences

Thesis department(s): Computer Sciences

Defect detection plays a critical role in industrial inspection and quality assurance, traditionally tackled using complex deep learning architectures and large annotated datasets. In this paper, we present a simple yet remarkably effective baseline that operates using only positive (defect-free) samples and incurs minimal computational cost. Our method leverages a lightweight feature extraction pipeline built on a ViT-style pretrained foundation model, combined with statistical modeling to identify anomalies as deviations from normal patterns. Despite its simplicity, the approach achieves competitive—often superior—performance compared to state-of-the-art methods on established benchmarks such as MVTec, requiring only a few minutes of dataset-specific adaptation. These results highlight the effectiveness of minimalist design and offer a strong baseline for future research in industrial defect detection.