2024 STAR SCHOLARS SUMMER SHOWCASE

DREXEL UNIVERSITY
Undergraduate Research & Enrichment Programs
Pennoni Honors College

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The STAR Scholars Program is administered by
Undergraduate Research & Enrichment Programs,
a unit of the Pennoni Honors College.

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A MESSAGE FROM THE DEAN

As I approach the end of my ten-year tenure as Dean, I am proud to say that STAR, our flagship undergraduate research program, remains one of the most successful and important programs at Drexel. Each year, that program has culminated in the STAR Showcase, an event in which students present posters about the work that they have spent their summer pursuing. Last year, for the first time, we were able to hold this event in Bentley Hall, a space dedicated exclusively to the Pennoni Honors College. We are again hosting this year in what we expect will be a continued tradition.

The STAR Showcase always draws rave reviews from visitors, surprised that such quality work can be produced by rising sophomores. It is also a tribute to our STAR Scholars that increasing numbers of faculty express interest in serving as their mentors.

As our STAR Scholars move on with their education, we know that some, who found that they love research, will continue to do it during their years at Drexel and will have a head start on their careers. Others, whose interests lie elsewhere, will have gained important skills that will serve them well, no matter what they do. The intellectual challenge and the camaraderie of STAR are valuable adjuncts to the college experience, likely to endure in students' memory for a long time to come.

We are pleased to have such a dedicated team in Undergraduate Research & Enrichment Programs in the Pennoni Honors College. Over the last few years, this unit has grown stronger and more unified under the stewardship of its director, Jaya Mohan.

We hope that our 2024 STAR Scholars will continue to take advantage of opportunities in the Pennoni Honors College as they move forward in their Drexel education. Bentley Hall is always open, and our staff is eager to engage with this talented group in new ways.

Dr. Paula Marantz Cohen
Dean, Pennoni Honors College

A MESSAGE FROM THE DIRECTOR

Welcome to the 2024 STAR Scholars Summer Showcase. The STAR Scholars Program engages highly motivated first-year students in faculty-mentored research, scholarship, or creative work during the summer between their first and second years as Drexel undergraduate students. The 123 students in our 2024 STAR Scholars cohort participated in projects guided by mentors in 10 of Drexel's 14 colleges and schools. These students, our 22nd cohort, lived in Bentley Hall, the home of the Pennoni Honors College, and participated in in-person social and co-curricular programming to help solidify their connections to one another and further develop their research-related skills. Of note this year:

- Two students completed their research internationally at the Indian Institute of Technology-Madras (IIT-Madras) as we relaunched the iSTAR Scholars Program
- Nine underrepresented students in STEM were funded by the Louis Stokes Alliance for Minority Participation (LSAMP) to participate in STAR (pg 137)
- Eleven students participated in the Frances Velay Fellows program, a subset of STAR designed to support women in STEM (pg 136)
- Forty students signed up to compete in the STAR Scholars Quick Pitch competition (pg 11)

In collaboration with Pennoni's Academic Programs, we are also pleased to award the first Teagle Civic Impact Award this year to two STAR Scholars whose research has contributed to the betterment of their local, national, or global community.

Our flagship event, the STAR Scholars Summer Showcase, will be held in Bentley Hall for the second year in a row. We're thrilled to celebrate the vast accomplishments of our STAR Scholars here in the home of the Pennoni Honors College. Congratulations to the 2024 STAR Scholars!

Jaya Mohan, MA
Director, Undergraduate Research & Enrichment Programs

OUTSTANDING MENTOR OF THE YEAR

The critical piece of the STAR Scholars Program that makes it such a valuable experience for the students is, without a doubt, their Mentors. The STAR Mentors give much to their students' summer experiences and do so with no compensation.

In Summer 2011, we created a process to recognize the STAR Mentors and to particularly celebrate the Outstanding Mentor(s) of the Year. STAR Scholars are given the opportunity to nominate their faculty mentors for the "Outstanding Mentor of the Year" award, which provides the awardee with a $1,000 award to futher their research with undergraduate students. Since 2011, this award has been given to 20 faculty.

Each nominated mentor receives a letter signed by the Provost that outlines the common characteristics held by all nominated Mentors, and each letter includes excerpts from the students' nomination letters to provide an individualized account of just how these Mentors have contributed to those specific students' experiences.

Based on these nominations, outstanding Mentors:

- Are passionate experts in their field who freely share their expertise with students
- Care deeply about their students and treat them with respect
- Generously foster students' intellectual and professional development
- Actively engage students in learning and celebrate their success
- Go above and beyond in supporting their students

All of our mentors go beyond the call in their work with STAR Scholars, and we are genuinely grateful for the time and effort they commit to furthering the education of undergraduate students.

2023 STAR SCHOLARS: OUTSTANDING MENTORS OF THE YEAR

Ellen Bass, PhD

Ellen Bass, PhD, is the Interim Senior Associate Dean for Research & Professor of Information Science in the College of Computing & Informatics. She has over thirty years of human-centered systems engineering research and design experience in air transportation, healthcare, meteorology and other domains. The focus of her research is to develop theories of human performance, quantitative modeling methodologies, and associated experimental designs that can be used to evaluate human-automation interaction and human-human collaboration in the context of total system performance.

Dr. Bass mentored three STAR Scholars in 2023: Sukriti Dhungel, Loren Lei, and Bhavya Isotia. All three of her mentees nominated her for Outstanding Mentor of the Year, noting her commitment to her students' learning and growth, both as researchers and as people. Loren wrote, **"I came into the STAR experience without prior experience of what research is like, let alone the analytical thinking that it requires. Professor Bass understands that, and instead of holding my hand throughout the process, she found the right balance of letting me make the mistakes and pointing them out to me, no matter how small or "stupid" they were. [...] Most importantly, Professor Bass cared about the development of me as a person, not just the research."**

Sukriti said, **"Her genuine enthusiasm for my progress surpassed my own, and she wholeheartedly embraced every stage of my learning process. Her mentoring efforts radiated genuine passion. Beyond guiding research, Professor Bass organized social events for all CCI STAR Scholars [...] Her focus consistently revolved around nurturing our learning and igniting a research-driven passion."**

Bhavya added, **"Professor Bass has been my most inspiring mentor who has consistently focused on broadening our horizons, nurturing our intellectual curiosity in research by giving us a chance to keep on working on our projects even after [STAR], and igniting a genuine fervor for research."**

2023 STAR SCHOLARS: OUTSTANDING MENTORS OF THE YEAR

Mauricio Reginato, PhD

Mauricio Reginato, PhD, is a professor and interim chair in the Department of Biochemistry & Molecular Biology, and director of the Graduate Program in Cancer Biology at Drexel University College of Medicine. His lab is interested in understanding how signaling pathways regulate metabolic reprogramming in cancer cells, particularly breast cancer, with the ultimate goal of developing novel treatment therapies.

In 2023, Dr. Reginato mentored two STAR Scholars: Anna Ramesh and Madhu Karuppiah.

Both of his students noted his commitment to teaching and mentoring all members of the lab, from the newest to the most experienced researchers.

Madhu said, **"Despite having students at all levels (undergraduates, graduates, volunteers), Dr. Reginato constantly made an effort to make sure everyone is engaged and enjoying the research they were participating in and always interacted and treated students of all levels in his lab equally."**

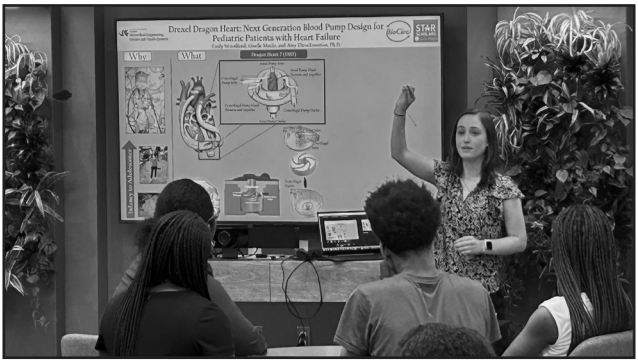
Anna added, **"Aside from daily check-ins, Dr. Reginato was kind enough to have weekly one-on-one meetings with me, where we would go over the data I had compiled the previous week, he would further explain the theory behind our experiments, and he would ask how I was feeling about my overall lab experience."**

Madhu said, **"Over my time in STAR, I have realized that it is easy to do experiments and get results without even understanding what we are doing and why we are doing it. Luckily, while working under Dr. Reginato, I never felt like I was doing tasks without understanding the underlying reasons and science behind it. Truly giving the work I was doing purpose and motivating me to continue to come in and challenge myself to learn."**

2023 STAR SCHOLARS: QUICK PITCH COMPETITION

The Quick Pitch Competition gives STAR Scholars the opportunity to distill their STAR projects into a three-minute, one-slide explanation to a general audience.

Up to 10 students participate in four preliminary sessions scheduled during the second half of the summer term. A panel of judges comprising of Drexel staff and faculty select two winners from each session to advance to the finals. Eight finalists present their Quick Pitches at the finals, and three winners are selected.



2023 STAR Scholars Quick Pitch Competition winners:

First Place: Emily Woodland, biomedical engineering '27
"Drexel Dragon Heart: Next Generation Blood Pump Design for Pediatric Patients with Heart Failure"
Faculty Mentor: Dr. Amy Throckmorton (BIOMED)

Second Place: Madhu Karuppiah, biomedical engineering '26
"Starving Breast Cancer in the Brain"
Faculty Mentor: Dr. Mauricio Reginato (CoM)

Third Place: Julia Wiafe-Jackson, global studies '26
"EcoHIV Effects on Reward Seeking Behavior and Stiatal Microglia Function"
Faculty Mentor: Dr. Mark Namba (CoM)

2024 STAR Scholars Abstracts

Jackson Lee Tignor II

Antoinette Westphal College of
Media Arts & Design
Architecture

Faculty Mentor: **Professor Jacklynn Niemiec**
Architecture, Design & Urbanism

The Living Grid: Visualizing the Architectural Culture of Two Philadelphia Neighborhoods

New developments have swept across Philadelphia in recent years, and gentrification is rampant in many of the neighborhoods these new buildings inhabit. This is because architects and developers lack experiential data that conveys the feeling of a neighborhood beyond stereotypes and statistics. Through methods like street photography, mapping, art, and conversation, architects can better understand how the built environment shapes cultural conditions. I spent the summer documenting my observations of the area around Dickinson Square Park in Southeast Philadelphia and Kensington between Berks and Huntingdon streets. I walked tens of miles each week up and down the same streets to observe how people use their stoops, where children play, what people do on the weekends, who comes and goes and when, and innumerable other aspects that define urban living. These patterns of life are unique to each neighborhood and develop in response to a distinct architectural culture. Cultivating an awareness of community identity is essential for architects throughout the design process. Architects' research methodology must expand to help extend and grow these local cultures rather than replace them.

Emery K.J.

Antoinette Westphal College of
Media Arts & Design
Game Design & Production

Faculty Mentor: **Dr. Frank J. Lee**
Digital Media

Co-Mentors: Dr. Erin J.K. Truesdell (STAR 2016), V.K. Tian

Under Watch: Are Narrative Games Better When They're Uncomfortable?

Video games are often designed to be fun, escapist experiences, but they do not have to be. Discomfort design has become an exciting way to provoke greater self-reflection and appreciation of a game's narrative. Most literature on discomfort design is limited to case studies of art, so Under Watch's goal is to create a controlled environment to test the impacts of uncomfortable or disturbing gameplay on player reflection and appreciation. To accomplish this, we created SnapGram, a fake social media app where players "hunt" each other, taking selfies with their targets. Over the course of the study, a narrative will be revealed, showing how social media companies like SnapGram can abuse user data. Fake advertisements will become increasingly malicious, eventually using selfies to train A.I. "deepfakes" of players, creating ads featuring fake versions of real users. Through interviews and usage metrics, we will collect first-hand quantitative and qualitative data, a rarity in the field of discomfort design. By telling a story with a lesson and utilizing uncomfortable design, we hope to demonstrate gaming as a reflective art medium, and discomfort design as an effective tool to prompt player enjoyment, engagement and reflection.

Daniel Quillen

College of Computing & Informatics
Computer Science

Faculty Mentor: **Dr. Frank J. Lee**
Digital Media

Designing a Game to Encourage Collective Action

How can we bring people together to achieve a common goal (i.e. act collectively for the benefit of the group)? The primary barrier to this collective action is participative self-efficacy (a person's belief in their ability to contribute to a group goal). *Hot Seats* aims to enhance participative self-efficacy (and therefore increase collective action) by encouraging players to work together in a fast-paced but low stakes environment.

Hot Seats a musical chairs-inspired game where players negotiate, strategize, and balance conflicting personal and group goals. These interactions and decisions mirror real-world collective action challenges.

Hot Seats combines physical interaction through lanyards and sensor-equipped chair cushions with a digital program managing the complex ruleset — a video game-like application on a central computer. This allows players to focus on strategizing as a group, giving us insight into how people can work together to achieve a common goal.

Sofia E. Muccitelli

Antoinette Westphal College of
Media Arts & Design
Animation & Visual Effects

Faculty Mentor: **Dr. Glen Muschio**
Digital Media

Co-Mentors: Dave Mauriello, Erik Sundqist, Trevor Phaneu

Digital Reconstruction of Peale's Museum: 3D Modeling the Menagerie and 3D Printing the Moses Williams Bust

Charles Willson Peale was an American artist and naturalist who ran an innovative museum at Philosophical Hall in 1794 and moved it to Independence Hall in 1802. The museum blended art, science, and technology, including portraits, taxidermy displays, scientific tools, and more to educate the public in entertaining ways. Peale's passion for taxidermy displays led him to create a menagerie with young animals to be raised to adulthood and used as taxidermic specimens.

For my research, I recreated the space for the menagerie by producing digital 3D models of Philosophical Hall, Independence Square, fencing, foliage, and cages based on historical descriptions and images. I experimented with a LIDAR scanner, and switched to a digital camera, to document Philosophical Hall. I tested various AI software for modeling and found Meshy AI most effective.

Moses Williams was born into Peale's household as a slave. As a child he tended to animals in the menagerie and prepared taxidermy displays. As a manumitted adult, he worked in the museum as the silhouette portrait artist. Another student created a 3D digital model of Williams, which I prepared to print as a life-size 3D bust intended for use at The Peale, *Baltimore's Community Museum*.

Sarah G. Bonsall

Antoinette Westphal College of
Media Arts & Design
Graphic Design

Faculty Mentor: **Professor Mark Willie**
Graphic Design

Censorship vs. The Polish Poster

"Could it be that repression produces the best art?" — Steven Heller, *Masters of Polish Poster Art*

The Frank Fox and Kenneth F. Lewalski Collections at the Westphal College consist of over 2,500 Polish posters from the 1950s to the 1980s. Vibrant in style and color, these posters were a part of a movement called The School of Polish Poster Art. Artists and periods within the movement are connected via visual symbols. Themes such as the eyeball, the circus, and the American Western are represented as slight nods to the reality of life in Cold War-era Poland, as artists were under strict censorship from their communist government. Despite being a compelling connection between art and state, there is little conversation about the collections at Drexel. In order to bridge this gap, I wanted to communicate the central themes of the collections and continued an Instagram account created by 2023 STAR Scholar Lillian Byrd. I made infographics that explain themes and artists essential to the School of Polish Poster Art's impact on art and censorship. On social media, this information is now easy to access and digest. Westphal's Polish Poster collection can now have increased visibility and recognition within the university.

Will Lazar

Antoinette Westphal College of
Media Arts & Design
Music Industry

Faculty Mentor: **Brendan Monahan**
Music Industry

Studio Design and Maintenance for Longevity and Upgradability

In the music industry we take for granted that, more often than not, when we walk into any recording studio everything works and follows a standard that any engineer can follow. With that being said, few people put much thought in how studios are wired to follow that standard and how they are maintained. My work saw me working as a maintenance engineer in the Music Industry studios, maintaining, upgrading and planning them. I made upgrades to many of the studios by installing new outboard gear and building cables and microphones. The maintenance included redoing two of the Music Industry's studios as well as instrument maintenance. The final portion was the planning I have done to retroactively upgrade one of the studios to support Atmos as well as create plans for a new studio space. Doing this gave me a much greater grasp of how the hundreds of inputs and outputs are routed together to make a studio work. Additionally this also taught me about what you should think about when designing a studio and common pitfalls that people can fall into when building studios. In particular the program taught me that a studio should be easily upgradable and how important that is as new technologies such as Atmos emerge.

Caleb Altizer

Antoinette Westphal College of
Media Arts & Design
Music Industry

Faculty Mentor: **Professor Ryan Moys**
Music Industry

An Exploration of Dolby Atmos: Creating Music in Immervise Audio

With the ever-changing sphere of recorded music, it is no surprise that the era of stereo sound, which is music that utilizes left and right audio channels, is coming to an end. Dolby Atmos, which is an immersive audio experience that creates a three-dimensional sound field, has become more prominent as streaming services have begun to support this new wave of audio experience. This innovative listening experience has created new career opportunities as artists can achieve this sound by delivering their mixed stems to Atmos-specific engineers. Through my project, I explored this role of Atmos engineering by putting my own compositions through this spatial audio process. Utilizing digital audio workstations, I produced and mixed jazz orchestral pieces that adhered to this immersive format. Then alongside my mentor, I took these compositions to recording studios and experimented with recording techniques that created a 360-degree hemisphere. After achieving a spatial audio sound in a digital format, we compared the two end products analyzing which method proved more efficient in achieving a true immersive feel within the music. This research helps provide efficient and successful methods for recording and mixing immersive audio.

Promise Nkhono

Antoinette Westphal College of
Media Arts & Design
Product Design

Faculty Mentor: **Professor Michael Glaser**
Product Design

Co-Mentor: Professor Ann Gerondelis

Malawi's potential for Art Education through its legacy of Ancestral craft-making

Growing up in Malawi, my appreciation for the arts was shaped significantly by what I absorbed from the West. Figures like Picasso and Van Gogh were revered whilst Malawian art influences faded into the background. This narrative, born from colonial legacies, distanced me from my cultural heritage and continues to feed the idea that local talent is primitive unless it fits into Western ideals. I recognized that now more than ever, there's an urgent need to invigorate Malawi's creative arts scene to celebrate our culture and bolster the economy.

Inspired by Malawi's ancestral craft legacy, I gravitated towards the humble basket: an everyday object woven with stories of trade, tradition and survival. My research aims to honor and recreate the basket-making process for culturally alienated users grounded in a collaborative craft-making experience. Looking forward, I envision a modern art education framework that not only uplifts Malawian artisans but fosters a deeper appreciation for our unique cultural identity; to fuel a new generation of artists empowered by a legacy of art that's been harvested and woven into the fabric of our shared history.

Aditi Moturi

Bennett S. LeBow College of Business
Business & Engineering

Faculty Mentor: **Professor Jonathan A. Liss**
Accounting

Navigating Tax Law Challenges in the Era of Remote and Hybrid Work

In response to the many new, atypical employment arrangements, tax law continues to evolve. With remote and hybrid work rapidly expanding since the COVID-19 pandemic, the taxation of non-resident employees has impacted millions across the U.S. Only a few states have modified their laws to accommodate the modern workstyle. New Jersey and Texas have been leading examples of accommodating worker relocations, retaining businesses using tax incentives, and addressing nexus and reciprocity issues.

Interviews with David Brunori and Jennifer Karpchuk, distinguished state and local tax specialists, highlight the long-standing history of complex tax law and the heavy tax burden individuals face under the current system. While there are several economic and political barriers preventing the establishment of an ideal uniform tax system, we have entered an era where remote work or relocation has become the norm. Without amendments to current economic nexus standards and regulations, small businesses and the majority of working-class Americans that travel, work remotely or on a hybrid work schedule, will continue to face a patchwork of puzzling tax obligations.

David Mai

Bennett S. LeBow College of Business
Finance

Faculty Mentor: **Dr. Murugan Anandarajan**
Decision Sciences

Assessing Global AI Risks with Analysis of Regulations and Threats

AI has dramatically reshaped the world by revolutionizing how we work, communicate, and make decisions. It has transformed businesses by automating routine tasks and enhancing productivity. Even in our everyday lives, AI-powered assistants such as Siri or Alexa have become common, helping people with their daily tasks. However, these developments have sparked significant privacy and digital security concerns, raising questions about the safe and fair use of AI.

To see how AI is affecting the world, we collected a list of 8175 AI incidents. These incidents can be categorized into sentiments, themes, AI principles, and harm types. By examining incidents, we identified key themes and principles that correlate most with negative outcomes. Notably, the theme of deepfakes often correlates with negative incidents. Recognizing these connections, we can identify the most pressing AI risks.

Overall, this research emphasizes the transformative potential of AI while acknowledging its dangers. To maximize AI's benefits and minimize its harm, implementing an AI framework is essential. Doing so will ensure that AI's advantages are maximized, its risks are effectively managed, and its positive impact on business growth is sustained.

Samirah R. Rahman

Bennett S. LeBow College of Business
Management Information Systems, International Business

Faculty Mentor: **Dr. Yanliu Huang**
Marketing

Co-Mentor: Xinge Li

Optimizing AI Recommendation Systems: The Impact of Message Type and AI Anthropomorphism on Consumer Response

With the rise of Artificial Intelligence (AI), AI recommendation systems have become an increasingly popular marketing tool for companies. These systems utilize a consumer's online behavior data — such as search and purchase history — to suggest new products. These recommendations can be delivered in various manners, further resulting in divergent outcomes. Thus, examining how to create an effective method of delivery to encourage consumers' purchases can provide practical implications for marketers. We proposed that the success of these systems varies depending on the interaction between the type of recommendation message (informative vs. persuasive) and the anthropomorphic nature of the AI system (robotic vs. human-like). An online survey was conducted to test our hypothesis. We found that informative (vs. persuasive) messages were more effective when delivered by a robotic AI, but the effect was mitigated when the AI was perceived as more human-like, likely due to the participants' innate perception of the system. Our research not only provides information on how consumers react to AI recommendations but also suggests that optimizing the recommendation's delivery based on the AI's anthropomorphism can enhance marketing efficacy.

Pablo Santos

Bennett S. LeBow College of Business
Economics, Mathematics

Faculty Mentor: **Dr. André Kurmann**
School of Economics

Geography of AI

This study examines regional disparities from large language model (LLM) exposure across the United States and its potential impact on the labor market. Combining data on LLM exposure by occupation from Acemoglu (2024) with regional employment shares by occupation from the Bureau of Labor Statistics (BLS) Occupational Employment and Wage Statistics (OEWS) program, the analysis constructs an index of LLM exposure across different Metropolitan Statistical Areas (MSA). This index is then related to various regional characteristics, offering insights into the potential impacts of LLM on regional inequality and employment patterns. The study highlights areas with varying degrees of LLM exposure, particularly noting that regions with higher percentages of college-educated individuals tend to have higher LLM exposure. However, it also acknowledges the presence of other confounding variables. While Acemoglu's work suggests that areas with higher LLM exposure may experience more growth, the study notes uncertainty about whether the resulting productivity boost will outweigh the potential displacement effects on workers.

Nihar Shah

Bennett S. LeBow College of Business
Economics & Data Science

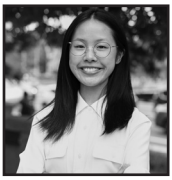
Faculty Mentor: **Dr. André Kurmann**
School of Economics

Variation in Regional Inflation Rates after the COVID-19 Pandemic and its Causes

In the wake of the COVID-19 pandemic, the United States experienced an increase in inflation from 2% to around 8%. This project examines the extent to which inflation varied across regions before, during, and after the pandemic and the role of fiscal stimulus, population growth rate, and other factors in accounting for these differences.

We use Consumer Price Index (CPI) data from the Bureau of Labor Statistics for 6 broad categories across 23 Metropolitan Statistical Areas (MSAs) to calculate regional inflation rates. This is compared to a database of statistics on population growth rate, per capita personal income, and fiscal stimulus in the form of personal current transfers, compiled from the Bureau of Economic Analysis and the Census Bureau data. Our findings show a significant inflation increase in regions with high population growth and low income, particularly in the South with an increase in housing prices being a major contributor to this.

However, the link between fiscal stimulus and inflation is unclear due to limited MSA-level CPI data. More granular evaluation of varied data sources could clarify each of these factors' impact on inflation individually, aiding strategies for a quicker recovery in future crises.



Hui Min Chen

Bennett S. LeBow College of Business
Economics, International Business

Faculty Mentor: **Dr. Ohyun Kwon**
School of Economics

Co-Mentor: Blaize Giangiulio

Unveiling Export Inflation: Discrepancies in China's Trade Data and Their Global Impact

China's trade data has long faced criticism for inaccuracies, often attributed to data manipulation. These inaccuracies undermine effective data collection, policy formulation, and econometric analysis. This paper investigates discrepancies between reported export figures from China and the U.S., examining whether China inflates its export numbers and the motivations behind such practices. By analyzing reported and modeled export data from 2019 to 2021, using sources such as the World Bank, Mario Larch's Regional Trade Agreements Database, and CEPII's Gravity Data, great divergences between expected (fitted) and actual (reported) values were identified. The findings reveal a notable increase in China's reported exports, surpassing those of the U.S. by 2021, while fitted values for traded goods showed steeper growth projections that did not fully align with actual figures. This suggests possible inflation of China's export figures, raising concerns about the impact on global trade policies and data integrity. Understanding these discrepancies is crucial for formulating accurate international policy responses. Further investigation into these patterns is necessary to comprehend their broader implications for global trade relations.

Chloe Mshana

Bennett S. LeBow College of Business
Economics

Faculty Mentor: **Dr. Teresa Harrison**
School of Economics

Navigating the Nonprofit Landscape: The Effect of State Regulations on Nonprofit Registrations, Mergers, and Dissolutions

Nonprofits are regulated by states rather than the federal government. As a result, nonprofit legislation varies greatly when considering registrations, mergers, and dissolutions. These differences may be the cause of low exit rates in the nonprofit sector. This presents a challenge since exits are crucial to the churn, efficiency, and vitality of an industry.

This research investigates the legal processes and implications of registering, merging, and dissolving a nonprofit in six key states. Tennessee, New York, Ohio, Arizona, Pennsylvania, and New Jersey were explored due to their unique initiatives. For instance, Ohio has a Charitable University program and Arizona has an advantaged tax credit system. We utilized Excel to analyze federal data for nonprofit density per 1000 people. This showed that states like New York and Pennsylvania with extensive documentation of nonprofits (e.g. a transaction or a non-profit registration database) tend to have a higher nonprofit density.

In the future, we aim to merge state and federal registration data in hopes of explaining low nonprofit exit rates. This research can better inform nonprofit leaders resulting in maximized social impact for beneficiaries and the broader community.

Kate Buskirk

Bennett S. LeBow College of Business
Economics

Faculty Mentor: **Dr. Tristan Potter**
School of Economics

Global Patterns in Protected Area: Understanding Socioeconomic and Political Determinants of Conservation Efforts

Policies like the U.S.'s plan for 30% conservation by 2030 attempt to address ongoing threats to natural areas, but little research has been done on its country-level influences. This project explores the socioeconomic and political determinants of conserved land such as National Parks, botanic gardens, and coastal reserves. We create a database of 182 countries (1960-2022) to assess how factors including population, GDP, agricultural employment, urbanization, net exports, and democracy impact conservation. Panel regression accounting for time- and country fixed effects and various other factors suggests that population size, net exports as a share of GDP, and CO2 emission growth rate are associated with significant area changes. Specifically, low-population countries see decreased conserved land growth until their populations reach roughly 20 million, after which growth increases; a 1 percentage point increase in net export share of GDP reduces conserved land growth by around 1377 sqkm; and 1 percentage point increase in growth of CO2 emissions compared to the previous year leads to an approximate 26 sqkm decrease in area change. These findings can provide insight into what impacts conservation and inform related initiatives.

Ranit Roy

Bennett S. LeBow College of Business
Economics

Faculty Mentor: **Dr. Tristan Potter**
School of Economics

Impact of Air Quality Deterioration on Climate Change Attitudes

Climate change is among the most urgent social problems of our time. Addressing climate change through public policy requires understanding what shapes the public's views. This research explores how air quality deterioration from events like the 2022-23 Canadian wildfires influences attitudes toward climate change. To do so, we constructed a database linking various dimensions of climate attitudes with air-quality metrics by scraping data from AirNow.gov for all US counties between 2016 and 2023, focusing on six pollutants. We mapped this data to county-level FIPS codes and merged it with the Yale Climate Opinion Map & Climate Opinion Over Time data to explore the correlation between pollutant exposure and public opinion. Our results show that increased exposure to ground-level ozone (OZONE-8HR) positively and significantly correlates with heightened public support for stricter environmental laws, even after controlling for county and year-fixed effects, though these effects are minimal—a two standard deviation increase in OZONE-8HR associated with less than half a percentage point rise in support for stricter emission limits. Our results suggest a need for more proactive approaches to influencing public opinion about climate change.

Nasya Tandiono

Bennett S. LeBow College of Business
Economics

Faculty Mentor: **Dr. Ricardo Serrano-Padial**
School of Economics

Cross-Country Time Series Analysis of Crypto and Forex Market Causality

The interdependence of crypto and foreign exchange markets is widely researched in finance literature with country-specific studies. However, since both markets are influenced by global factors, a multicountry analysis is needed. I attempt to address this gap by comparing the time series of two exchange rates from each continent against Bitcoin, Ethereum, and Tether, exploring whether both markets are interdependent and influence each other using Engle-Granger and Granger statistical tests, along with VECM and linear modeling.

I discovered a structural break in the time series and split them into pre- and post-break series. Except for Ethereum and Bitcoin, no stationary series exhibit causality and a strong linear relationship. Among non-stationary series, only CAD/USD and COP/USD exhibit cointegration with Bitcoin and Ethereum. The presence of at least one cointegrating vector in our VECM model is related to the aforementioned structural break, which exists due to the Fed's monetary tightening around October 16, 2022. This shows that both markets' price dynamics are not influenced by each other but by external factors such as monetary policy.

James Biernat

Bennett S. LeBow College of Business
International Business, Business Analytics

Faculty Mentor: **Professor Sarah Napoli**
Sport Business

Examining the NFL's Global Markets Program and its potential growth of fandom and revenue

The National Football League has followed in the path of many other professional U.S. sports leagues by placing a strong emphasis on international expansion over the past five years. As the NFL continues to host games overseas and grow its international fan base, they have taken a different approach to global expansion than their U.S. sports league counterparts. The NFL took a team-oriented approach towards global expansion by creating the Global Markets Program, which grants teams rights to market and expand their brand in a country for five years. The current NFL broadcast rights deal stands at $110 billion over eleven years (2022-2032), and is one of the prominent avenues for a league to expand its brand reach globally. Teams allocate resources and time towards growing fandom and merchandise sales internationally, as well as increasing the size of the talent pool by finding new players. Additionally, when analyzing the NFL's global program, it's important to consider why the league chose the international markets they did, which is based on intricate data the league provided. This research will examine the NFL's current global expansion program, as well as providing professional input from league and team officials.

Brianna Kong-Quee

College of Nursing & Health Professions
Health Sciences

Faculty Mentor: **Dr. Sean O'Donnell**
Biodiversity, Earth & Environmental Science

Co-Mentor: Laura Miller

Measuring the Occurrence of Cell Death in Highly Social Paper Wasps and Their Queens

From mammals to insects, environmental stressors have been known to impact reproductive ability, inducing a starvation pathway. As seen in fruit flies, *Drosophila melanogaster*, low chances of survival or reproductive success causes cell death at critical checkpoints during oogenesis, the process of egg cells development, stalling egg production. The reproductive pathway of eusocial insects, such the primitively eusocial paper wasp *Polistes exclamans*, is unique because their sterile workers undergo reproductive suppression as a part of their life cycle. Research on the cellular pathways influencing reproductive plasticity in eusocial insects is limited. *P. exclamans* are ideal models for this area because their flexible caste system allows workers to mature their ovaries and replace the queens, in contrast to highly developed eusocial insects like honeybees. By using the immunofluorescent antibody, DCP1, to visualize apoptosis (programmed cell death), we can observe how the reproductive suppression of workers is facilitated. Through this experiment, we can identify which cellular pathways in mature organisms can induce reproductive plasticity in sterile workers, and whether this differs from what has been seen in *D. melanogaster*.

Velay Fellow

Aiden Rodriguez

College of Arts & Sciences
Environmental Science

Faculty Mentor: **Dr. Shelby Rinehart**
Biodiversity, Earth & Environmental Science

Predator Populations on Prey Dynamics and Tidal Marsh Resilience

Anthropogenic effects can influence the populations of vital predators. For instance, blue crab harvesting targets large-bodied adults, skewing their populations towards smaller sizes. Shifts in blue crab sizes may have further impacts on prey populations. Thus, we evaluated the relationships between blue crab population demographics and the population dynamics of a common prey resource, ribbed mussels. First, we conducted a laboratory feeding study assessing the impacts of predator body size on their feeding rates. Second, we conducted surveys of blue crab demographics and mussel population density and survival at seven marsh locations. Large blue crabs ate 8 mussels per day while small crabs only ate 2.5 mussels per day. All blue crabs preferentially consumed smaller mussels. Our field study showed substantial differences in the mortality of mussels between bay and creek habitats, with greater mortality creek-side. Mussels in creeks may experience greater blue crab predation due to a greater abundance of blue crabs than bayside sites; but blue crabs in bayside sites tend to be larger. Future research should explore to create predictive models that integrate climate change, shifts in predator populations, and prey resilience.

Mariam Stewart

College of Arts & Sciences
Biological Sciences

Faculty Mentor: **Dr. Shelby Rinehart**
Biodiversity, Earth & Environmental Science

Environmental impacts on the on Ribbed Mussels in the Tidal Salt Marshes

Ribbed mussels are an important foundation species in tidal marshes that promote shoreline resilience and aid in water filtration. Ribbed mussel populations and traits (physiology/morphology) may be impacted by both 'top-down' (predation) and 'bottom-up' (wave energy/food availability) controls; however, detangling these effects can be challenging. We used a robust field survey to start evaluating when and where top-down and bottom-up controls impact the morphology and physiology of ribbed mussels in tidal marshes. We found that mussel shell morphology is most likely mediated by bottom-up factors. Habitats with low wave energy and high food availability contained ribbed mussels with larger shell sizes. There was also a tendency for mussels to have larger shells in habitats with small-bodied blue crabs, suggesting that top-down factors may also play a role in determining ribbed mussel morphology. To assess top-down and bottom-up effects on physiology, we used mussel tissue stoichiometry (carbon: nitrogen) as a proxy — these samples are still being processed. Overall, this study helped to identify the factors underlying spatial variation in ribbed mussel populations and traits across tidal marshes, which can promote marsh management.

Danielle Weeks

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Environmental Science

Faculty Mentor: **Dr. Loÿc Vanderkluysen**
Biodiversity, Earth & Environmental Science

Assessing Travertine Terrace Growth in Yellowstone National Park Using Structure-from-Motion Photogrammetry

Travertine terraces are natural formations where calcium carbonate deposits in step-like layers from hot springs in volcanic or geothermal areas. The amount of calcium carbonate deposited can show how active the geothermal system is, but we don't know the rate of carbonate builds up. In this study, I looked at the Mammoth Terraces in Yellowstone National Park (Wyoming) to measure the yearly rate of carbonate buildup, with the hypothesis that this rate has slowed down over time. This research aims to quantify the growth of the terraces and compare the total growth from previous years.

Using Structure-from-Motion, overlapping 2D images to estimate a 3D structure, we generated 3D models and point clouds, data points creating a 3D model. The point clouds of each terrace were aligned and compared yearly to see the distance between key points indicating growth or decay. The higher the Euclidean Value, the greater the change. The R-value did decrease with some significant years implying that external factors limited the growth during specific years. In the future, we can further this study by monitoring annual precipitation and droughts in Mammoth, WY to see if there is a correlation between this and the yearly deposit rate.

Velay Fellow

Kai J. Doron

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Environmental Science

Faculty Mentor: **Dr. Jason D. Weckstein**
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Co-Mentor: Emily V. Griffith

X-Ray Imaging of Museum Study Skins Reveals At least Three Different Wing Spur Morphologies in Waterfowl (Anseriformes).

Some species of ducks and geese (Order: Anseriformes) possess wing spurs, which are bony projections on the wrist often used as weapons. However, it is unclear when or how these spurs evolved, as spur presence is varied and poorly documented in the Order. Prior attempts to catalogue the presence and characteristics of anseriform spurs have failed to fully assess the osteology of these birds. I evaluated spur presence through X-ray imaging of the wings of museum specimens deposited at the Academy of Natural Sciences to document spur presence and absence for each genus in the order, and then reconstructed the evolutionary history of these spurs using phylogenetic comparative methods. I found that there are at least three distinct spur morphologies within Anseriformes, which seem to be highly conserved within Aves. This research represents the most comprehensive analysis of wing spurs in Anseriformes based on physical specimens via the novel use of X-ray imaging of museum specimens. This technique can be utilized in the future to investigate the possible presence of spurs and spur-like morphology of specimens within other avian orders and non-avian dinosaurs to fully understand the evolutionary history of this unique weapon.

Paige Quigley

College of Arts & Sciences
Biological Sciences

Faculty Mentor: **Dr. Ali Afify**
Biology

Co-Mentors: Huiruo Zeng, Phil Baldassari

Oviposition Generalization of Butyl Anthranilate by Anopheles coluzzii Mosquitoes

The *Anopheles coluzzii* mosquito is the vector of malaria, which kills over half a million people annually. Mosquitoes use olfaction to select egg-laying (oviposition) sites, making repellents and attractants especially useful in controlling mosquitoes and preventing the spread of disease. Previous studies showed that butyl anthranilate (BA) is an attractant to *An. coluzzii* at 10 ppm, but a repellent at 100 ppm and 1000 ppm. First, we asked if the presence of BA in the air will affect oviposition on nearby water even if the mosquitoes do not have direct access to BA. Next, we asked if *An. coluzzii* would generalize between 10 ppm and 100 ppm BA and avoid ovipositing on 10 ppm (an attractant) if exposed to both concentrations and water simultaneously. The first experiment showed that egg laying was not significantly affected by the presence of BA, as gravid females indirectly exposed to BA laid a similar number of eggs as the control group. Therefore, mosquitoes must come in direct contact with BA to be affected. For the second experiment, the mosquitoes were less attracted to 10 ppm BA, showing a slight generalization. Overall, this aided our understanding of how odorants interact to guide *Anopheles* oviposition behavior.

Chakrika Aluri

College of Arts & Sciences
Biological Sciences

Faculty Mentor: **Dr. Felice Elefant**
Biology

Co-Mentors: Gu Gu Nge, Christina Thomas

Testing Tip60-Activators as a Therapeutic for Parkinson's Disease

PD is a disorder that affects the central nervous system through epigenetic dysregulation, causing locomotor defects. Epigenetics studies the interplay of genes and environmental factors through modifiers such as histone acetyltransferases (HATs) that transfer acetyl groups onto histone tails and histone deacetylases (HDACs) that work antagonistically by removing the acetyl group. Our lab has shown that disruption of HAT/HDAC balance contributes significantly to epigenetic dysregulation. Inhibition of histone acetylation through the protein A-synuclein is a hallmark of PD. In pharmaceutical treatments, HDAC inhibitors are common treatments for neurological disorders, yet these inhibitors cause global hyperacetylation. In contrast, our lab studies small molecular HAT activators, specifically compounds that target Tip60, a HAT implicated in both Alzheimer's disease (AD) and PD. Recent studies have highlighted these compounds' ability to rescue locomotor defects within an AD model. To further elucidate the effects of these compounds on PD, we will administer these compounds to our PD fly lines and track their movement through our larval locomotion assay, where we anticipate these compounds to rescue the locomotor defects.

Riya Tadi

College of Arts & Sciences
Biological Sciences

Faculty Mentor: **Dr. Tali Gidalevitz**
Biology

Co-Mentor: Julia Perhacs

Investigating the Specificity and Mechanistic Process of PERK in Neuronal Growth Factor Localization

Neurons require the proper sorting and secretion of proteins to establish polarity and maintain normal function. While the targeting and localization of transmembrane proteins is well-characterized, little is known about soluble proteins like neuronal growth factors (ie. IGF & TGF-β). Our lab found a novel role for PERK (PRKR-like endoplasmic reticulum kinase), a stress sensor in the endoplasmic reticulum (ER), in neuronal growth factor (nGF) localization. Loss of PERK leads to mislocalization of an axonal IGF-like, and a dendritic TGF-b-like nGF in *C. elegans*. To explore the link between PERK and its novel function in nGF localization, we are testing known pathways downstream of PERK and assessing the specificity of PERK's role to gain insight into the mechanism. Our lab observed that the CAMKII pathway may be downstream of PERK for IGF localization, leading us to test TGF-b. To determine if PERK's role in protein localization is selective for nGFs, we are asking if it is necessary for localization of other types of dendritic proteins, like DES-2, a transmembrane protein, and OSM-6, a ciliary transmembrane receptor. Through this, we aim to uncover more about PERK's novel function in nGF localization.

Rina Devi Notani

College of Arts & Sciences
Biological Sciences

Faculty Mentor: **Dr. Kari F. Lenhart**
Biology

Co-Mentor: Beth Kern

Germline Stem Cell Dedifferentiation: Determining Mechanisms of Incomplete Cytokinesis

Tissue homeostasis requires maintenance of a robust pool of stem cells. Yet, various stressors result in stem cell loss and tissue atrophy. To replenish stem cells, specialized daughters can pause differentiation and reacquire stem cell fate in a process termed dedifferentiation. Yet, due to mammalian tissue inaccessibility, this process remains understudied. Using the *Drosophila* testis niche, we aim to identify the requirements for germ cell dedifferentiation. Under homeostasis, germ cells execute mitosis followed by incomplete cytokinesis, forming interconnected cysts — this process is conserved across species and supports spermatogenesis. Previously, we have indicated that FGF activity is required for incomplete cytokinesis; upon depletion of either FGF ligand or receptor, germ cell F-actin disassembles, promoting cyst abscission. We hypothesize that loss of FGF signaling is required for dedifferentiation. To quantify FGF signaling, we measured downstream target Erk as an indicator of pathway activity. Excitingly, we found a significant decrease in Erk during dedifferentiation, followed by restoration to homeostatic levels once GSCs are restored. Future work will determine if FGF attenuation is *required* for dedifferentiation.

Velay Fellow

Sam Simon

College of Arts & Sciences
Biological Sciences

Faculty Mentor: **Dr. Megan Phifer-Rixey**
Biology

Co-Mentor: Dr. Adrienne Kasprowicz

Patterns of multiple paternity in populations of urban and rural Mus musculus

As cities rise and expand, it is increasingly important to understand how wild populations adapt to the novel conditions of urban habitats. The house mouse (*Mus musculus*) is a biomedical model organism. Because they are found nearly worldwide in association with humans, they are also a useful system for the study of urban evolution, including life history traits. Previous research has shown multiple paternity, when a litter is sired by more than one male, is more frequent in higher-density populations of house mice. Because they are vertebrates and their habitat is complex, population density and the size of mating groups are difficult to estimate through direct methods. Here, we evaluate multiple paternity in house mice from urban and rural locations in order to better understand how habitat influences life history. To estimate the frequency of multiple paternity, we extracted maternal and embryonic DNA from house mice collected from New York, Philadelphia, and Richmond. We then genotyped eight microsatellite loci in four multiplex reactions and determined the minimum number of fathers per litter.

Timothy Lao

College of Arts & Sciences
Psychology

Faculty Mentor: **Dr. Erica LaFata**
Center for Weight, Eating & Lifestyle Science

Co-Mentor: Madison L. Corso

Why Do We Eat It?: The Factors Influencing Ultra-processed Food Consumption

Ultra-processed food (UPF) addiction is a proposed phenotype gaining recognition in society. UPFs are industrially made products with low nutritional value and few whole food ingredients. UPFs include ready-to-eat convenience food (frozen/fast food), packaged snacks (candy, chips), and sweet drinks (soda, juice). When consumed excessively, UPFs harm health. UPFs are high in rewarding ingredients like saturated fat, refined carbs, and additives (e.g., flavor enhancers), though research is needed to understand individual differences in one's sensitivity to UPF reward. A secondary data analysis was conducted including 22 adults (86% female) who completed the Perceived Stress Scale, Anticipated Effects of Food Scale, Reward Based Eating Drive Scale, and a measure of UPF intake frequency. More positive anticipated mood effects of UPF intake were correlated to higher frequency of eating UPFs; perceived stress was correlated to both negative and positive anticipated emotional effects of eating UPFs. The results emphasize the value of building mindful, healthy relationships with UPFs and highlight the need for future research examining how stress and mood-related expectations of UPFs interact to predict addictive-like eating habits.

Lourdes Moore

College of Arts & Sciences
English, Law

Faculty Mentor: **Dr. C. Clare Strange**
Criminology & Justice Studies

Precedent and Progress: The Change Process Behind Pennsylvania's 8th Edition Guidelines and Its Approach to Racial Disparities

Pennsylvania's 8th edition sentencing guidelines represent a significant shift toward addressing racial and ethnic disparities in criminal sentencing. Aimed at enhancing fairness and proportionality, these guidelines focus on reweighing the influence of criminal history, which often leads to disproportionately harsh sentence recommendations for Black and Latino individuals. By refining sentence calculations and standardizing processes, the 8th edition seeks to reduce unwarranted punishments and promote equitable outcomes.

My project evaluates the change process preceding the guidelines' implementation, emphasizing the Prior Record Score (PRS) and its impact on sentencing. Using qualitative data collection methods, I transcribed and coded sentencing commission meetings and reports to thematically analyze discussions on the guidelines' revision and PRS's influence on outcomes. Key themes that emerged include simplification, PRS calculations, fairness in sentencing, and addressing racial disparity. This analysis highlights the importance of policy reforms in understanding how racial and ethnic disparities develop in sentencing.

Khristina Lilia Cabrera

College of Arts & Sciences
English

Faculty Mentor: **Professor Jill Moses**
English & Philosophy

Filipina Identities: Malakas At Malayang Kababaihan (Strong and Independent Women)

The Philippines has been defined by many periods of colonization, dictatorship, and revolution, but as a daughter of Filipino/a immigrants, I often experienced a disconnect from my culture. Growing up, there existed a significant gap in my knowledge of its history, especially involving women. Because a strong national devotion to Catholicism intersects with an allegiance to traditional gender roles, Filipina voices have particularly been silenced, despite their many contributions to society. The great task has been to bring recognition to these identities, in order to celebrate the women who shaped Philippine culture as it is today. Though we have been separated by an ocean and centuries of history, they, too, have shaped my own life.

By conducting research through books, journal articles, and interviews, I have written a series of hybrid essays highlighting Filipina identities. These essays are experimental in nature, such as poems written in the voices of feminist leaders and creative nonfiction pieces reflecting on my experience as a Filipina-American. Throughout this project, I have developed a greater understanding of my culture and my place in it, allowing me to discover more about my heritage, ancestry, and identity.

Abby Holmberg

College of Arts & Sciences
Environmental Science

Faculty Mentor: **Dr. Steve Vásquez Dolph**
Global Studies & Modern Languages

Building a toolkit for relationship-driven university-community partnerships in climate justice education

Community-based research is difficult and time-consuming. Often, this research is extractive, and researchers treat communities as *subjects* rather than *partners*. Although this work has recently shifted to be more inclusive of communities, researchers often don't have clear guidelines and can unintentionally cause harm. I worked with the Climate Pedagogy Incubator (CPI), an initiative aimed at educating faculty about climate justice alongside Philadelphia community partners. We met leaders of these organizations to initiate relationships toward the goal of collectively developing the project to fit everyone's needs. Early in the process I created a survey to aid this work, which I modified to be more inclusive of the researchers after we spent time with partners interrogating this tool. Informed by background research and what I learned in these meetings, I developed a toolkit outline for building equitable, relationship-driven university-community partnerships. I then created the first half of the toolkit, focused on initiating these relationships. It includes principles, reflections, and activities, including my own survey. The CPI will use this tool and distribute it to other researchers, educators, and community organizations.

Rose Pillifant

College of Arts & Sciences
Mathematics

Faculty Mentor: **Dr. Shari Moskow**
Mathematics

Making Waves

When waves propagate through nonuniform mediums, they tend to scatter. We are interested in constructing objects with incident waves that do not scatter, that is, incident waves which behave as if the object was absent. Frequencies at which this may occur are called transmission eigenvalues. Transmission eigenvalues are in many cases governed by a fourth-order boundary value problem (BVP). We investigate the behavior of solutions of this BVP in the presence of a periodic microstructure. We consider the one-dimensional case and are interested in expansions for the solution as the period size approaches zero. We first set the spectral parameter to zero, allowing us to derive and compute exact solutions. From this, we observed the convergence of the solutions to the limiting function and computed the convergence rate empirically. The convergence rate was one, even though the first nonzero corrections were second order. Adding the second-order corrections, including a boundary correction, improved the convergence rate to be higher than second order. Additionally, we computed solutions numerically for any nonzero spectral parameter, using finite differences.

Velay Fellow

Michael Gribbin

College of Arts & Sciences
Mathematics

Faculty Mentor: **Dr. Luis Cruz Cruz**
Physics

Co-Mentor: Zeyuan Wang

A Modified Principal Component Analysis to Process Data with Large Differences in Variance

If the same song was played at different volumes, the human brain would recognize the songs as the same, but our current neuron model can't tell when it is receiving the same signal with a different magnitude. This is because the current idea explaining how neurons simplify information to process, where only the most significant dimensions of the data are used, is unable to control the magnitude of the neuron's output signal. To do so, we derive a method to mimic biological neurons when processing received information with variances of different orders of magnitude, reducing dimensionality while bringing the output magnitude closer to 1. This method finds the most significant dimensions of the data, but now the dimensions are scaled to the order of magnitude of the data. We find a linear transformation that scales the most significant dimensions back down to 1, and apply it to our information. Then, the order of magnitude of our information is much closer to 1. The result is that the same information, but at different variances, will all be scaled back down to the same order of magnitude, making it possible for an artificial neuron to recognize the same phenomena at different magnitudes, like the same song at different volumes.

Michelle Nicole Casilli

College of Engineering
Mechanical Engineering

Faculty Mentor: **Dr. Michelle Dolinski**
Physics

Co-Mentor: Beryl Bell

EMPHATIC: A Table-Top Detector for the Capture of Hadrons

Research in particle physics has significantly advanced our understanding of the building blocks of the universe. One of the most puzzling and elusive discoveries made by physicists so far is a particle called the *neutrino*. Neutrinos are nearly impossible to detect and can pass through almost anything, including entire planets; this has earned them the nickname "ghost particle." Neutrinos are produced in the decay of larger subatomic particles called *hadrons*, which are particles made up of quarks. Physicists can produce these particles by using a particle accelerator to smash protons into a solid target. This produces a hadron beam, which will eventually decay to become a neutrino beam. The EMPHATIC experiment's purpose is to create a convenient table-top spectrometer that can easily detect and track the production of hadrons that decay into neutrinos. This experiment will give physicists greater certainty in their measurements of hadron production so that they may have updated and reliable results for computer simulations. This allows for more precision in future experiments concerning neutrinos, which may explain why matter prevailed over anti-matter during the origin of our universe.

Gabrielle Bamberski

College of Arts & Sciences
Physics

Faculty Mentor: **Dr. Gordon T. Richards**
Physics

Co-Mentor: Keri Heuer

An Analysis of the Automatability of Spectroscopic Analysis of Black Holes through XMM-Newton Data

Spectroscopic analysis of quasars, supermassive black holes in the center of many galaxies, holds the potential to bring light to questions regarding the formation of galaxies, the nature of black holes at large, and how they may fit into a subclassification schema. This study presents a thorough analysis of the potential to extend the scripting and automation of spectroscopic analysis through the *Chandra* X-ray telescope archives to the *XMM-Newton* X-ray telescope archives, specifically via a Linux-based interface, the associated Scientific Analysis System (SAS) software, and a mix of bash and python scripting. Close examination reveals software requirements, a clear analysis pipeline, potential limitations, and differences between *Chandra* and *XMM-Newton* analysis, paving the way for automated spectroscopy of large numbers of quasars in the future — allowing us to determine the feeding rate for quasars with a large of amount of data in the form of X-ray counts, which can then be applied to quasars with less data.

Konnor Seace

College of Arts & Sciences
Physics

Faculty Mentor: **Dr. Gordon T. Richards**
Physics

Co-Mentor: Keri Heuer

Analyzing Quasar Spectra through Chandra X-ray Observations

Quasars are some of the most luminous galactic objects known to mankind. These supermassive black holes offer insights into the large-scale structure of the universe and the evolution of the universe. A large swirling mass of cosmic dust accretes onto the black hole, causing massive amounts of heat and light to be released. By studying quasars, we can gain crucial insights into the growth of supermassive black holes, the distribution of matter in the universe, and the role of black holes in shaping the structure of the cosmos. This project explores quasars found through observations of the Chandra X-ray Observatory. Through the use of automated scripts, we provide the framework for the downloading of observations and recalibration of files. The observations are then compiled into X-ray emission spectra and analyzed to learn more about the respective properties of the quasar. The quality of information extracted is dependent on the number of x-ray counts detected, influencing our ability to accurately measure how fast the black holes are accreting matter. If direct measurements are not possible, predictive models are used to estimate the feeding rate of these distant quasars.

Neshal Kothari

College of Arts & Sciences
Physics

Faculty Mentor: **Dr. Brigita Urbanc**
Physics

Co-Mentor: Rachit Pandey

Creating a Coarse-Grained Lipid Model for Bilayer Self-Assembly and Formation of Fluid Phase

Fluid lipid bilayer membranes are a vital component to biological systems, but simpler, intuitive lipid models are currently a small area of research. In this study, we use discrete molecular dynamics simulations to explore the formation of different phases in lipid molecules using a flexible, four-bead coarse-grained water implicit model. The model replicates the self-assembly of lipid bilayers, and showcases the phase transitions between the gel phase, the fluid phase, and the gas phase by increasing temperature. By finding the existence of the fluid bilayer with this model, it has the potential to be used in future research simulations containing these fluid bilayer membranes.

Zane Furat Al-Saleem

College of Arts & Sciences
Political Science

Faculty Mentor: **Dr. Travis B. Curtice**
Politics

Power and Protest: Examining the Influence of Historical and Socio-Political Dynamics on Kenyan Youth's Perceptions of Policing

How have historical and socio-political dynamics shaped contemporary attitudes towards the police among Kenyan youth, particularly in the context of political protests and perceptions of policing serving the elite? This research explores how historical factors and governance have shaped perceptions of the police as tools of political elites rather than community protectors.

Kenyan youth, aged 15 to 35, face unique social and economic challenges, including high unemployment. The study shows that interactions with police, particularly during protests, reinforce the youth's view of law enforcement as protectors of the status quo, deepening mistrust.

Using a qualitative approach, this research employs thematic analysis to identify patterns in interview data and protest footage, exploring how youth perceptions of police legitimacy are influenced by both historical policing practices and the history of protests, as well as their connections to historical governance factors.

The research aims to guide policy reforms to improve police legitimacy and effectiveness, building trust between police and youth. By addressing the underlying causes of distrust, the research seeks to contribute to more equitable and effective policing in Kenya.

Shrayaa Jayapal

College of Arts & Sciences
Political Science

Faculty Mentor: **Dr. Travis B. Curtice**
Politics

The Impact of the US Withdrawal from Afghanistan on Women's Health and Education

Women in Afghanistan have experienced inconsistent access to education, healthcare, and the job market, especially throughout the last 20 years. This brings us to question: what are the changes in health and education services provided in Afghanistan before and after the US withdrawal, and how have these changes impacted women's rights? This research explores the changes in healthcare and education before and after the US withdrawal from Afghanistan while investigating the impacts it holds on women's rights in the country. This is done using a comparative analysis of data collected from various sources, including government reports, NGO assessments, and academic studies. Through the analysis, it was found that there was a decline in both health and education services after the US withdrawal. This can be attributed to the rise of Taliban rule and authority, a decrease in international aid, and overall instability in the region. The reemergence of Taliban control in the country significantly restricted women's access, especially within education. The goal of this study is to build a deeper understanding of the impact of the US withdrawal and Taliban ideology on women's rights in Afghanistan.

Tanmayi Rao

College of Arts & Sciences
Psychology

Faculty Mentor: **Dr. Brian Daly**
Psychological & Brain Sciences

Adolescent Depression Among Chinese Immigrants and American Youth: A Comparative Study Before and After the COVID-19 Pandemic

Adolescents are susceptible to depression during a critical developmental period, negatively impacting their social relationships. Depression impacts various cultures, including Americans and Chinese immigrant adolescents. A literature review that examined depressive symptoms from before and after the COVID-19 pandemic reveals that during the pandemic the prevalence of depression in both American and Chinese adolescents significantly increased. Notably, research indicates higher increase in prevalence of depressive symptoms among Chinese adolescents in immigrant families, in comparison with American adolescents, primarily due to acculturation being an added stress. A crucial factor for adolescent mental health is their relationships with their peers. Academic pressure and reduced opportunities for in-person interactions related to the COVID-19 lockdown likely intensified symptoms of depression in adolescents. In contrast, a positive and uplifting environment amongst peers provides support for someone who may be depressed. Future research should focus on developing better social skills and tracking rates of depressive symptoms in adolescents, focusing on acculturation with Chinese immigrant adolescents.

Caitlin Betson

College of Arts & Sciences
Psychology

Faculty Mentor: **Dr. Kirk Heilbrun**
Psychological & Brain Sciences

Co-Mentor: Hailey Fasone

Reentry Programming for Justice-Involved Individuals: Comparing the Good Lives Model and the Risk-Need-Responsivity Model

Empirical scientific research regarding the effectiveness of interventions for justice-involved individuals is incorporated into the two major models in the field: Risk-Need-Responsivity (RNR) and the Good Lives Model (GLM). To address the critique of RNR that it is too narrowly focused on re-offense risk reduction, the GLM was subsequently developed. The GLM takes a less direct approach to reducing recidivism, focusing on building life skills to diminish the need to reoffend. The present project reviews these two models as they apply in reentry programming for justice-involved individuals. The review included theoretical frameworks, empirical support, cross-cultural application, and outcome analysis. The review focused on the published literature, but also included weekly observation of two clinical supervision teams encompassing interventions with reentry clients. By combining a literature review with clinical application supervision observation, the construct and ecological validities were enhanced. The study concludes with recommendations for future research and policy, emphasizing the need for a broader scope in outcome assessments and further investigation into the application of the models for minority groups.

Leah Angelina Guerra

College of Arts & Sciences
Psychology

Faculty Mentor: **Dr. David DeMatteo**
Psychological & Brain Sciences; Kline School of Law

The Effects of the Psychopathy Label, Familiarity with Psychopathy, and Age on Sentencing Decisions and Perceptions of Dangerousness Among Mock Jurors

Background: Defendants labeled as "psychopaths" are perceived to be more dangerous than other defendants, but studies have yielded mixed results regarding the label psychopath and jury sentencing.

Aim: We examined how the label psychopath and familiarity with psychopathy affect juror sentencing and perceptions of dangerousness.

Method: Mock jurors (N = 150) completed a demographic questionnaire, read a vignette (label or no label), and answered questions about sentence length and perception of dangerousness. We used t-tests and one-way ANOVAs to examine between-group differences, and three-way ANOVAs to examine interactions among label, familiarity, and age on both outcome variables

Results: There were no significant differences between sentence length and psychopathy label, perception of dangerousness and psychopathy label, and sentencing and familiarity with psychopathy, and no significant interaction. Perceptions of dangerousness and familiarity with psychopathy were trending towards significance, along with the interaction of label, age, and familiarity on perception of dangerousness.

Discussion: Perceptions of dangerousness may be more prominent in studies with a larger sample and a more detailed case vignette.

Zeyan Lin

College of Computing & Informatics
Computer Science

Faculty Mentor: **Dr. Jeremy Johnson**
Computer Science

Co-Mentor: Steve Earth

From Proofs to Code: Investigating the Relationship Between Equational Reasoning and Programming Proficiency

As a field of study deeply rooted in mathematics and logical reasoning computer science education studies have often explored the link between a student's mathematical and logical capabilities and their programming ability. However, minimal research has explored how equational reasoning — a technique for formally proving properties of recursive programs — correlates with programming ability. In this study, we examined the relationship between students' recursive programming skills and their proficiency in equational reasoning. We investigated the mistakes students make while solving recursion problems with equational reasoning and categorized these errors to understand common difficulties that students face.

Although the student self-assessment survey suggested otherwise, our analysis of the course midterm exam determined there is a mild correlation between student performance on proof-writing tasks and programming questions. We are hopeful that the findings of this study will lead to improvements in programming teaching methodologies, ultimately enhancing students' programming abilities.

Velay Fellow

Bhavika Choudhary

College of Computing & Informatics
Computer Science

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Computer Science

Sparse Coding for Neural Data Compression: Addressing Computational Efficiency and Signal Integrity in Brain-Computer Interfaces

Efficiently compressing large volumes of neural data is crucial for advancing brain-computer interfaces and biomedical technologies. Under strict constraints, traditional compression methods fail to balance high compression rates with the preservation of essential signals. Our research explores sparse coding to address the computational inefficiency and high energy demands of existing approaches, specifically in the context of the Neuralink Compression Challenge, which necessitates over 200x compression of electrode data from a non-human primate's motor cortex to meet a 1Mbps wireless transmission rate.

Sparse coding was implemented by constructing a dictionary of basis functions that efficiently represent the electrode data. The algorithm was then compared to other techniques, including Principal Component Analysis and traditional compression algorithms, based on compression rate, computational efficiency, and the preservation of signal characteristics for downstream decoding tasks.

Findings suggest that sparse coding may offer advantages over traditional methods, potentially achieving a favorable balance between compression ratio and data integrity, which could make it suitable for applications with stringent transmission limits.

Shams Mohammad Abrar

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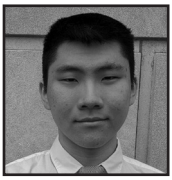
Faculty Mentor: **Dr. Edward Kim**
Computer Science

DistillMed: Efficient ICD Coding through Neural Distillation

The healthcare industry faces significant challenges in ensuring accurate and efficient medical coding, especially with the International Classification of Diseases (ICD) system, which is vital for patient care, billing, and research. This research introduces DistillMed, a novel approach to automate and accelerate ICD coding using knowledge distillation techniques, addressing the growing demand for quicker processing, efficient, and accurate coding systems without sacrificing accuracy.

DistillMed leverages the MedAlpaca-13b model as a teacher, distilling its knowledge into a smaller, efficient student model. The student model, trained on the ICD-10-CM dataset, incorporates cross-entropy and Kullback-Leibler divergence losses to capture both raw data and teacher model outputs. With just 8 layers and 168 million parameters, the student model achieves a compression ratio of 98.7%, a significant reduction from the teacher model's 13 billion parameters.

Using a dataset of 74,044 ICD-10-CM examples, split into training and validation sets, DistillMed demonstrates strong performance. It maintains high accuracy in ICD coding while drastically reducing computational costs, offering a practical solution to improving medical coding efficiency.



Daniel Ting

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Integrating eBPF System Calls and Network Data for Enhanced Cloud Security Detection

Drexel researchers are actively developing novel eBPF (Extended Berkeley Packet Filter) tooling to model the complex behavior of applications deployed in the cloud by capturing system calls executed in the Linux kernel. These models train machine learning algorithms capable of detecting cybersecurity threats. Building on this foundation, we expanded this tooling to add another Linux kernel filter that intercepts network packet data. This enhanced approach now integrates and uses system calls, along with our new network eBPF filters, to produce a time-series data stream as a realistic proxy for the system's runtime behavior. The raw data captured by our high-performance logging infrastructure is then processed using a script that extracts important features required for machine learning. This expanded integration should better model the complex behavior of systems running in the cloud compared to using system calls alone. As an initial next step, we plan to run our existing ML classifiers and anomaly detectors to see if this enriched dataset improves our ability to detect cybersecurity threats. After that, we plan to investigate how this data can power more advanced AI models targeted at cloud security use cases.

Danny Zhang

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Streamlining Cloud-Native Security Research: A Collaborative Platform for Deployable Vulnerable Systems

Conducting cybersecurity research on cloud-native systems is a time- and labor-intensive process. Researchers must invest substantial effort to setup and deploy these systems before they start investigating potential security vulnerabilities. Inspired by the success of platforms like HuggingFace for AI/ML models and Kaggle for ML datasets, we developed a prototype platform designed to streamline and advance cloud-native security research. This platform allows researchers to collaborate using a web-based portal where they can upload deployable cloud-native systems with vulnerabilities, eliminating much of the time and labor typically spend on these preliminary tasks. It allows them to focus directly on their research, making the process more efficient. It should also help to address issues with using AI in cloud-native research where investigators bypass setting up real environments and instead use static datasets that likely will not produce results that generalize. This work is the foundation for a product that Drexel plans to bring to market, providing a valuable tool for researchers in the cloud computing domain. The prototype lays the groundwork by proving the concept and providing a clear path for future development.

Aidan Dul

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Reviving the ENIAC: Integrating Photographs with 3D Reconstruction

The ENIAC (Electronic Numerical Integrator and Computer), developed during World War II, was the first general-purpose electronic digital computer, originally built for calculating artillery trajectory tables. Its innovative design laid the foundation for modern computing, accelerating scientific calculations and shaping the future of technology. The ENIAC no longer exists as it did originally; its pieces are now scattered across museums and colleges, making simulation the only way to experience its operation today.

This research builds upon Dr. Stuart and his previous STAR mentees' work that created an immersive 3D model of the ENIAC, which primarily captured its geometry but lacked photographic detail. We analyzed techniques for including texture in CAD models and developed a method to integrate photographs of the original machine with our 3D model, resulting in an algorithm that applies textures for a more immersive experience. The algorithm determines how to apply textures by mapping a given texture to the related XYZ coordinates, ensuring precise alignment with the model's surfaces. This ensures that the 3D simulator now offers a more accurate and engaging representation of the ENIAC as it appeared in 1945.

Toshan Gosain

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Investigating the visual cortex's suitability for object recognition through AI

Human brains are mimicked in a variety of ways when developing machine learning models to create artificial intelligence. Oftentimes, learning models in the brain are quickly replicated by looking at reward and punishment mechanisms found in human behavior. However, it is unclear as to what the impetus for the visual cortex is when distinguishing between different shapes and objects. This leads us to wonder how the visual cortex actually learns, and if it is optimal for object recognition. My research intends to answer these questions by studying behaviors exhibited from a machine learning model based experiment. I utilized the Cybernetic Automaton Model created by Dr. Brian L. Stuart, in order to set up experiments where I fed the model features of different shapes, analogous to how a visual cortex takes in information. In the results of the experiment, I studied behavior where the model would automatically fill in the last feature to correctly guess the shape that it was given. Additionally, the model performed well under circumstances of randomizing the shape's orientation. However, there was no clear indication of internal connections being made without external input (rewards).

Chibuike Nwume

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A or B? Simulating object recognition and handling simultaneous visual input

Recognizing objects is a complex cognitive ability for organisms, making it challenging to replicate in AI, especially with simultaneous inputs like object and positional data. To explore object recognition in computational systems, we drew inspiration from novel object recognition (NOR) experiments and the object context recognition test in animal studies, attempting to replicate this using simultaneous input in Cybernetic Automata. To tackle this, we developed a model utilizing multiple automata to process different types of input.

Each automaton was trained separately to recognize object symbols and process positional information. Their outputs were combined and input for a third automaton to manage the overall recognition task. This approach successfully identified objects and configurations, enhancing the model's ability to distinguish between different object configurations and laying the groundwork for more advanced recognition systems. Future research will focus on refining this approach and exploring its applications in more complex environments, aiming to better simulate the brain's ability to process simultaneous inputs in real-time.

Suhruth Thunga

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Exploring Learning Behaviors and Stimulus Recognition Using a Machine Learning Model

Recognizing and reacting to threatening or beneficial stimuli and situations is a central component of learning in biological organisms. Animals can learn whether a plant is safe to eat based on a stimulus of taste while humans learn to avoid certain situations after bad experiences. My research intends to further examine this idea of avoidance conditioning and pattern recognition by testing how efficiently an A.I. model exhibits this behavior. For my experiments, I relied upon the cybernetic automata model, created by Dr. Brian L. Stuart to mimic the learning abilities of a real brain. The model was placed in an environment where it randomly encountered either a beneficial or dangerous situation. In each situation the was given the choice to stay, flee, or interact after being presented various characteristic stimuli. In the "Beneficial"scenario interaction led to reward while in the "Dangerous" scenario it led to punishment. The goal was to see how efficiently the model could grow to recognize and react accordingly to the unique stimuli in each scenario while filtering out the similarities between the two. Additionally, the experiment gave insight into how different Punishment/Reward setups led to differing learning outcomes.

Jeffrey Ukachukwu

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Faculty Mentor: **Dr. Yue Zhang**
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Co-Mentor: Dr. Eric Sun

Cloud Antivirus Services: A Critical Analysis of Privacy Risks and Mitigation Strategies

Modern antivirus software increasingly relies on cloud-based scanning to improve malware detection efficiency. This process involves uploading files to the cloud for analysis. While this method enhances security with better threat detection, it also raises privacy risks that users may not fully grasp, making it a key area for investigation. Our research focuses on how Android antivirus software handles users' metadata and files uploaded to the cloud, the extent of user awareness of these implications, and developing tools to strengthen user privacy.

We first conducted a program analysis on antivirus software, utilizing reverse engineering tools to uncover the function code and fact-check the data collected. We then transitioned to the document study to compare the claimed data from antivirus documents and resources with the actual data seen from the analysis. Once completed, we will assess users' understanding of these results and develop strategies and tools to help users address and mitigate privacy issues.

At the end of the research, we aim to create awareness and bolster user privacy, influence policy on data protection, and contribute to cybersecurity by proposing solutions for secure cloud antivirus operations.

Dior White

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Penetration Testing of an Academic Computing Network

This penetration testing project targeted the College of Computing and Informatics' (CCI's) network at Drexel University to identify potential security vulnerabilities that attackers could exploit. Methods included conducting reconnaissance to find targets on the network, scanning targets to find open ports, and running vulnerability scans to find vulnerabilities. Using tools such as Amass, Recon-ng, Nmap, and OpenVAS, we identified 22 key vulnerabilities across 51 CCI targets, with severity levels ranging from 2.3 to 7.5 (out of 10). The most critical vulnerabilities were found in multiple IT administrator virtual machines (VMs), which are essential for managing CCI's IT infrastructure. If these vulnerabilities are exploited, attackers could gain access to sensitive research data, disrupt educational tools and resources, and launch additional network attacks, such as data exfiltration, privilege escalation, and ransomware deployment, resulting in widespread damage at CCI. The potential for VM escape and hyperjacking — where attackers gain control of the host system and other VMs — underscores the critical importance of securing these environments to protect CCI's infrastructure and sensitive information.

Rhea Phadke

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Co-Mentor: Dr. Michal Monselise

TikTok as a Platform for Harassment Disclosure: Themes, Emotional Tones, and Implications

Short videos on social media are popular among youth, and the type of harassment shared through these formats can lead to either supportive or negative responses. Understanding harassment disclosure characteristics is essential for designing effective support interventions. This research investigated TikTok videos tagged with #harassment, focusing on content type and purpose. A random selection of 191 videos was qualitatively analyzed and categorized using a codebook defining video themes, harassment types, emotional tones, etc. Our findings revealed that a large portion of videos depicted inappropriate sexual behavior (n=94), bullying (n=44), and verbal abuse (n=37). Most videos were recorded by harassment victims (n=97), documenting real-time harassment or sharing personal experiences (n=102). Additionally, an overwhelming number of videos had emotional tones of alarm and concern (n=111). These results showed that many users utilize TikTok as a social media platform to speak out on personal harassment experiences, mostly of inappropriate sexual behavior. This research highlights the potential for policy changes on TikTok's platform to support victims and address harassment on social media.

Velay Fellow

Trevor Canfor-Dumas

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Co-Mentor: Aria Pessianzadeh

Why do you trust and/or distrust generative AI?

Generative Artificial Intelligence (GAI) has become an integral part of the lives of millions all around the world. It's innovative, yet scary, because nobody truly knows its potential. Since the introduction of OpenAI's ChatGPT 3.5, numerous studies have explored what it is, and more importantly, if it can be trusted. To effectively answer this, we must have an understanding of what is meant by trust and distrust. For this purpose, we first employed a comprehensive literature review to understand how trust in technology was studied and what dimensions of trust are more prevalent when analyzing emerging technologies such as GAI. To understand the applicability of these dimensions, we started to manually annotate a random sample of user-generated posts extracted from Reddit, between December 2022 and December 2023. The preliminary results show that the dimensions that occurred most frequently throughout the first set of posts were Competence/Functionality, Usability, and Helpfulness. We plan to use the annotated data to extend the dataset and train a model to automatically extract trust/distrust from our data and provide insight into the dimensions and aspects of GAI that result in such feelings toward emerging technologies.

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Co-Mentor: Layla Bouzoubaa

Empathetic Language Regeneration: Leveraging Large Language Models to Reduce Stigma in Substance Use Disorder Communications

Substance Use Disorder (SUD) remains a major public health challenge, with stigma against People Who Use Drugs (PWUD) serving as a significant barrier to treatment-seeking behavior. This systems modeling introduces a web-based platform that harnesses the contextual abilities of Large Language Models (LLMs) to regenerate user-inputted text, making it more empathetic and less stigmatizing toward PWUD. Our full-stack website analyzes user prompts, even if they don't explicitly mention drugs or contain inherently stigmatizing language, offering destigmatized alternatives. By leveraging style information and advanced natural language processing techniques, the system aims to reduce the perpetuation of harmful stereotypes and negative attitudes associated with SUD. The platform ensures that users' stylistic profiles and voices are preserved, with only necessary changes made to remove stigma. This service has the potential to significantly impact how we communicate about substance use, improving treatment engagement and outcomes for individuals with SUD. Future efforts will focus on evaluating the platform's effectiveness in real-world scenarios and its impact on users' perceptions and attitudes toward PWUD.

Jesús Eduardo Romero Sánchez

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Co-Mentor: Aria Pessianzadeh

Exploring the Ethical and Societal Implications of ChatGPT and Generative AI

Generative AI (GenAI) has rapidly risen in popularity, offering advancements in automating tasks and reshaping public discourse. Technologies such as ChatGPT are increasingly being integrated into various sectors, driving both innovation and efficiency. However, as their influence grows, so too does the scrutiny of their impact on society. Despite their potential, critical gaps still exist in the logic and trustworthiness of these large language models (LLMs). Concerns have risen about the role GenAI plays in shaping public trust, particularly through the creation of content that may either foster innovation or contribute to misinformation.

This research investigates the trustworthiness of GenAI, focusing on its effects on public trust and behavior, especially within social media. By examining a rich dataset from the platform Reddit, performing a thorough literature review, annotating data to train an LLM model, and applying techniques like close-reading, NLP, ML, and social computing, we aim to examine how AI-generated content influences human interaction and societal norms. The future findings will guide the development of strategies to mitigate negative impacts and promote the ethical integration of GenAI into society.

Patricia Tran

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Co-Mentor: Elham Aghakhani

Exploring Generative AI Sentiments and Emotions across Reddit Posts

Generative artificial intelligence (GenAI) has gained significant attention in recent years and is used by people of diverse backgrounds. People often have questions, stories, or comments they post on social media such as Reddit expressing opinions about emerging technologies including AI tools.

To explore the ethical implications of GenAI, we performed sentiment analysis to record positivity, negativity, and neutrality of Reddit posts mentioning GenAI. To better understand how Reddit users feel about specific technologies, we used aspect-based sentiment analysis using AI-related keywords to identify feelings on AI topics. We further used emotion detection to identify specific emotions such as confusion or joy towards GenAI. Our aim is to understand emotions expressed by users across various subreddits and how they change throughout the year, as previous studies have not focused on these temporal shifts.

Our preliminary results reveal people often feel neutral about popular GenAI topics and positive about specific AI models. In technology communities, although many feel optimistic towards GenAI, people often question it. These results indicate that as AI capabilities surge forward, public attitudes continue to diversify with time.

Velay Fellow

Anthony Vaygen

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Understanding Social Media Perceptions of Artificial Intelligence

The emergence of artificial intelligence (AI) technologies in recent years has amplified the need to understand the public perception of AI. Examining sentiments and insights of users is integral in addressing ethical, regulatory, and development decisions regarding AI.

To gain insights into public perceptions of AI, we conducted aspect-based sentiment analysis to evaluate Reddit posts, revealing overall sentiment (positive, negative, neutral) and attitudes toward specific AI tools. We also used emotion detection to uncover emotions in user posts. These approaches allow us to analyze patterns in how end-users feel about AI and how sentiments change over time. While there are existing studies examining user sentiments toward AI, this study offers an in-depth analysis and comparison of sentiments over time.

The results of the study show that overall, users feel neutral, curious, and confused towards AI. They also suggest users have nuanced opinions, not strictly positive or negative. There also has been increased positive sentiment toward open-weight LLM models like LLaMA and BLOOM from non-OpenAI companies. This broader understanding of user insights allows for a more informed and balanced approach of integrating AI into society.

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Co-Mentor: Elham Aghakhani

Heart to Heart with AI: Emotional Analysis of Reddit Surrounding Generative AI

As artificial intelligence (AI) evolves daily, public perception and user feedback play a pivotal role in shaping the development of advanced AI models. Understanding how users feel drives the growth and ongoing innovation of these emerging technologies.

In this study, we conducted an in-depth analysis of public perception using social media data, namely Reddit, to analyze the emotional trends across Reddit communities, extending beyond traditional sentiment studies. Using aspect-based sentiment analysis, we evaluated user sentiments on specific AI topics such as "OpenAI," "ChatGPT," and "language models." We also performed emotion detection analysis to examine public reactions, including frustration and approval, when discussing AI.

Furthermore, our preliminary findings show a shift in public sentiment about AI over time. While general AI topics prompt neutral responses, specific models like GPT, Llama, and LaMDA generate growing enthusiasm. In technology-focused communities, AI discussions primarily initiate curiosity, confusion, and neutrality. These cyclical emotions indicate that although AI continues to advance, questions remain about its potential and limitations.

Emily Ernst

Pennoni Honors College
Custom-Designed Major

Faculty Mentor: **Dr. Aleksandra Sarcevic**
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Co-Mentor: Angela Mastrianni

Analyzing the Use of Digital Checklist Features for Pediatric Trauma Resuscitation to Inform Design Improvements

Trauma resuscitation is a dynamic medical event in which critically injured patients are evaluated and treated by an interdisciplinary team. We studied the use of an enhanced digital checklist designed for physicians leading pediatric resuscitations at Children's National Hospital. Among other features, the checklist includes automatic vital sign updates that are displayed through color-coded banners and trend graphs. We analyzed 55 checklist logs from actual resuscitations, 15 videos of simulated checklist use, and 7 interviews with team leaders to understand how these features are being used in actual and simulated patient care. While interviews suggested positive impressions about trend graphs, simulations showed only one of 15 participants accessing the graphs. Trend graphs were also rarely accessed in actual patient care (2/24 automatic logs). Physicians noted that color-coding vital sign status based on pre-established normal/abnormal ranges primarily aids less experienced leaders. Of 37 checklist logs that stayed in the manual mode, 26 lacked documented vital signs. Although our results highlight the potential benefits of advanced vital sign features, they also show challenges in use, requiring further design improvements.

Baden Stickley

College of Engineering
Civil Engineering

Faculty Mentor: **Dr. Abieyuwa Aghayere**
Civil, Architectural & Environmental Engineering

Is there adequate structural protection around the piers of major US bridges in navigable waterways?

Bridges are crucial to everyday life, enabling the seamless movement of people and goods across the United States. However, the safety of these structures, particularly those spanning navigable waterways, is paramount. The tragic incidents, such as the collision at the Francis Scott Key Bridge in Baltimore, underscore the dire need for effective pier protection systems. These systems are essential to safeguard bridges from potential vessel impacts, which can cause catastrophic failures and disrupt vital transportation links. This research investigates the design and effectiveness of pier protection systems through a comprehensive literature review of engineering reports, case studies, and news articles. Additionally, insights were gathered from interviews with bridge engineers from various State Departments of Transportation and bridge engineering firms. The findings aim to identify the safety of bridges in the United States that span over navigable waterways and identify the best practices in pier protection design to enhance the resilience and safety of critical infrastructure.

Karamoko Sow

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Civil Engineering

Faculty Mentor: **Dr. Amir Yaghoob Farnam**
Civil, Architectural & Environmental Engineering

Co-Mentor: Dr. Parsa Namaki Araghi

Use of Vascularized 3D Printed Network and Phase Change Materials for Self-Heating Concrete

Researchers have pioneered the use of bio-inspired vascularized composites for thermal energy management in buildings. The concept draws inspiration from internal thermal regulations processes observed in nature with architected vascularization on one hand, and phase change perspiration on the other. It is a revolutionary process that will reduce the energy consumption from heating systems and air conditioners. Different designs of 3D-printed architectures have been experimented with in this study to observe how the shape of the network affects the heat distribution and the reinforcement strength. As the shape of the network can affect the flow rate of the Phase Change fluid within that network, this study also investigates the effect that architecture has on the flow rate by designing an experiment using principles of fluid mechanics. To set up the experiment, a flow rate peristaltic pump was used to create a liquid circulation inside the networks at a constant rate, and then the flow coming out of the network was measured.

Dean DiPrinzio

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Environmental Engineering

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Civil, Architectural & Environmental Engineering

Sensor-Based Analysis of Pluvial and Coastal Flood Hazards: Correlating Meteorological Factors in New Jersey Communities

Previous research suggests climate change increases flood frequency and intensity. Planning adaptation and preparedness in flood-prone communities requires data on flood hazards. Quantitative measurements of pluvial and coastal flood depths, and varying depths of tidal bodies, can aid in hazard evaluation. However, that data is generally lacking. Working in flood-prone communities, this research seeks to evaluate such hazards. To quantify pluvial flood hazards, ultrasonic sensors that measure the distance to a point beneath them were installed in Camden, N.J. Data were collected at one-minute intervals and plotted on distance vs time graphs for two months. To quantify coastal flood hazards, pressure transducers were installed at coastal sites in Stafford, N.J. and collected data at five-minute intervals for several months. The calibrated data were plotted as a time series. In each case, data analysis seeks to determine which meteorological factors are best correlated to the flood hazards. At the pluvial sites, the correlations focus on precipitation. At the coastal sites, the correlations focus on meteorological drivers of tides and precipitation. Conclusions focus on the utility of this monitoring data for emergency preparedness.

Lizzy Grace Mairead Aakesson

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Faculty Mentor: **Dr. Adam Fontecchio**
Electrical & Computer Engineering

Co-Mentor: Santiago Sosa (STAR 2022)

Aerial Animal Vision Simulation Through Stacks of Switchable Color Filters

The development of self-driving cars in the automotive industry began a widespread demand for creative visual systems. An intriguing dive into the visual systems of aerial animals revealed alternative ways to navigate our world beyond the human eye's capabilities. For instance, butterflies use a combination of fifteen photoreceptor types to track fast-moving objects across the sky, quadrupling the human photoreceptor amount. To replicate animal retinas, our lab developed a rover with a vision system comprised of chemical filters that reflect a single-color wavelength. The filters are made of holographic polymer dispersed liquid crystals (HPDLC) that reflect or pass on light with the application of an electric field. We hypothesized that switching stacks of filters would reflect multiple wavelengths of light, creating a hyperspectral imaging system. This research developed filter procedures to reflect red, green, and infrared wavelengths integrating switching voltage requirements to create strong electromagnetic fields. These results contributed to the animal vision system on the autonomous rover.

Velay Fellow

Jaren J. Hopkins

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Bio-Inspired Vision Systems for Hyperspectral Imaging Using Holographic Polymer Dispersed Liquid Crystals (H-PDLCs)

Within the animal kingdom there are a variety of biological optical systems that allow animals to see different wavelengths of light. Hyperspectral imaging technology mimics this ability by capturing high-resolution visual data across the electromagnetic spectrum. Using Holographic Polymer-Dispersed Liquid Crystal (H-PDLC) filters on cameras, an enhanced optical system can capture data beyond the visible spectrum, including infrared and ultraviolet light. These switchable filters enable optical systems to alternate between visible and non-visible spectrums, allowing for comprehensive data collection and analysis. Such technology has applications in autonomous vehicles, agricultural drones, and smart cities. Current filters cover visible to near-infrared ranges, with research aiming to extend this further into infrared and UV. Much of my role in this project has been 3D modeling mounts, chassis, and other parts necessary for the creation of a rover that is integrated with H-PDLCs. I also ran the 3D printing and assembly of these parts. The culmination of this research is an autonomous terrestrial drone which navigates its environment based on an optical system relying on the H-PDLCs.

Khushal Patel

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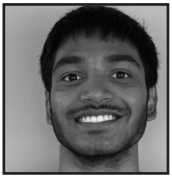

Faculty Mentor: **Dr. Adam Fontecchio**
Electrical & Computer Engineering

Co-Mentor: Santiago Sosa (STAR 2022)

Holographic Polymer-Dispersed Liquid Crystals (H-PDLC) Switchable Filters for Biological Vision Mimicry

Holographic Polymer-Dispersed Liquid Crystals (H-PDLC) filters can selectively reflect certain wavelengths on the electromagnetic spectrum, including those in the ultraviolet and infrared bands. Combined with a camera and the H-PDLC's ability to be switched off electronically, this property can be leveraged to develop a vision system that captures and analyzes a scene in several spectral bands, a process known as multispectral imaging. This system can then be applied to mimic the biological vision systems found in animals, with the wavelength reflected by an H-PDLC filter corresponding to the wavelength absorbed by the visual pigment in an animal's eye. Vision systems operating outside the range of human vision can impact numerous applications such as autonomous vehicles, crop monitoring, and search-and-rescue operations. To demonstrate the feasibility of this concept, this research outfits an autonomous rover with an H-PDLC-based vision system to mimic the biological vision of an animal and develops a control system to navigate the rover based on vision system data.

Tyler Hein, Liam Stoops

Downington STEM Academy,
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Biomimetic Vision Systems Through Switchable Holographic Polymer-Dispersed Liquid Crystals (HPDLCs)

Initial research into Holographic Polymer-Dispersed Liquid Crystals (HPDLC) has focused on its formulation and its ability to both selectively reflect wavelengths of light and become transparent. HPDLCs reflect individual wavelengths of light dependent on incident angles of interfering lasers, forming a bragg grating, and become transparent when exposed to a square wave. This technology can be used in biomimetic vision systems to create specialized detection systems for diverse implementations around the world. Our design uses a drone, containing a series of HPDLC filters, vision and movement systems, and a switching mechanism. Our vision system captures reflected light to detect and navigate to specific light sources. By including a voltage system to switch the filters' transparency, one rover can be programmed to identify a broad spectrum of wavelengths and light sources. This design is meant to replicate the cones and rods used by various animals in nature and create a comprehensive robotic vision system which can identify and locate specific wavelengths of light. The success of this design proves that HPDLC filters can be used in computer vision systems for navigation, environmental monitoring, search and rescue, and more

Key Ramjattun

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Exploring the Limits of Naive Bayes Classification for Novelty Detection Across Taxonomic Levels

Robust classification of novel data is a challenging task in many machine learning applications. In the field of metagenomics, classification algorithms leverage large datasets of microbial sequences to categorize organisms into various taxonomic levels. Our approach employs a Naive Bayes classifier (NBC), a supervised learning algorithm that is trained on labeled data, to classify and detect novel organisms across these taxonomic ranks. The model operates probabilistically, calculating the log likelihoods of an organism belonging to a particular taxonomic group based on k-mer frequencies. The first phase of my work has been to generate training and testing datasets that can leave classes out of the training database to test on. Then, the second phase is to investigate the classifier's performance at each taxonomic level, generating receiver-operating characteristic curves (ROC), from superkingdom to genus, and assess its effectiveness in novelty detection on each level. This systematic approach allows us to gain more insights into the strengths and limitations of using this algorithm and how it can be optimized for improved accuracy in metagenomic classification and novel organism discovery.

Jessica Wu

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Detection of Novel DNA Sequences in Microbiome Data

As our understanding of genetics and microbiology deepens, the accurate identification of DNA sequences from microbiome samples is an essential first step to every metagenomic pipeline. This research aims to develop and test algorithms for better detection of novel DNA sequences.

In this project, we use the Naive Bayes Classifier (NBC) for classification and begin to test Centrifuger as an alternative classifier. The key steps are: (1) collect DNA sequences, (2) use Jellyfish to create k-mer count files, (3) use the NBC to classify known and unknown sequences and obtain scores, and (4) determine the best threshold between known and unknown score distributions to detect novel sequences. To find the best point to decide if a sequence is novel, we use receiver operating characteristic (ROC) curve analysis. The ROC curve shows the trade-off between correctly identifying sequences (true positive rate) and incorrectly identifying them (false positive rate) at different thresholds, revealing the NBC's effectiveness at classification levels. We then develop an algorithm to turn NBC scores into confidence scores, helping determine how similar a sequence is to known ones and identify novel DNA.

Jonah Taylor

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Electrical & Computer Engineering

Benchmarking Solution Quality of Oscillator-Based Quantum Computing

Current superconducting quantum computers (SQCs) require cryogenic operation, making them costly and impractical. By leveraging the practicality of semiconductor operation, oscillator-based quantum computing stands out as a promising alternative to SQCs for solving NP hard problems. Solving such problems has significant applications across many areas including scheduling, logistics, planning, VLSI design, cryptography, data mining, and phylogenetics. Given the complexity of NP hard problems, benchmarking the solution quality of an oscillator-based quantum computing implementation requires a comparison to current software-based solvers. The focus of this work is a comparative analysis of various software solvers for NP hard problems. Each solver was tested by running extensive simulations on a diverse set of NP hard problems. This analysis informs future testing of oscillator-based quantum computers, ensuring accurate measurement of solution quality.

Peyton Buie

College of Engineering
Materials Science & Engineering

Faculty Mentor: **Dr. Caroline Schauer**
Materials Science & Engineering

Co-Mentors: Divya Kamireddi, Emma Snelling (STAR 2017)

Electrospun Polyhydroxybutyrate-co-hydroxyhexanoate nanofibers for biomedical applications

Poly-hydroxybutyrate (PHB) is a biodegradable and biocompatible polymer produced through microbial fermentation that is known for its high crystallinity. This material has shown improved inflammatory response compared to materials such as polylactic acid, a widely used biopolymer for tissue engineering application. These properties make it highly suitable for biomedical applications like tissue engineering scaffolds, drug delivery, and filtration. Its high crystallinity and brittle mechanical properties have limited its application. This study investigates methods of improving ductility of PHB nanofiber through the incorporation of hydroxy hexanoate (Hx). Varying mol% of hydroxy hexanoate from 3.5 -13.0 mol% was processed using a solvent of chloroform and acetic acid. The addition of acetic acid changes the viscosity and evaporation rate of the solution which impacts how the PHBHx electrospins. Processing parameters were optimized, showcasing the importance of optimizing parameters such as voltage, distance, and pump rate during electrospinning. Future research aims to experiment with lignin which has properties to reduce fiber diameter and increase porosity enhancing PHB's mechanical properties.

Autumn Dorothy Jones

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Co-Mentor: Emma Snelling (STAR 2017)

Sustainable Biomass Extraction from Agricultural Waste

Plastics from renewable sources, such as biopolymers, are emerging as biodegradable synthetic plastic alternatives. While they have excellent sustainability, they possess poor mechanical properties and benefit from natural fiber reinforcement.

Plant-derived, natural fibers are primarily comprised of cellulose, hemicellulose, and lignin. Cellulose is the world's richest renewable polymer; it is cost-effective, and non-toxic. Lignin is a versatile biomass ideal for pharmaceutical applications.

Agricultural waste is a pollutant despite upcycling potential. Previous literature has focused on extracting functional components such as oils and antioxidants. Nevertheless, these approaches result in landfilled fibrous mass despite their prospect as a natural fiber source.

This study focuses on the simultaneous extraction of cellulose and lignin from the fibrous mass of spent coffee grounds. Procedures that use environmentally friendly solvents and processes were formulated to obtain various biomasses without compromising the functional components.

This research adopts a circular approach, aiming to maximize the upcycling potential of agricultural waste, create multiple value-added products, and advance biopolymer applications.

Velay Fellow

Devin Liu

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Mechanical Engineering

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Mechanical Engineering & Mechanics

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Design Optimization with FEA Applied to Structural Batteries

Structural battery composites (SBCs) are an emerging technology that simultaneously integrates energy storage and structural load bearing capabilities into a single material. By combining the roles of energy storage and structural capabilities, SBCs can significantly reduce the overall weight of a system, which is notably beneficial for automotive applications. Through this research, we optimize the design of SBCs through applications of topology optimization and finite element analysis. The goal is to identify the best material distribution between the structural and electrolyte phases to enhance the overall performance. This work aims to boost the structural integrity and energy storage of SBCs for practical vehicle applications. Via a parametric study, this work assesses how varying the properties of the constitutive material phases impacts the optimized performance and design of SBCs. The performance is characterized by two critical metrics: ionic conductivity, which measures the ease with which ions move through the electrolyte, and compliance, defined as the material's ability to deform under mechanical stress. Through this study, we develop a stronger understanding of the effects of material properties on SBC designs.

Sahil Khan

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Faculty Mentor: **Dr. Yue (Luna) Zheng**
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Co-Mentor: Madhi Baniasadi

Using Metamaterials for Prosthetic Leg design

Prosthetics have evolved significantly since ancient times, with the Greville Chester toe from about 3000 years ago being an early example. Despite advancements, modern prostheses face challenges such as cost, durability, and performance. Researchers are exploring new approaches, including metamaterials, to enhance prosthetic design. Among these, tetrachiral structures offer potential improvements in mechanical performance and user comfort. This study investigates tetrachiral lattices in prosthetic legs to address weight, durability, and shock absorption issues. Using advanced 3D printing, mechanical testing, and Solidworks FEA simulation, tetrachiral structures were assessed under compression. Results indicate these structures provide better load distribution and reduced impact forces compared to traditional designs. This research suggests that tetrachiral structures could significantly advance prosthetic leg technology by offering a balance of strength, flexibility, and lightweight design. Future work should focus on optimizing these structures and evaluating their long-term performance in real-world conditions.

Alexander Morgan Pfeffer

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Co-Mentors: Mahdi Baniasadi, Simeng Wu

SoftStretch – Automated Unixial Tensioner for Soft Materials

Soft materials are intensively exploited as human-machine interfaces in tactile sensors, though their pre-stretched properties are not fully utilized. By straining a soft material a prescribed amount, the mechanical properties and texture of the material will vary accordingly, giving greater control in tactile sensing. The purpose of this project was to develop an automated stretching device that can apply uniaxial strain on a soft material to allow for precise testing and quantification of the effect on mechanical properties. By documenting the relation between strain and mechanical properties using an automated stretching machine, the range of properties of these materials can be instantly replicated. The stretching device can be paired with an auxiliary resource such as digital image correlation (DIC) to accurately visualize a strain field. To achieve these purposes in practice, the design and fabrication of all the prototypes for the stretching machine, as well as the programming of the motor function to apply the deformation and track it using DIC, have been performed. The prototypes in this project are designed to later incorporate biaxial stretching to provide a wider range of testing capabilities such as unequal strain.

Jasmine Wang

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Geometric Measurement of Gel Compression Testing Utilizing U-Net

Gels are extensively studied for many engineering applications—their mechanical properties are commonly characterized by compression tests. The challenge in obtaining geometrical information during testing stems from the gel's fragility, which requires real-time, touchless measurements. This study refines video analysis of gel compression tests by leveraging U-Net, a convolutional neural network (CNN), instead of traditional pixel-based methods (e.g. Otsu's Method) which rely on image thresholding based on color intensity. While conventional methods struggle with images of similar intensities, our approach overcomes this drawback and extends applicability to videos with low-contrast backgrounds. Specific frames throughout its compressive state are annotated with polygons to train the U-Net by detailing transition patterns on the boundaries of the gel, enabling precise image segmentation. U-Net then predicts all the remaining frames with accurate geometric variation. Our method leverages the CNN's capabilities to improve accuracy and efficiency in predicting material deformation. The results demonstrate that it outperforms the traditional method in terms of width measurements and potential applicability.

Benjamin Charles Hogan

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Mechanical Engineering & Mechanics

Co-Mentor: Taylor Baugh

Development of a whole new form of lunar rover for improved surveillance of asteroids and other celestial bodies

When looking at our solar systems, very few celestial bodies are as valuable and deadly to humanity as asteroids. Because of this, investing in monitoring asteroids and researching more about them would be helpful. My project centers around this and involves creating a rover that could be sent to an asteroid/lunar surface to collect data. However, instead of sending one larger rover, my project centers around sending multiple smaller rovers that could work collectively or as individuals. These rovers would connect via electromagnets placed on all six faces of the rover. My current prototype only contains one electromagnet as a proof of concept for the idea. For movement, each rover will consist of 4 wheels, two wheels powered by 12v DC motors, and two roller wheels for balance and to help improve steering. These motors will be controlled by a joystick in my prototype but could be controlled via a machine learning AI. The body is created from a transparent acrylic sheet for demonstration purposes. Future improvements and additions to the current prototype include adding additional electromagnets, control of both electromagnets and motors via Bluetooth or AI, and creating a ferroaluminum body for the rover's electronics to sit in.

Janani Krithivasan

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Public Health

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Health Sciences

Effects of a 24 Week Resistance Exercise Training Intervention on Cognitive Function in Adults with Alzheimer's Disease and Related Dementias

Dementia is a common public health issue expected to increase three-fold by 2050. The prevalence of cardiometabolic disease risk factors has increased for the past 25 years and has been associated with declines in cognitive function. Given pharmacologic therapies have demonstrated mixed effects on cognitive function, lifestyle therapies such as exercise are recommended; however, studies have been limited to community-dwelling older adults and have not trialed resistance training (RT), which may offer clinical benefit for those with dementia. We conducted a 24-week RT program in older adults with dementia. Participants completed RT thrice weekly, including exercises performed for 1-3 sets and 10-20 repetitions. Cardiometabolic health and cognitive function measures were assessed at baseline, 12 and 24 weeks. Statistics were performed using JASP with a priori alphas set to $p<.05$. On average, participants were older, obese, pre-hypertensive, and diabetic with dementia. No significant differences were found in cognitive function across time, but effect size estimates were moderate ($p>.05$, $n^2=.06$). RT may provide clinical benefits for improving cognitive function but studies replicating and bolstering our sample size are encouraged.

Tillia L. Thompson

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Collagen Content Variation in the Lateral Gastrocnemius of Mice

Cerebral palsy causes progressive skeletal muscle dysfunction, characterized by impaired growth and hyperactivity. Botulinum neurotoxin (BoNT) injections are used to reduce the muscle hyperactivity and resulting stiffness by generating local paralysis. New research suggests that after prolonged use, BoNT may inhibit muscle growth and increase stiffness while decreasing function. The increased stiffness is a thought to be a result of muscle fibrosis and increased collagen content.

The goal of this project was to assess collagen levels in muscle that has received BoNT injections versus a control group. Collagen content cannot be directly measured, but approximately 13.5% of collagen is comprised of hydroxyproline, which can be measured by a chemical assay. Thus, the collagen content of the lateral gastrocnemius muscles in mice at various time points following BoNT injection have been performed using hydroxyproline assays.

We found at 12 weeks post-injection, there was no significant difference in collagen content between the control and BoNT injected legs throughout the length of the muscle, though the content varied throughout the length of both legs, as expected.

Caleb Bergman

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Nursing

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Physical Therapy & Rehabilitation Sciences

Enhancing Vestibulospinal Tract Plasticity Through Downhill Training

Spinal Cord Injuries (SCI) affects 15 million people globally. Impacting an individual's ability to perform daily activities. Rehabilitation can improve function and independence after SCI. The vestibulospinal tract (VST) maintains stability during walking by transmitting information on head position to control posture. Different terrains engage the vestibular system more such as downhill training.

Thus, downhill training may foster VST plasticity and improve locomotion following SCI by engaging the VST. By exploring how downhill walking influences the VST we aim to find new strategies to promote recovery of walking after SCI.

6 adult rats were trained to walk on declined surfaces up to -20°. Ankle kinematics is collected before vestibular injury. On collecting pre-injury data, rats received an injection of gentamicin in the ear disrupting signals to the VST. Data was collected on day 2 and 7 and was compared to pre-injury.

We found > 80% of rats had increased ankle flexion (maximum ankle yield) in the first week after gentamicin injection when walking on -20°. > 65% of the rats also show increased total yield post-injection walking on -20°.

Downhill training can be used to promote vestibular plasticity and improve yield after SCI.

Sanaa Rogers

College of Arts & Sciences
Psychology

Faculty Mentor: **Professor Monica Harmon**
Undergraduate Nursing

The Black Bottom: A Community Displaced by Urban Renewal in Philadelphia

Stretching from Walnut Street to Lancaster Avenue, from 32nd to 40th streets, Philadelphia's Black Bottom neighborhood was home to a tight-knit community of people with varying economic backgrounds. The neighborhood was deemed blighted for the Federal Government's Urban Renewal plans, which involved eliminating substandard conditions, building new interstates, and displacing low-income residents to revitalize the economy. Roughly 5,000 people were displaced from the predominantly African-American neighborhood to make the University City Science Center and expand Drexel, The University of Pennsylvania, and West Philadelphia. This project's objective was to gain the perspectives of residents, city officials, and planners—examining the lasting effects on the community and raising awareness about the Black Bottom's history and its impact. Suggested reparations were also identified by a coalition of former Black Bottom residents and concerned citizens to measure repairs for the damages and the lasting effects on communities. This project is only part of a larger project to commemorate and celebrate the lives and times of the Black Bottom community.

Melissa Guerrero

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Economics & Public Health

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Community Health & Prevention

Assessing Mental Health Intervention Efforts for Latino Populations in Philadelphia through Quantitative Data Collection

Background: Historically, Latino populations have disproportionately struggled to access mental health care. Philadelphia is not exempt from this, with studies showing that 43% of local Latino immigrants have met the criteria for clinical anxiety, depression, and/or post-traumatic stress syndrome. The needs of our community motivated the CRISOL Mente Project, an intervention aiming to improve mental health outcomes and promote access to culturally appropriate mental health treatment.

Methods: Working closely with CRISOL, I have developed and will implement a quantitative survey that will record feedback from community members before and after they have made contact with the CRISOL Mente campaign. This survey will be administered before and after community outreach events throughout Philadelphia and will assess individuals' knowledge and attitudes toward mental health and treatment.

Expected Results: Collecting data from before and after events will help us to determine the efficacy of said events in spreading resource awareness and stigma reduction. Further, feedback may indicate areas of success and improvement within the campaign's approaches, allowing us to identify and make changes to optimize the project's overall impact.

Patricia Frimpong

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Epidemiology & Biostatistics

Co-Mentor: Justin Jones

Defining and Measuring HIV and HPV Screenings in the US

HIV and HPV are both preventable viral infections, but prophylaxis – as well as treatment – depend upon access to appropriate resources. For public health researchers interested in exploring disparities in access, data are needed to describe such resources, because understanding how individuals engage with healthcare through screenings is pivotal in accomplishing primary prevention.

The U.S. Centers for Disease Control and Prevention (CDC) define five indicators of healthcare access: availability, affordability, effectiveness and quality, medically underserved areas, and health literacy. We sought to understand how these can be measured specific to HIV and HPV healthcare access. First, we compiled a comprehensive table of screening recommendations for both infections from various agencies and societies. Then, we identified publicly available data that measure each of the CDC's indicators tailored to these screening recommendations. The data that we compiled may be used to describe and quantify barriers to access faced by patients in seeking preventative care, and how these barriers may exacerbate existing disparities.

Tiffany Getonga

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Mathematics

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Epidemiology & Biostatistics

Exploring the Relationship between Upward Mobility from Poverty and overall Mortality in the United States.

The Urban Institute, an independent policy-making organization, created an upward mobility from the poverty framework in 2019. It identifies five pillars that support mobility from poverty and their predictors, to ensure equitable access for all, including people of color and marginalized groups. There is evidence that links the predictors of upward mobility to health outcomes that impact quality and length of life.

To clearly establish the relationship between upward mobility and mortality. We used R programming to generate descriptive statistics, which includes measures of central tendency, measures of variation, and measures of frequency. A heat map correlation matrix was created using Pearson's correlation to assess the association between premature mortality and each metric.

Through analysis, the share in debt collections had the strongest positive correlation with premature mortality, and the share of the voting-eligible population had the strongest negative correlation with premature mortality. Our findings would be a beneficial tool for community leaders during the implementation of the framework to effectively allocate resources to the predictors if their community struggles with high numbers of premature deaths.

Angelina Lugo

College of Arts & Sciences
Mathematics

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Epidemiology & Biostatistics

Correlations Between Predictors of Upward Mobility from Poverty

Research shows that individuals who experience systemic roadblocks in achieving a financially and socially fulfilling life face challenges in attaining upward mobility from poverty. The Urban Institute, a policy think-tank aiming to advance upward mobility and equity, has crafted a framework for upward mobility to encourage the development of initiatives that promote upward mobility within local communities. It consists of five domains of ideal community conditions for upward mobility: Opportunity Rich and Inclusive Neighborhoods, High Quality Education, Rewarding Work, and A Just and Responsive Government. Pearson-correlation matrices were created with R programming to investigate the correlation of the metrics within each domain. In utilizing Urban's nationally scaled county data, we focused on the correlation of each domain's metrics within all 3,144 counties of the US, with emphasis on Pennsylvania counties. Qualitative observations were made based off the correlation matrices and summary statistics generated for the data. These observations can aid in identifying possible systemic roadblocks towards achieving external upward mobility and provide incentives for conversations about underlying national systemic issues.

Velay Fellow

Prajanya Prabakaran

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Faculty Mentor: **Dr. Ridhdhi Desai**
Biochemistry & Molecular Biology

Co-Mentor: Erik Schubert

Generating Tools To Understand How Tumor Suppressors Influence Development Of Pancreatic Precancerous Lesions

Pancreatic ductal adenocarcinoma (PDAC) is the deadliest disease that arises from non-invasive precancerous lesions, such as intraductal papillary mucinous neoplasms (IPMNs). Early stages of IPMN lesions are characterized by mutations in oncogenes GNAS R201C and KRAS G12V while high-grade IPMNs bear inactivating mutations in tumor suppressor genes such as TP53. Due to a lack of models to study human IPMNs, the role of these mutations in IPMN development is unclear. Recent studies using human stem-cell derived pancreatic organoids show that oncogenic GNAS is insufficient to develop IPMN lesions *in vivo*, alone or coupled with KRASG12V. We generated a doxycycline-inducible lentiviral plasmid with a dominant-negative TP53 mutant (TP53R175H) to explore whether TP53 inactivation cooperates with oncogenic GNAS to promote IPMN development. TP53 was amplified through PCR and ligated into a lentiviral plasmid using NEB-based assembly. TP53 containing colonies were then verified using restriction digest and sequencing. Pancreatic progenitors transduced with lentiviral particles bearing these plasmids will be used to assess how ductal and acinar-specific inactivation of tumor suppressors influence oncogenic GNAS-derived IPMN lesions *in vivo*.

Matthew Uppani

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Biological Sciences

Faculty Mentor: **Dr. Ridhdhi Desai**
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Co-Mentor: David Crowell

Understanding the effect of MAPK signaling on oncogene-induced proliferation of human stem-cell-derived pancreatic ductal organoids

Pancreatic Ductal Adenocarcinoma, the most common type of pancreatic cancer, develops from precancerous lesions: Intraductal Papillary Mucinous Neoplasms (IPMNs). Studies show that mutations in GNAS(R201C) that primarily activate the canonical cAMP/PKA signaling pathway are exclusive to IPMNs. Our lab has shown that GNAS(R201C) can promote cell proliferation independent of PKA, specifically in pancreatic ductal organoids. Other evidence suggests that a hyperactive long isoform of GNAS can activate MAP Kinase (MAPK/ERK) signaling, independent of PKA, to support tumor growth. To understand the relationship between oncogenic GNAS and MAPK signaling, we treated oncogenic ductal organoids with varying doses of two clinically approved MEK inhibitors, Selumetinib and Trametinib. Using Phase Imaging and EdU-based proliferation assays, we assessed changes in cell morphology and cell proliferation. Initial findings indicate that inhibition of MAPK signaling dramatically reduces the total percentage of EdU+ ductal cells both in the presence and absence of PKA signaling. Since PKA signaling is clinically untargetable, identifying other PKA-independent pathways has strong implications for developing other therapeutics for pancreatic cancer.

Navya Kundula

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Pharmacological Inhibition of Breast Cancer Brain Metastasis via hACSS2 Inhibition

My current research is on breast cancer brain metastasis. Breast cancer tumors in the brain rely on converting acetate to acetyl-CoA by the enzyme ACSS2. My specific role in this research is to test compounds that may act as ACSS2 inhibitors. Two compounds have already been published with tumor with tumor-killing activity. I started testing analogs of these compounds.

A GFP-based assay was used to determine which compounds did the best job eliminating the cancer cells. In the GFP assay, breast cancer cells would be exposed to green fluorescent protein. Then, these cells would be treated with various compounds and exposed to UV light. If the compound was potent, we would see low GFP levels in the cells since the tumor is being killed. Next, a PAMPA test was done. This test checks the drug's ability to diffuse through the blood-brain barrier passively. Lastly, an ex-vivo evaluation of the best-performing compounds was performed where pieces of mice brain tissue with tumor injected were treated with the various compounds. With this data, we can pinpoint specific compounds which may be able to inhibit ACSS2 from producing breast cancer tumor.

Rujula Warade

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Co-Mentors: Riley Young, Nusaiba Ahmed

Role of ACSS2 in Regulating Ferroptosis in Breast Cancer Brain Metastatic Cells

Breast cancer is the second leading cause of cancer-related deaths in women. Brain metastasis in patients with breast cancer is extremely deadly, with few treatment options. Tumors in the brain depend on acetate as a preferred carbon source for growth. Acetyl-CoA synthetase 2 (ACSS2) enzyme converts acetate to acetyl-CoA and, therefore, serves as a key regulator for tumor growth in the brain. Our lab has preliminary data showing that targeting ACSS2 in breast cancer brain metastasis (BCBM) induces a form of cell death called ferroptosis and is associated with changes in ferroptosis regulator SLC7A11. To explore the role of SLC7A11 in BCBM, we first generated stable BCBM cells containing genetic knockdown of SLC7A11 (shSLC7A11) in MDA-MB-231Br and 4T1Br cell lines and confirmed this using western blotting. BCBM cells injected into mice stably expressing SLC7A11 RNAi contained reduced tumor growth compared to control cells. In addition, using an ex vivo model, we showed that treating BCBM cells with SLC7A11 inhibitor Sulfasalazine (SFS) slowed tumor growth. These results suggest that ACSS2 inhibitors that target SLC7A11 may function in inducing ferroptosis and correlate with slowed BCBM growth in the brain.

Syd Worthington

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Co-Mentors: Nusaiba Ahmed, Riley Young

P90-RSK1: A novel target of O-GlcNAc in Breast Cancer Brain Metastasis

Triple negative breast cancer accounts for 10-15% of breast cancers and is the subtype that has the highest occurrence of brain metastasis (BCBM). Unfortunately, within one year of brain metastasis diagnosis, 80% of patients will not survive. We have previously shown that BCBM cells contain high levels of a post-translational modification known as O-GlcNAc. Our lab had previously shown that the enzyme responsible for this modification OGT and its modification O-GlcNAc are highly elevated in BCBM cells compared to parental breast cancer cells. A proteomic analysis identified p90-RSK1 as being O-GlcnNAc enriched in BCBM cells compared to parental BC cells. Western blotting demonstrated that p90 is elevated in BCBM cells and correlates to an increase in O-GlcNAcylation using inhibitors such as OSMI-4 and Thiamet-G that reduce or increase the process of O-GlcNAcylation respectively. In addition, treating BCBM with p90-RSK inhibitor (BRD7389) blocked cell growth in BCBM cells. Ex vivo data displayed the progression of tumor shrinkage after increasing the amount of RSKi added over 10 days. Thus, this study identifies p90 as a novel O-GlcNAc regulated protein and as a potential therapeutic target for targeting BCBM.

Hailey M Graff

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GeneGPT: Gene function prediction and explanation using OpenAI Large Language Models

Current tools for predicting the biological function of a gene rely on traditional machine learning algorithms. However, technological advancement in Large Language Models (LLMs) provides the opportunity to amplify these techniques and create a responsive expert chatbot for gene function prediction. This research aims to develop a chatbot capable of assessing gene function more accurately and efficiently, while overcoming the challenges of typical LLMs such as hallucinations. Custom OpenAI chatbots were developed that employ Python scripts to search the input sequence for known motifs before drawing its conclusion. This model was evaluated by quizzing it with 8 genes of known function. A grading rubric was used to assess each model's understanding of the genetic sequence provided. The results were ultimately quite promising, with a consistent increase across all samples as opposed to using previous versions of the custom models and the ChatGPT created model. This work identifies that synergizing traditional methods with LLMs the hybrid is stronger than either alone. Through this research, gene function analysis can become more efficient and precise, as a field.

Numa F. Kamal

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Faculty Mentor: **Dr. Jennifer Hope**
Microbiology & Immunology

Co-Mentors: Laura Cort, Katie Hausman

Real-Time Quantification of T Cell-Mediated Pancreatic Cancer Cell Death

The average lifetime risk of developing pancreatic cancer (PC) is about 1.5%, yet PC is the third leading cause of cancer-related deaths in the United States. This poor clinical outlook is likely the result of late-stage diagnosis and resistance to currently available cancer treatments. Further, the pancreatic tumor microenvironment is highly immunosuppressive with limited infiltration of anti-tumor immune cells observed. From an immunological perspective, little is known about what regulates anti-tumor immunity to PC and particularly what limits CD8+ T cell responses to PC. We designed an assay co-culturing mouse PC cells modified to be recognized by CD8+ T cells in order to evaluate and quantify CD8+ T cell-mediated PC cell death. Recent studies suggest that signaling through the cell surface marker P-Selectin Glycoprotein Ligand-1 (PSGL-1) promotes CD8+ T cell exhaustion, a state of decreased cytotoxicity and proliferation. We hypothesize that PSGL-1 deficiency will promote increased T cell responses and improved tumor control. Future studies of this research may include targeting PSGL-1 expression in T cells as a method of attacking PC.

Madhuram Sundararajan

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Co-Mentors: River Larson-Pollock, Ijeoma Okoye, Dr. Anurag Shukla

Creating A Transgenic Plasmodium falciparum Parasite Line Using CRISPR/Cas9 Genome Editing

Malaria remains one of the deadliest infectious diseases worldwide, with *Plasmodium falciparum* responsible for the most severe cases. Despite global efforts, the emergence of drug-resistant parasite strains has hindered the development of effective antimalarial drugs. Thus, there is an urgent need for novel drug targets. My research focuses on determining the function of gene PF3D7_1105800, which encodes a highly conserved, mitochondrially targeted protein unique to Apicomplexan parasites, making it a potential target for selective antimalarial drug development. To understand the function of PF3D7_1105800, we utilized CRISPR-Cas9 gene-editing technology to create a parasite line conditionally expressing the gene in *P. falciparum*. A donor plasmid containing homology regions, as well as TetR-DOZI conditional knockdown system were generated, in addition to a Cas9 plasmid containing a gRNA sequence. Future experiments include transfecting *P. falciparum* with these plasmids to assess parasite viability as well as other phenotypic consequences of the protein removal in the parasite. By investigating the effects of PF3D7_1105800 knockdown on parasite survival, we aim to uncover the protein's function at the cellular level.

Riya Chawla

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Neurobiology & Anatomy

Co-Mentors: Bridie D. Eckel, Dr. Emanuela Piermarini

Mutations in the M1 isoform of spastin cause defects in the Axon Initial Segment in a mouse model of Hereditary Spastic Paraplegia type 4

Hereditary Spastic Paraplegia type 4 (SPG4-HSP) is an autosomal dominant disease that manifests with gait impairment, muscle weakness, and spasticity. It emerges from mutations in SPAST, a gene that encodes spastin. Spastin has two main isoforms: M1 and M87. M87 has higher expression, but it is the mutant form of M1 that has been hypothesized to underlie corticospinal tract degeneration in SPG4-HSP. To better understand the mechanism of axonal degeneration, we are using SPAST-C448Y, which is the only mouse model for SPG4-HSP that expresses human mutant spastin. We hypothesize that mutant M1 may lead to defects at the axonal initial segment (AIS), which is a structure located at the base of the axon that is responsible for producing action potentials and regulating neuronal polarity and excitability. Our preliminary results on primary neuronal culture reveal that mutant M1 interacts with the AIS, causing changes in its position and length, which also correlates with reduced neuronal activity. These findings support the hypothesis that mutant M1 causes degeneration in SPG4-HSP by disrupting the AIS, resulting in defects in the electrical properties of the axon, leading to decreased neuronal activity.

Chan Nicholas Chung

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The Transition to Ethanol Dependence Leads to Sex-Related Changes in Gene Expression of the PACAP Receptor Population

The neuropeptide, pituitary adenylate cyclase-activating polypeptide (PACAP), can inhibit ethanol drinking via the nucleus accumbens (NAc) in non-dependent animals. Data from our lab, however, show that the effects of PACAP can change as animals develop dependence on ethanol. To determine if this shift is related to changes in PACAP PAC1 receptors, we tested male and female C57BL/6J mice (*N* = 46) maintained on water and chow alone (*n* = 16), or exposed to 20% ethanol on an intermittent access paradigm for 4 weeks and then either induced to a dependent state (*n* = 15) via chronic intermittent exposure to ethanol vapor or kept non-dependent (*n* = 15) through air exposure. We then sacrificed the mice and extracted the NAc for quantitative real-time PCR to compare expression of the two PAC1 receptor vaariants, HOP and SHORT. We found that, in mice made dependent on ethanol, HOP mRNA was increased, specifically in male mice. In mice with any exposure to ethanol, SHORT mRNA was increased, specifically in female mice. These data suggest that changes in the PAC1 receptors may be a mechanism through which PACAP alters its function with the development of ethanol dependence, and they highlight important sex differences in how this may occur.

Jonathan Y. Stein

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Co-Mentors: Jason J. Wheeler, Patrick J. McGinnis, Meredith A. Singer

Effects of Nanotherapeutic Rolipram–PgP on Chronic Pain after Spinal Cord Injury

Globally, over 15 million individuals live with a spinal cord injury (SCI). Chronic neuropathic pain is the most common sensory disability that occurs after SCI. It drastically reduces quality of life, and there is no effective cure. Here, we aimed to reduce pain in chronic SCI and promote recovery by targeting inflammation. Rolipram (Rm) is an anti-inflammatory drug that selectively inhibits phosphodiesterase-4 which leads to increased activity of cyclic AMP and ultimately reduced inflammation at the injury site and in areas surrounding neural circuitry that transmits pain signals. Adult female Sprague Dawley rats received a unilateral C5 SCI. Four weeks later, SCI-induced changes in mechanical sensitivity (von Frey) and thermal sensitivity (Hargreaves) were determined, and rats randomly received intrathecal injection of either a bioengineered nanoparticle cationic amphiphilic copolymer poly-graft-polyethylenimine (PgP) loaded with Rm (Rm-PgP), empty, control PgP or saline. Pain-like behaviors were followed weekly post injection, and we expect that Rm-PgP will reduce mechanical and thermal pain compared to both control groups. Our end goal is to reduce human suffering, pain, and improve recovery in those affected by chronic SCI.

Dwij Rana

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Biological Sciences

Faculty Mentor: **Dr. Wen-Jun Gao**
Neurobiology & Anatomy

Co-Mentor: Nadia Bouras (STAR 2020)

Investigating Prefrontal Norepinenphrine and Calcium Dynamics During Discrete Social Dominance-Related Behaviors.

Animal models have revealed that repeated negative social experiences can lead to depressive and anxiety-like affects. Moreover, previous research has demonstrated that inactivation of the medial prefrontal cortex (mPFC) increases susceptibility to defeat in social dominance contests. Norepinephrine (NE), a neurotransmitter synthesized in the locus coeruleus (LC) and released in the mPFC, plays a crucial role in arousal, stress, and anxiety. Given its involvement in these processes, we hypothesize that NE signaling in the mPFC modulates social dominance behaviors. In this pilot study, we employed fiber photometry to monitor real-time NE and calcium dynamics in the mPFC of dominant and subordinate male mice during social dominance competitions. Our findings may provide insights into the complex interplay between NE signaling and mPFC activity in shaping social behavior. This preclinical study has potential applications to understanding the neurobiological perturbations shown in neurological disorders that exhibit related social deficits, such as autism spectrum disorder (ASD).

Tejasvi Pathipati

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Neurobiology & Anatomy

Co-Mentor: Jennifer Pastorino

Exploring Corticospinal Regeneration: CaRheb Activation in SCI Models and its Impact on Neuronal Growth and Pathway Stimulation

Spinal cord injury (SCI) affects 15.4M globally, with 17.5K new US cases yearly, resulting in paralysis, muscle weakness, and pain. This study aims to enhance understanding of corticospinal tract regeneration achieved using a retrograde viral vector to express constitutively active ras homolog (CaRheb) in adult rat neurons. Animals analyzed received a complete thoracic level 10 transection followed by spinal injections of AAV CaRheb and control GFP. Our goal was to observe how retrograde AAV CaRheb stimulates growth pathways by targeting long descending cortical cells. Similar retrograde viral vectors expressing shPTEN drive regeneration but induce problematic growth of neuron soma sizes. However, our results indicate that CaRheb does not induce significant growth in soma sizes when compared to nearby cells that did not express CaRheb treatment. In further analyses, sectioned brain tissue was immunostained after experimental treadmill training and cage rest. Results indicate CaRheb and growth-associated protein 43 (GAP-43) co-express, indicating CaRheb activates mTOR-related growth pathways as expected. Future directions include comparing the percentages of GAP-43 expressing neurons in treadmill-trained versus cage-rest animals.

Samridhi K Sudan

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Impact of BHLHA9 Overexpression on Neurons during Cortical Development

Our project focuses on the effect of the overexpression of the gene, which is implicated in genetic disorders, on neuronal morphogenesis during cortical development. Specifically, we are investigating the BHLHA9 gene, located on the chromosome 17p13.3, whose duplication is a potential cause of autism. By analyzing its overexpression in cortical neurons, we aim to determine its impact on neuronal development and morphology. To achieve this, we employed a combination of in vivo and in vitro techniques. Specifically, the development of neurons influenced by the BHLHA9 overexpression was examined using cell labeling by in vivo electroporation, called in utero electroporation. Subsequently, we use confocal imaging to capture brain sections, allowing us to examine the neuronal development. Currently, we are in the process of analyzing neuronal morphology using confocal microscope images, focusing on neurite numbers and length from the soma.

Faith Clark

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Co-Mentor: Jason DaCunza

Effect of MCP-1 on miR-106b-25 Cluster Expression in Immune Cells

Complex regional pain syndrome (CRPS) is a chronic neuropathic pain disorder occurring in an extremity after trauma. CRPS currently lacks an FDA-approved treatment. Circulating microRNA (miRNA) is a promising avenue to better understand disease mechanisms. miRNAs are short RNAs that negatively regulate the translation of genes into proteins. Dysregulation in miRNA expression has downstream effects in cellular function that can contribute to disease. Our previous work identified miRNAs dysregulated in CRPS patients, including miR-106b, miR-93, and miR-25, which comprise the miR-106b-25 cluster. This study investigates how expression of this cluster in T cells and monocytes is affected by monocyte chemoattractant protein-1 (MCP-1/CCL2), a proinflammatory chemokine that is upregulated in CRPS patients. Expression changes in miR-106b, -93, and -25 after MCP-1-treatment will be determined by quantitative PCR. The data from this study will inform future studies verifying target genes of these miRNAs and shifting to an *in vivo* model for increased clinical relevance.

Anaahat Brar

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Co-Mentor: Dr. Mitchell Nothem

Sex-Dependent Effects of Cannabinoid Combinations on Mechanical Allodynia in a Chronic Neuropathic Pain Model

Chronic neuropathic pain (CNP) is a debilitating condition that affects millions of people worldwide, and treatments are limited by side effects and addiction risk. Studies have shown that cannabinoids such as cannabidiol (CBD) and cannabigerol (CBG) have potential in treating CNP by acting on the brain regions that regulate pain. However, it is currently unclear whether the effects of the cannabinoids on pain behavior and brain activity differ based upon sex or when used in combination. We used the spared nerve injury (SNI) model of CNP in mice to induce mechanical hypersensitivity. The mice were given doses of either vehicle, CBD (10mg/kg), or CBD + CBG (10mg/kg + 10mg/kg) before using von Frey and dynamic weight bearing assays to test mechanical hypersensitivity and weight bearing behavior. We found that CBD reduced pain behavior in females but not males, while the combination of CBD+CBG was effective in both groups. This suggests that cannabinoids could be used as an alternative treatment for CNP. Ongoing work is investigating the effect of cannabinoids on activity in brain circuits that regulate pain to provide insight into mechanisms of cannabinoid analgesia.

Nicholas M Brattini

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Co-Mentor: Henok Ermias

Novel Allosteric Modulation of Glycine Transporters

Research into glycine transporter regulation has been of great interest in the pharmacology industry to develop new treatments for common neurological disorders such as schizophrenia and pain. Our lab previously successfully identified allosteric modulators of monoamine neurotransmitters such as the dopamine transporter. These findings have influenced our current work in identifying potential novel allosteric modulators of glycine transporters (GlyT1 and GlyT2) and in this project, are being tested for their positive or negative allosteric modulation of the transporters. By running radiolabeled glycine uptakes with stably transfected MDCK cells with GlyT1 and transient transfected COS-7 cells with GlyT1 and GlyT2, exposing both lines to the experimental drug, we are able to determine the potential allosteric activity of 15 newly synthesized drugs. When classification of the drugs' effect is complete, further confirmation of drug/transporter interaction employing a biotinylation/mutagenesis assay will be pursued as well as experiments with rodent models of disease to determine therapeutic potential. If successful, these drugs will be used to supplement existing neurological disorder medications stimulating greater symptom relief.

Anna Till

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Faculty Mentor: **Dr. Andreia C. K. Mortensen**
Pharmacology & Physiology

Co-Mentor: Simran Gill

Evaluating Surface Expression of EAAT2 in Stroke Model

Glutamate is the most abundant excitatory neurotransmitter in the CNS and its action is terminated primarily by excitatory amino acid transporter 2 (EAAT2). The transporter is critical in regulating glutamate levels to prevent glutamate-mediated excitotoxicity, when a surplus of glutamate in the synaptic gap overwhelms postsynaptic glutamate receptors, causing neuronal cell death. This is linked to several neurological disorders and stroke.

In our study, we performed a stroke insult by depriving glia cells of oxygen and glucose (OGD) for two hours. 24 hours after OGD, glutamate uptake and surface expression of EAAT2 decrease, suggesting that transporters are not working properly.

We hypothesize that EAAT2 surface proteins are internalized because of the insult, resulting in a decrease in glutamate uptake. To investigate this, immediately after ending the OGD insult, we biotinylated surface proteins to evaluate surface and total expression of EAAT2 proteins, using phorbol 12-myristate 13-acetate (PMA) as a positive control, which is known to cause internalization of EAAT2. Gaining an understanding of how transporters are damaged in a stroke model allows us to find better ways to treat neuronal death after stroke.

Zakir Jiwani

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Faculty Mentor: **Dr. Swathi Sudhakar**
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Innovative 3D-Printed Zinc(II)-Curcumin Loaded Zein-Chitosan Hydrogel Scaffolds: A Promising, Accessible, and Cost-Effective Alternative for Treating Severe Bone Defects like Bone Cancer and Osteoporosis

The global incidence of severe bone defects is surging, while standard Bone Autograft treatments remain inaccessible, painful, and risk infection for patients. This study presents a novel natural hydrogel matrix of Zein and Chitosan, loaded with a Zinc(II)-Curcumin complex, as an effective treatment for bone defects. 8% Chitosan and 20% Zein w/v were dissolved in acetic acid, stirred together, crosslinked with 17M NaOH in a 1:1:1 ratio, and lyophilized to form a porous bone scaffold. 20% Zein and 7% Chitosan w/v dissolved in 50% acetic acid were 3D printed(0.3mm resolution) inside 5M NaOH for pH-neutral patient-specific implants. 500nm SEM analysis revealed a porous hydrogel structure like the extracellular matrix, suitable for angiogenesis. The scaffold withstood a 10N load, strengthened to 1227N/m with 3D printing. The formation and incorporation of the Zinc(II)-Curcumin complex was validated by FTIR, XRD, and UV Spectroscopy. Biocompatibility was confirmed via chick embryo assays and successful MG63 osteoblast cell proliferation. The scaffolds presented offer a promising advancement in minimally invasive patient-specific bone defect treatment while being simpler, more accessible, and cost-effective than traditional bone grafts.

External: Indian Institute of Technology – Madras

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Zn/Curcumin-Loaded Zein/Chitosan Scaffolds for Bone Tissue Regeneration: Freeze-Drying Method and 3D Printing Applications

Curcumin's anti-inflammatory, antimicrobial, and anticancer properties are hindered by limited bioavailability and therapeutic efficacy. Zinc, also known for its osteogenic properties, can stabilize curcumin by forming a bioactive complex with enhanced therapeutic potential. In this study, a natural composite hydrogel matrix of Zein and Chitosan, loaded with a Zinc (II)-Curcumin complex, has been developed and characterized as a promising alternative to traditional bone grafts via a freeze-drying method. Additionally, its 3D printing capability significantly enhances its applicability. SEM analysis revealed highly porous structure capable of supporting angiogenesis from the 1mm to 500 nm view. FTIR, XRD and UV Spectral analysis confirmed the successful integration of the Zinc (II)-Curcumin complex within the crystalline matrix. Mechanical testing demonstrated moderate load-bearing capabilities up to 10N, which were further enhanced by varying the 3D-printed structure. Furthermore, Biocompatibility was validated through successful embryo trials and the proliferation of MG63 osteoblast cells. These findings demonstrate that Zinc/Curcumin complex loaded hydrogels have immense potential as scaffolds for bone tissue engineering applications.

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Neuroergonomic Human-Robot Interaction

Over the last few years, there has been an increase in the integration of robotics technology into diverse applications in human life. As the capabilities of robots expand, there is a growing potential for them to become integral team members with humans. Despite advancements, there is limited understanding of humanoid robot characteristics that improve collaboration and teaming. This study aims to investigate verbal and non-verbal robot behavior while human operators' brain activity, hormonal response, and behavior are monitored during a series of physical and cognitive collaborative tasks. In the experimental setup, the humanoid social robot "Pepper" collaborates with humans to perform five distinct tasks. The study involves designing and implementing the tasks, recording the experiment videos, recording brain activity using fNIRS technology, analyzing video recordings to assess task performance for each task, and comparing user's neural response and task performance when the robot operates erroneously and correctly. The analysis will provide insights into the neural correlates of human-robot interaction, enhancing our understanding of how humans bond with robots over time and under varying task performance conditions.

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Mapping Neural Pathways: Unraveling Sensorimotor Transformations in Odor-Guided Locomotion of Drosophila melanogaster

Understanding sensorimotor transformations are vital for deciphering how the brain interprets sensory inputs to drive complex motor behaviors essential for survival. Odor- guided locomotion in Drosophila melanogaster, serves as an ideal model for studying these processes. Odor perception, key to life-sustaining behaviors like foraging and mating, begins when olfactory receptor neurons (ORNs) in the antennae detect an odorant. The ORNs relay sensory information to the antennal lobe, where projection neurons (PNs) transmit it to higher brain centers, including the mushroom body and lateral horn.

Within the lateral horn, third-order neurons (LHONs) integrate sensory signals, which may either circulate within the lateral horn or proceed to premotor neurons, essential for motor output. These premotor neurons can then further convey information to descending neurons, which directly influence motor outputs and ultimately, Drosophila behavior. By mapping the neural pathways from the antennal lobe to descending neurons, this project aims to identify specific circuits that govern Drosophila behavior in response to sensory stimuli, advancing our understanding of the neural basis of behavior.

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Enhancing CAR-T Cell Function Using Precision Interleukin-2 Particles

Advancements in cancer research have highlighted the immune system's potential to be used as treatment. Specifically, T cells can be modified to Chimeric Antigen Receptor (CAR) T cells that are engineered with receptors that recognize, bind to, and kill target cancer cells. However, this approach still faces challenges as patients who receive CAR-T cell therapy often relapse and cancerous cells reappear due to CAR-T cell count dropping in vivo.

Here, we developed precision biodegradable particles, with antigen and co-stimulation signals attached to the particle surface via DNA scaffolds, which offer a potential route to cell-extrinsic manipulation of CAR-T cells, given optimized stimulation to promote proliferation while reserving their effector function. T cell expansion is also dependent on a third immunomodulatory signal, interleukin-2 (IL-2), a growth and signaling cytokine. We have developed a particle with IL-2 attached to the surface to dose functional biomaterials to promote T cell expansion in CAR-T cell populations in vitro. Future steps aim to use animal models for in vivo experimentation. Particles will be used to deliver immunomodulatory signals to CAR-T cell populations through a vaccine approach.

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Modularized Gold Nanocarriers for Targeted CAR Delivery

Chimeric antigen receptor (CAR) T-cell therapy, in which T-cells are genetically modified to fight certain cancers, is becoming increasingly prevalent with advances in cell-engineering. However, current methods of making CAR T-cells, by viral and non-viral means, creates concerns of oncogenic risk, cytotoxicity, and inefficiency. To improve these aspects, we use a promising design of hollow gold nanoshells (HGNs) that are activated by near infrared (NIR) light while leaving human cells undamaged. Multifunctional CRISPR components were adapted to the HGN's internalization via TAT peptides and NIR light-activation. Through confocal imaging, we have found internalization of HGNs in untransduced and CAR T-cells at various TAT levels. A saturated level of payload release (~75%) from NIR laser irradiation has been calculated at 400mW. Next, we will test CRISPR functionality post-activation as well as optimizing the design. This should allow for highly efficient site specific genome editing, which will be compared against the lentiviral standard for CAR T-cells. Significant improvements in the aforementioned concerns, specifically efficiency, have the potential to revolutionize the current state of cell engineering.

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Improved CAR-T Cell Expansion with Bioengineered Particles

Chimeric antigen receptor (CAR) T cell therapy is a promising treatment for blood cancers. Despite the success of FDA-approved CAR-T therapies like BCMA CAR-T, challenges remain, particularly in achieving sustained cell persistence crucial for long-term efficacy and reducing relapse rates. Our research utilizes precision biomaterials to enhance reliable cell expansion and improve CAR-T cell persistence. We employ DNA-scaffold-mediated functionalization to establish particles of constant ratio of antigen to costimulatory antibodies to stimulate BCMA CAR-T cells. We hypothesize that this process of in vitro stimulation will expand and enrich CAR-T cells. Preliminary data indicate that the particles lead to greater BCMA CAR-T cell expansion compared to the control. Additionally, there was no observed difference in cell proliferation between lentivirus-based (retroviral) and TRAC-locus-based engineering methods. Our findings suggest that precision biomaterials enhance CAR-T cell expansion, and TRAC-locus-based engineering is a viable alternative to retroviral methods. Further investigation into long-term persistence and functionality is needed, with future steps involving comprehensive in vivo studies.

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Ria Goel

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Exploring Oncogenic Pathways and Immune Interactions: Therapeutic Targets Across Breast, Liver, Lung, and Blood Cancer

Cancer is a complex group of diseases characterized by the uncontrolled growth and spread of abnormal cells that destroy healthy tissue. Accounting for an estimated 9.6 million deaths in 2018, it's the second leading cause of death globally. Many patients don't have access to timely quality diagnosis and treatment which exerts tremendous physical, emotional, and financial strains but survival may improve with early detection and quality treatment.

I investigate critical alterations in signaling pathways across four major cancer types — breast, liver, lung, and blood cancers — to reveal potential therapeutic targets and biomarkers for each cancer type. In comparing the signaling alterations across these diverse cancers, the aim is to uncover shared mechanisms of oncogenesis and resistance, providing insights for the development of targeted therapies and personalized treatment strategies. More specifically, this review focuses on suggesting new and better immunotherapy options by exploring the interplay between cancer signaling pathways and the immune system. Understanding these interactions can lead to innovative approaches that enhance the efficacy of immunotherapies, offering hope for improved outcomes in cancer treatment.

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Development of a Portable and Versatile Functional Near-Infrared Spectroscopy (fNIRS) System

Functional near-infrared spectroscopy (fNIRS) is a brain imaging technique that uses near-infrared light to measure brain activity. Traditional fNIRS systems are large and cumbersome, limiting the potential applications of this technology. The aim of this project has been to create a new, portable fNIRS system that can be utilized in a wide array of settings. The portable and less obtrusive nature of the device enables its use in more naturalistic, real-life environments. The system uses 735 nm and 850 nm light to penetrate the skull and reach the brain. Reflected light is measured by skin-mounted probes and used to calculate levels of oxygenated and deoxygenated hemoglobin in the targeted region of the brain. Integrated accelerometers on the probes detect and compensate for motion artifacts in the data. The design of the new system and probes was done in Altium, with programs for data collection and analysis written in Python and MATLAB. Development of this system is ongoing, with the next phase focused on improving motion artifact compensation.

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Maria Afonkina

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Strain-Stiffening Injectable Hydrogels for Modulating Cell Behavior

Intracellular fibrillar networks and the extracellular matrix stiffen in response to strain, enabling them to endure physiological shear stress while maintaining structural integrity. For biomimetic materials to effectively model cell-matrix interactions, they should replicate these properties. Photo-crosslinked polymeric hydrogels stiffen under shear strain due to entropic factors, but their usage requires surgical implantation. In contrast, supramolecular hydrogels with shear-thinning properties can be injected directly into tissues but often fail to mimic cellular-scale strain stiffening. To achieve both microscale strain stiffening and macroscale shear thinning, we covalently photo-crosslinked methacrylated dextran (DexMA) with methacrylated cyclodextrin (MeCD), followed by granulation of the bulk hydrogel via extrusion fragmentation. We achieved the intended rheological properties, which could be adjusted by altering DexMA and MeCD concentrations and processing conditions. Additionally, cyclodextrin moieties can host drugs to modulate cellular functions, expanding the applicability of the hydrogel. Our study demonstrates the biomedical potential of guest-functionalized soft matrices with tailorable material properties.

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Making PLGA Microparticles of Specific Size Ranges for Drug Delivery

PLGA microparticles (MPs) are powerful tools for delivering drugs to the human body. The rate and timing of their release is determined by the characteristics of the MPs, with size being particularly critical. However, existing protocols to make these particles often result in a broad size distribution, which limits their capacity to deliver substances in a controlled manner. Thus, the goal of my STAR research was to determine how to make PLGA MPs of specific sizes.

Particles were made using a double emulsion method and measured using an AccuSizer device. My findings confirmed that the homogenizing (stirring) speed directly influences their size distribution, the faster it is the smaller the particles are on average. Nevertheless, even at high speeds some large MPs remain. Although they are few in number, these larger particles can absorb most of the drug due to their volume, skewing the release profile. This research underscored the importance of straining the samples before use to remove these larger particles. Currently, this method of adjusting homogenizing speed and sample straining is being used to develop protocols for making MPs of various sizes so they can be used in multiple applications in Drexel's laboratories.

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CRISPR-CAS9 Mediated Gene Editing of Inflammation-Associated Genes in Human Monocytic Cell Lines

Macrophage functionality and mechanisms play an important role in understanding its therapeutic utility and applications. This project investigated the potential of genetically altering monocytes as a potential mechanism for creating macrophage based cell therapies and therapeutic platforms. We utilized CRISPR-Cas9, a precise genetic editing tool, to target and cleave specific DNA sequences in THP-1 cells, leading to gene knockouts through insertion/deletions by Non-Homologous End Joining (NHEJ). Over a ten-week period, we cultured and maintained THP-1 cells, performed CRISPR transfection, and subsequently seeded single-cell colonies for monoclonal isolation and expansion. Successful gene knockout was confirmed via flow cytometry on protein products of targeted genes. Our findings suggest that targeted genetic modification of monocytes can successfully induce specific gene knockouts in an efficient and consistent manner. This provides valuable confirmation, paving the way for future research on the value of gene editing in monocytic cell as a therapeutic strategy for conditions that could benefit from modified macrophage mechanisms and functions.

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Abbey Merrigan

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Porous Scaffold Synthesis

Surgifoam is a widely used porcine gelatin absorbable sponge used in medicine and has the potential to be used in other ways, such as a dressing to promote the healing of chronic wounds. Unfortunately, Surgifoam is expensive, its composition and synthesis are unknown, and it is not adaptable to its potential use as a wound dressing. The goal of this research was to synthesize an in-house Surgifoam that could be adaptable to assist in different applications across the research and medical fields. Three sub-goals were determining the weight per volume ratio of gelatin, the type of crosslinker to best stabilize the gelatin, and the procedure for which the scaffold will be made. Various tests have been done to show how different synthesis of the material affect different attributes of the sponge, such as pore size, swelling ratio, and a release study. It was shown that increasing the weight per volume of gelatin increases the swelling ratio as well as increasing the lifespan of the scaffolds. In addition, genipin crosslinked scaffolds were also shown to be an unsuitable Surgifoam replacement. These findings are essential to the understanding and improvement of scaffolds in regenerative medicine and other fields of research.

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Katharine Pham

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Development of Hydrogels for Controlled Drug Delivery in Wounds

Hydrogels are crosslinked, hydrophilic polymers resembling tissue through mechanical properties. They can be used for drug delivery on wound sites, such as diabetic foot ulcers, which affects about 18.6 million people in the world — including 1.6 million people in the US. These ulcers are slow healing as their macrophages are difficult to transition into the pro-regenerative phenotype. In this project, hydrogels made from gelatin and sodium alginate were chemically crosslinked to investigate their roles in delivering drugs and cells into the ulcer to promote healing. The aim of this project was to design a hydrogel such that it covers the entire wound, prevents loaded cells from escaping the hydrogel, and withstands its structure for a week. These requirements were tested through measuring its dimensions and performing a swelling, degradation, and rheology study with the hydrogels. Results indicate that concentration of the polymer and crosslinker has no effect on the hydrogel's dimensions. However, the rate of swelling and degradation decreased with higher crosslinker concentration added, leading to a more stable hydrogel. These results indicate the effectiveness of controlled drug delivery, which may apply to clinical use.

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Aidan Crozier

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Rapidly Deployable Collapsible Blood Pump for Complex Cardiac Defects in Children

Thousands of infants are born each year with life-threatening, cardiac malformations, leaving only a single functioning pumping chamber, rather than two. These children must undergo multiple, open-heart surgeries to establish a survivable lungs-to-body pumping circuit. This anatomy, even with surgery, leads to a high risk of blood clots, irregular heartbeats, and fluid retention. Over time, these compound, and they develop premature heart failure, requiring transplantation. Extended waiting periods require the use of blood pumps to provide cardiac support; there are, however, no pumps available. To address this unmet clinical need, we have innovated a collapsible, pediatric blood pump. This device has a bladed impeller that rotates and transfers pressure momentum to the blood. The impeller has an outer cage or stent of filaments that protects the blood vessel from the rotating blades. I advanced its design by investigating the pressure-flow generation of 10 new impellers and 3 cages. This was accomplished using high fidelity, computer modeling; prototypes of the designs were tested in a hydraulic flow loop. All demonstrated the capability to provide bridge-to-transplant support to patients with complex congenital heart failure.

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The morphological and transcriptional signature of astrocytes across Drosophila melanogaster development

Astrocytes, a primary class of glial cells in the nervous system, are essential for synapse formation and function, yet their morphological and transcriptional development is poorly understood. Their development coincides with neural circuit formation and refinement; understanding astrocyte-circuit interactions can reveal how their dysfunction contributes to neurodevelopmental disorders. We here studied astrocytes in the fruit fly *Drosophila melanogaster*, a model with developmental parallels to vertebrates. By labeling and examining optic lobe astrocytes at different stages, we observe that morphology varies based on the cell body's position. Additionally, astrocyte branching patterns become more complex as they mature into adult cells. We also analyzed the transcriptome of astrocytes across development, identifying genes key to establishing morphology. One gene of interest, inx2, facilitates gap junction activity, enabling electrical communication between cells. Future experiments will manipulate inx2 expression and assess its impact on astrocyte morphology and function. Overall, this work provides novel insights into astrocyte development and lays a foundation for further research into their role in neural circuit formation.

Regina McLean

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Policy, Organization, & Leadership

Co-Mentors: Brian McCleery, Dr. Selcuk Acar, Rachel Willey

Exploring the Associations between Brain Wave Patterns, and the Type of Cognitive Learning Difficulty during Creativity Tasks using an Artificial Intelligence (AI) Platform

This study explores how specific EEG patterns, especially from the frontal and temporal lobes, correlate with cognitive learning difficulties and creative thinking during interactions with the AI tutor, LightningMind (LM). The study aims to enhance creativity via LM, ensuring reliable data. EEG data will be collected during creative tasks facilitated by LM, examining how these interactions affect cognitive performance as outlined in Bloom's Taxonomy, including memorization, application, analysis, evaluation and creativity. Prior studies have shown a strong link between alpha brainwave activity and divergent thinking, with alpha power increasing at the start of the creative process. Key questions include: How do learners interact with LM during creative problem solving (CPS)? How does brain wave activity change during CPS, and what does this reveal about the frontal/temporal brain activity? How do different types of cognitive learning difficulties affect alpha power during CPS tasks? Preliminary results from LM, using AI Large Language Model (LLM) technology as demonstrated in other studies, will analyze AI-learner interactions to deepen our understanding of creativity's neural basis and guide future educational AI research.

Velay Fellow

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Corruption and Education: A Literature Review

This paper is a summary of literature on corruption in education. It takes a global analysis, including 40 articles from multiple disciplines across all continents. The researcher identified studies, read and analyzed their contents, and developed findings. Importantly, this paper finds corruption in education is a widespread problem with serious effects on education quality, fairness, and public trust. The literature review reveals different forms of corruption, including financial mismanagement, academic fraud, extortion, and bribery. Findings also suggest corruption negatively impacts trust and educational outcomes. Effective ways to fight corruption include boosting media oversight and addressing how resources are distributed. By promoting transparency and accountability in education, we can build a more fair and effective education system that benefits everyone, no matter their social or economic background.

FRANCIS VELAY FELLOWS

The 2024 STAR Scholars cohort includes our ninth cohort of Frances Velay Fellows, thanks to the generous support of the Panaphil Foundation. This year's cohort of 11 women in STEM are participating in the full STAR experience, including faculty-mentored research, while also having the opportunity to engage with each other in weekly meetings throughout the summer. These sessions have included meetings with women in STEM mentors, as well as the presence of a peer mentor, Lorelei Booth (STAR & Velay 2022). Through this program, we are able to provide these exceptional young women with the structure and time to reflect on what it means to be a woman in STEM, to help them build their identities as women in research, and to introduce them to others at Drexel who support and encourage them in their future goals.

The Frances Velay Fellowships have been created in the memory of Frances Velay, a remarkable scientist, artist, musician, and citizen, to assist undergraduate women in the Greater Philadelphia area increase their opportunities to pursue science careers. This opportunity is provided to support individual research efforts in the hope that the Fellowship recipients will embody the spirit and determination Frances Velay brought to her work and life.

This program is jointly managed by the Center for Advancement of STEM Teaching and Learning Excellence (CASTLE) and Undergraduate Research & Enrichment Programs. We would like to thank the Panaphil Foundation for their generous support of undergraduate research and women in STEM, as well as the faculty mentors, graduate students, and industry professionals who come together to support these exceptional women.

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LOUIS STOKES ALLIANCE FOR MINORITY PARTICIPATION

Promoting success and excellence among historically underrepresented student populations engaged in the study of science, technology, engineering and mathematics (STEM) disciplines.

The Louis Stokes Alliance for Minority Participation at Drexel University or Drexel-LSAMP is part of a national effort to increase the number of underrepresented minority (URM) students who successfully complete baccalaureate and advanced degrees in Science, Technology, Engineering and Mathematics (STEM) disciplines. Drexel-LSAMP has been in existence at Drexel University since 1994 with funding provided by the National Science Foundation (NSF). ***In 2024, Drexel-LSAMP is proud to provide financial support for a cohort of nine diverse STEM undergraduates to engage in research activities across the Colleges of Arts & Sciences, Computing & Informatics, and Engineering.***

Drexel-LSAMP partners with University staff, faculty, undergraduate/ graduate students, alumni and other stakeholders with an interest in supporting URM-STEM communities to:

- Promote academic preparation, agility and resilience through coaching
- Facilitate participation in co-curricular opportunities that build social capital, expand students' support networks and enhance their competitiveness for future participation in the greater STEM community
- Provide financial support for undergraduate research, conferences and other co-curricular opportunities
- Provide peer fellowship and mentorship

DREXEL UNIVERSITY
Louis Stokes Alliance
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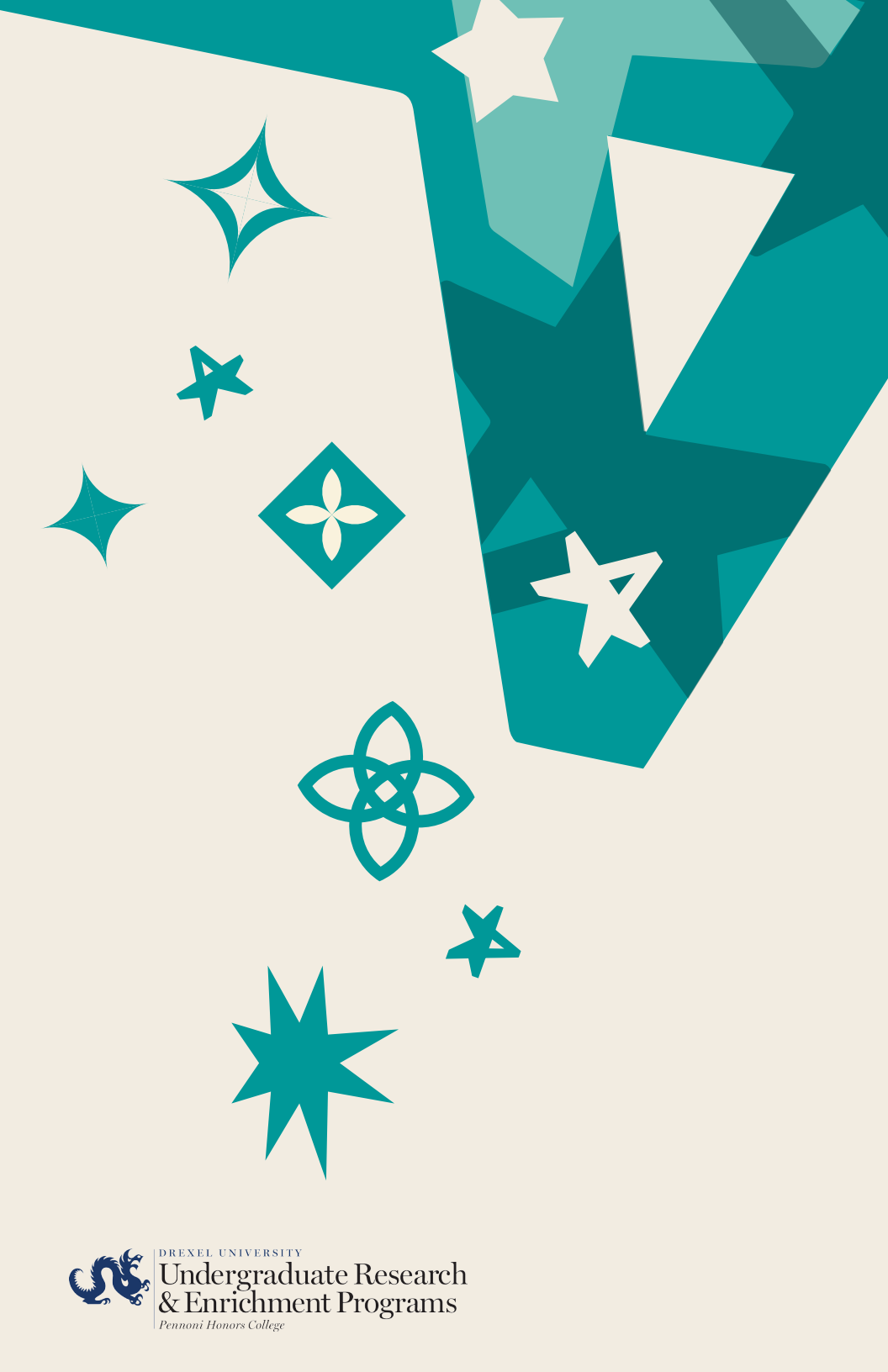
SPECIAL THANKS

We would like to extend our sincere gratitude to all faculty mentors, graduate students, and others at Drexel University who have helped teach, guide, and mentor these STAR Scholars.

The STAR Scholars Program helps shape these students' academic and professional futures for years to come, and it would not be possible without your participation.

We applaud and thank you.



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