



IMSAloquium



2024



April 17, 2024

Dear IMSA Students, Faculty, Staff and Friends,

Welcome to IMSAloquium 2024. This is IMSA's 37th year of leading in educational innovation, and the 36th year of the IMSA Student Inquiry and Research (SIR) Program.

Within this booklet, you will find a collection of abstracts from outstanding student projects. The topics range from biomedical research, chemistry and physics to mathematics to the social sciences, as well as business and entrepreneurial projects from our Internship students. Our students have worked hard on their projects, some individually, some in groups, and today is the day for them to display their hard work.

This year, we have over 200 projects to showcase. Many of our students have worked with mentors at leading universities, research laboratories, and businesses. Some students have worked remotely with off-campus mentors. Other students have worked with IMSA faculty on campus. In addition, this is the fourth year that students participated in on-campus SIR courses, and their work is represented at IMSAloquium. The SIR team would very much like to thank both our off-campus and on-campus mentors for their outstanding work with our students. The IMSA SIR program and the IMSA Internship program could not exist were it not for all of our mentors working with and advising our students.

In addition to thanking our SIR mentors, we wish to thank all the IMSA faculty and staff who helped support the SIR and Internship programs throughout the year, and their assistance with coordinating and hosting this year's IMSAloquium.

We hope you enjoy your day and find it to be a rewarding and educational experience!

Sincerely,

IMSA SIR Program Team

Cathy Cunz
Dave DeVol, Ph.D.
Peter Dong, Ph.D.
Andrew Reif
John Thurmond, Ph.D.

IMSA President & CEO

Evan Glazer, Ph.D.

IMSA Business Internship

Sue Fricano, Program Coordinator

Research, Inquiry Skills & Experimentation (RISE)

Allison Hennings, Program Coordinator

IMSA Principal's Office

Angie Rowley, Ph.D., Interim Principal and CAO
Luke Berryman, Ph.D., Director of Experiential Learning
Paul Gaszak, Dean of Student Support and Equity
Anita Connors White, Ph.D., Dean of Academics and Equity



Student Inquiry
and Research

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Session III SIR Presentations	178-242
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Introduction **8:05a.m. Welcome** *Public Address System*

Session I Project Presentations (10 min. + 5 min. Q & A)

8:15a.m. - 8:30a.m.
8:35a.m. - 8:50a.m.
8:55a.m. - 9:10a.m.

Session II Project Presentations (10 min. + 5 min. Q & A)

9:20a.m. - 9:35a.m.
9:40a.m. - 9:55a.m.
10:00a.m. - 10:15a.m.

Session III Project Presentations (10 min. + 5 min. Q & A)

10:25a.m. - 10:40a.m.
10:45a.m. - 11:00a.m.
11:05a.m. - 11:20a.m.

Lunch Break **11:25a.m. – 12:45p.m.**

Cafeteria

Off-campus

Keynote

1:00p.m. – 1:40p.m. Auditorium / *Live stream to:* Lecture Hall

Poster Presentations & Info Graphic Displays

1:45p.m. – 2:35p.m. Main Gym - Student Inquiry & Research

1:45p.m. – 2:35p.m. IN2 Commons - Business Internship

IMSAlloquium 2024 Keynote

“The Quantum Realm: Fun, Games, and Utility”

Kishor T. Kapale, Ph.D.

Chair & Professor of Physics, Western Illinois University

Coordinator of Graduate Studies

kt-kapale@wiu.edu

Credentials

Physics, Math, and Astronomy Division Chair, ISAS

Member, Macomb School Board

Former Member, Macomb Educational Foundation (2021-2023)

Former Member, University of Illinois Extension Council (2019-2022)

Member, IAI, Physics Major Panel



Research Interests

Dr. Kishor T. Kapale is currently serving as the Chair and Professor of Physics at the Department of Physics, and Interim Coordinator of Graduate Studies both at the Western Illinois University. Prior to joining WIU faculty in Fall 2007, Dr. Kapale held the prestigious National Research Council Research Associate position at NASA’s Jet Propulsion Laboratory, California Institute of Technology, CA during 2004-2007 timeframe. Dr. Kapale received his Ph.D. in Physics from the Texas A&M University in December 2002. His thesis research was centered on developing fundamental theoretical understanding of the new state of ultra-cold matter that is termed as Bose-Einstein Condensate. He currently conducts research in the area of quantum optics, which involves study of interaction between light and matter at the microscopic level, and quantum information science, which is a new paradigm in information processing, for development of better, faster, and more secure quantum computers. Recently, Dr. Kapale has been interested in development of ultra-powerful optical microscopes for unobtrusive imaging of live biological samples using the techniques of quantum optics.

Accomplishments

Dr. Kapale has more than 35 publications to his credit that have appeared in the journals of international repute in the area of physics. Dr. Kapale has given more than 100 presentations about his work at various avenues. Dr. Kapale’s recent research in the area of super-resolution has been recognized and featured in the American Physical Society’s weekly publication spotlighting exceptional physics research. Dr. Kapale has delved into artistic adventures recently---he is teaching himself classical guitar and he appeared as the character of Prince in the local production of the ballet “Nutcracker” in December 2014. Dr. Kapale is keenly interested in science communication and during the COVID times, initiated and coordinated a monthly Virtual Science Saturday event for the benefit of school going children to get them excited about science to not just incite curiosity but also to introduce it as an excellent career option.

April 17, 2024

Abstract Titles by Category | Project ID Reference List

<u>SIR Categories</u>	<u>Codes</u>	<u>Entries</u>
Behavioral and Social Sciences	BHVSO	16
Biology	BIO	17
Chemistry	CHEM	17
Computer Science	CMPS	42
Engineering	ENGN	12
Environmental Science	ENVR	6
Earth and Space Sciences	ERSP	3
History	HIST	1
Mathematics	MATH	1
Medical and Health Sciences	MEDH	47
Physical Science	PHYS	30
Business Internship	BIZ INTRN	26
Independent Study	IND STDY	1
Intersession	INTRSN	1
Research, Inquiry Skills & Experimentation	RISE	8

Behavioral and Social Sciences | BHVSO

<i>Analyzing and Predicting Concussion Reporting Behaviors of student athletes</i> Charles Conner	BHVSO 01
<i>Implementing Social-Emotional Learning Programming into School Curriculum through Creative Writing Workshops</i> Sahil Veeravalli	BHVSO 02
<i>Luminosity Data as a Proxy for Evaluating Different Carbon Tax Systems</i> Avyay Duggirala	BHVSO 03
<i>Transgender and Gender-Diverse Youths' Fertility knowledge in the context of Pubertal Suppression Treatment</i> Luke Mauk	BHVSO 05
<i>The Influence of Undergraduate University's Prestige on Top Firm Executives</i> Michael Capriotti, Danica Sun	BHVSO 06
<i>Data Science to Identify Inequalities in CPS</i> Alvena Bhutiani, William Guo and Dhaatri Maviti	BHVSO 07
<i>Delineating Perceived Chicago Neighborhood Boundaries Using Crowdsourced Geospatial Data</i> Keyan Dunmore	BHVSO 08
<i>Analyzing the Correlation Between the Absence of Linguistically Aligned Mental Resources and Adverse Teen Outcomes in Chicago Southside Neighborhoods</i> Ashley Hernandez and Chiamaka Okoli	BHVSO 09
<i>Effects of Gender on Persistence and Performance in STEM Classes at the Illinois Math and Science Academy</i> Laasya Nagumalli	BHVSO 10
<i>Evaluating Access to Healthcare In Chicago's Chinatown</i> Yicole Ng	BHVSO 11
<i>The Role of Dopamine in the Prioritization of Information and Reward in Reinforcement Learning</i> Carolyn Zhang	BHVSO 12
<i>Centering Those Engaged in Transactional Sex: A PrEP Initiative</i> Natalia Morales	BHVSO 13
<i>Investigating the Immigrant Paradox in Alcohol Consumption</i> Ellen Nguyen	BHVSO 14
<i>Disparities in alcohol use behaviors and disorders by race, ethnicity, and sex</i> Fopefoluwa Ojomalade	BHVSO 15

Influence of depressive symptomology on alcohol abuse liability in women BHVSO 16
Shanya Yang

Feasibility of a Regional Rail Model for Chicago's Metra based on station-level analysis BHVSO 17
Stephen Walsh

Biology | BIO

Amyloid- β Oligomer Formations Over Time BIO 01
Maitreyi Pandey

Stabilizing regulatory T cell function in vitiligo using Treg-promoting genes FoxP3 and TIGIT BIO 02
David Dickson

The Effects of Chemotherapeutic Stress on NAT10 Expression in U937 Cells BIO 03
Haoran Shi

Hyolingual Kinematics and Biplanar Videoradiography Reveal Hydrostatic Deformation of the Tongue Base BIO 04
Riya Gumidyala

Nuclear Speckles as a Mediator of Dynamic Intron Retention in Developing Neuron Cells BIO 05
Joshua Mu

Development of a Baculovirus-based Packaging System for Efficient Recombinant Retrovirus Production BIO 06
Rachel Qi

Effects of Initial Domain Packing in Lipid Monolayer Shear Banding Collapse BIO 07
Deepanjali Samal

The Context-dependent Effects of Fiber Fermentaon on Klebsiella pneumonia Suppression BIO 08
Lucinda Stocco

Genomic, transcriptomic, and epigenomic correlates of outcome among patients with high-risk neuroblastoma treated with anti-GD2 antibody BIO 09
Sahil Veeravalli

" β -Actin as a Transcription Factor of Hox Genes in Mouse Embryonic Stem Cells" BIO 10
Kohl Vonder Haar

<i>Mechanism Exploration and Screening for Drug Resistance Induced by SAM-RNA in Breast Cancer</i>	BIO 11
Lily Zhang	
<i>Cloning Plasmids for Gene Editing in Human Lung Cells</i>	BIO 12
Shatakshi Chatterjee	
<i>FAV Intake's Effect on Kidney Filtration</i>	BIO 13
Ria Cherukuri	
<i>Studying the effect of JIP3 on Lysosomal Heterogeneity</i>	BIO 14
Pranavi Korapati	
<i>Understanding the Disease Progression of Acute Myeloid Leukemia in Murine Models and Identifying Therapeutic Targets for Leukemic Stem Cells</i>	BIO 15
Sreehaas Chinnala	
<i>The Interactions Between Proteins and Automating Predictions with Mass Spectrometry</i>	BIO 16
Vedanti Joshi	
<i>Single-Cell Analysis of ChP-BAM Co-Cultured Organoids</i>	BIO 17
William Yu	

Business Internship | BIZ INTRN

<i>Quantum Computing at Google Quantum AI</i> Nishna Aerabati and Aashima Singh Sisodia	BIZ INTRN 01
<i>APS Data Technologies Internship</i> Blessita Charly, Srihari Gurugubelli, Angel Lopez, Andre Mendez, Anmol Singh, Raphael Talusan and Aruuke Ulanbek	BIZ INTRN 02
<i>Affordable Housing Policy with the City of Aurora Mayor's Office of Economic Development</i> Pranet Swain	BIZ INTRN 03
<i>Scientific Technology Advertising at the Polsky Center for Innovation and Entrepreneurship</i> Sydney Hunter	BIZ INTRN 04
<i>Impact of Artificial Intelligence (AI) on Business Operations</i> Einsteinia Socrates	BIZ INTRN 05
<i>Pet Welfare in Chicago</i> Alyssa Abendroth	BIZ INTRN 06
<i>Legislation for After School Program to Improve Literacy Rates in Elementary Education</i> Ellen Hsuan	BIZ INTRN 07
<i>Legislative Research at the Office of the State Representative Maura Hirschauer</i> Sabriya Attia	BIZ INTRN 08
<i>Behind the Legislative Process</i> Avyay Duggirala	BIZ INTRN 09
<i>Nuclear Energy Policy with Office of Illinois House Representative</i> Jacob Nendza	BIZ INTRN 10
<i>Representative Internship for Rep. Hirschauer</i> Evan Trone	BIZ INTRN 11
<i>Designing IMSA's AI Future: The IMSA AI Center</i> Neev Patel and Rachel Tsang	BIZ INTRN 12
<i>Computational Finance analysis at Illinois State Treasurer's Office</i> Pranav Pabbisetty	BIZ INTRN 13
<i>Financial Products with The Illinois State Treasurer's Office</i> Evelyn Cunneen	BIZ INTRN 14
<i>Strengthening Cybersecurity and Linux Integration</i> Aneesh Bargaje	BIZ INTRN 15

<i>Construction Design with PM Construction</i>	BIZ INTRN 16
Ryan Mojzis	
<i>Forecasting Stock Profitability Using Language Models</i>	BIZ INTRN 17
Sufiya Hussaini	
<i>Various Testing Methods to Diagnose Pediatric Hearing Loss</i>	BIZ INTRN 18
Gabriella Boscarino	
<i>Rebranding and Rebuilding with SciTech</i>	BIZ INTRN 19
Xander Albertson, Byrd Gilissen and Donovan Morrow	
<i>Equity in STEMM Innovation and AI (EQ-SI) Grant Writing and Program and Web Development</i>	BIZ INTRN 20
Victoria Nalepka and Asad Sheikh	
<i>Mechanic Intern</i>	BIZ INTRN 21
Noah Walker	
<i>Stem Cell Research in the Lens of Orthopedics</i>	BIZ INTRN 22
Sar'aiyah Murphy	
<i>Intern at Torch Architecture</i>	BIZ INTRN 23
Jaxon Womack	
<i>Business Operations Intern</i>	BIZ INTRN 24
Shridhar Mehendale	
<i>Product Development in Airline Heavy Maintenance Planning</i>	BIZ INTRN 25
Netra Rameshbabu	
<i>Utilizing Discord for the Establishment of Online Youth Advisory Councils: A Mixed Methods Study Advancing Digital Strategies for Youth Health Preventions</i>	BIZ INTRN 27
Anna Yang	

Research Inquiry Skills & Experimentation | RISE

<i>Utilizing Artificial Intelligence and Single-Cell RNA-seq Data for the Investigation and Discovery of Novel Genetic Biomarkers in Age-Related Macular Degeneration</i>	RISE 01
Ibrahim Arif	
<i>Mathematical Modeling of the Optimal Light Wavelength for Increasing Biomass and Cell Size of <i>Chlorella vulgaris</i> as a Basis for Enhancing Biofuel Production</i>	RISE 02 (poster only)
Sidharth Brahmandam	
<i>The Impact of 2-Propanol and Sodium Hypochlorite on Quantity of Extracted DNA from Human Fingerprints for the Advancement of Forensic Fingerprinting Technologies</i>	RISE 05 (poster only)
Maggie McIntyre	
<i>The Effect of Various Fin Designs on the Stability, Apogee, and Drag of Model Rockets to Maximize Efficiency</i>	RISE 06 (poster only)
Varun Nagaraj	
<i>FlaviExplore: An Integrated Bioinformatics Platform for West Nile Virus Research</i>	RISE 07
Aarav Patel	
<i>Meta-Analysis Research to Discover Novel Method for Increasing the Role of NK Cells in LAG-3 Immunotherapy to Increase Efficiency of Melanoma Treatment</i>	RISE 08
Anirudh Saravanan	
<i>Novel Convolutional Neural Networks for Improved Accuracy in User-Accessible Brain Tumor Detection</i>	RISE 09
Kevin Tian	
<i>Permafrost Thaw in Relation to the Varied Photosynthetic Pathways and Abundance of <i>Chlorophytum comosum</i>, <i>Sedum angelina</i>, and <i>Senecio cineraria</i> to Limit Thermokarst Action</i>	RISE 10 (poster only)
Ashrith Valluri	

Chemistry | CHEM

<i>Atomically Precise Cobalt Nanoclusters with Nickel Dopants</i>	CHEM 01
Aubrey Miller	
<i>Examining the Pervasiveness of COVID-19 Pharmaceuticals in the Environment</i>	CHEM 02
Blaise Jones	
<i>Walter Sanford and the Materials Used in his Pieces</i>	CHEM 03
Dael Garzon Torres	
<i>Chemical Synthesis of a Lysyl Oxidase-Based Probe for Positron Emission Tomography Imaging of Tumors</i>	CHEM 04
Rushina Patel	
<i>Spreading a Slurry Layer</i>	CHEM 05
Arjun Brahmandam	
<i>A Feasible Approach to Cubane Synthesis and Functionalization</i>	CHEM 06
Tate Schneider	
<i>Synthesis of Novel Medicinal Compounds Against Leishmaniasis</i>	CHEM 07
Hagen Arriaga and Daniel Cano	
<i>Synthesis of Potential Therapeutics for Mycetoma</i>	CHEM 08
Chinara Caldwell, Alyssa Hernandez and Nataliya Stewart	
<i>Synthesis of a Benzoxazole Derivative to be Used for the Treatment of Tropical Cutaneous Leishmaniasis</i>	CHEM 09
Aditya Hansoty, Ayan Trivedi and Prabhav Veeramachaneni	
<i>Leishmaniasis and its Potential Treatments Through Synthesis and Computation</i>	CHEM 10
Brayden Lindstrom, Torin Schroeder and Dylan Xianto	
<i>Synthesis of New Compounds for Leishmaniasis Treatment</i>	CHEM 11
Mia Park	
<i>Synthesis of amide derivatives as preclinical drug candidates for Visceral Leishmaniasis</i>	CHEM 12
Mila Wolkowitz	
<i>Synthesis of Novel Medicinal Compounds for Leishmaniasis using DNDI's Hit Compound DNDI0003202883</i>	CHEM 13
Hagen Arriaga, Tristen Castillo and Angel Lopez	
<i>Design and Synthesis of Potential Treatments for Leishmaniasis</i>	CHEM 14
Semi Campos Gonzalez, Dael Garzon Torres and Shanya Yang	

Developing Novel Therapeutics for Leishmaniasis: Design and Synthesis Strategies CHEM 15

Josefh Hernandez and Atharva Kapale

Synthesis of Potential Treatments for Leishmaniasis CHEM 16

Alyssa Hernandez, Jazmyn Johnson and Raven McKelvin

Developing Novel Therapeutics for Leishmaniasis CHEM 17

Pruschothum Sureshkumar

Computer Science | CMPS

<i>Microturbine Decarbonization with Machine-Learning Regression Modeling</i> David Biruduganti	CMPS 01
<i>Cooperative cache optimization for HPC using binary tree overlay with Linux FUSE</i> Samuel Brownell	CMPS 02
<i>The Effects of De-identified Tokens on the Performance of Clinical Large Language Models</i> Ishan Buyyanapragada	CMPS 03
<i>The Application of Federated Learning in the Detection of Heart Arrhythmias</i> Manya Davis	CMPS 04
<i>LSTM-Based Classification of Time Series Data for Predicting Thermoacoustic Instability Regimes</i> Shrishant Hattarki	CMPS 06
<i>Knowledge Graph Assisted Large Language Models</i> Sohum Kashyap	CMPS 07
<i>Using Machine Learning to Determine Peptide Sequences with High Heme Binding Propensity</i> Nathan Laud	CMPS 08
<i>Testing the Type 2 Diabetes Risk Prediction Efficacy of a Synthetically Trained Machine Learning Model</i> Sadkrith Malladi	CMPS 09
<i>Understanding Entanglement for Quantum States</i> Ellen Guan and Aashima Sisodia	CMPS 10
<i>Human Body Detection with Occlusion</i> Aditya Prashanth	CMPS 11
<i>Random Forest In Options Pricing</i> Shruthi Vasudevan	CMPS 12
<i>Artificial Intelligence's Role in Cybersecurity and Global Dynamics</i> Nethra Shanbhag	CMPS13
<i>Utilizing a Framework to Evaluate the Performance of Explainable AIs on Deepfake Detection Models</i> Kavya Uppal	CMPS 14
<i>Self-Determination Theory (SDT) in Gamification</i> Ryan Li	CMPS 15

<i>Using Single-Cell Analysis and Machine Learning to Predict Gastroesophageal Reflux Disease (GERD) and Systemic Sclerosis (SSc)</i> Himani Musku and Rhea Shah	CMPS 16
<i>Sentiment and Topic Modelling in Tweets and News Articles from the Russia-Ukraine War</i> Himani Musku	CMPS 17
<i>Media Influence and Public Opinion in the 2023 Israel-Hamas Conflict</i> Michael Granger and Ryan Li	CMPS 18
<i>Distributed Classification by Divide and Conquer Approach</i> Max Chen	CMPS 19
<i>Enhancing Stroke Rehabilitation through a Deep Learning-Enabled Wearable Sensor and a User-Friendly GUI</i> Ethan Remedios	CMPS 20
<i>Monte Carlo Evaluation of Dynamic Spectrum Allocation Techniques for Bandwidth Optimization in Wireless Communication Systems</i> Eduardo Gutierrez, Aidan Kim, Ankit Walishetti and Colin Ward	CMPS 21
<i>Using a Framework to Evaluate the Performance of Explainable AIs on Deepfake Detection Models</i> Kavya Uppal	CMPS 22
<i>Towards Understanding Large Language Models for Multilingual Semantic Encoding</i> Diego Nava	CMPS 23
<i>How can we use NLP to understand the emergence of network ties?</i> Raghav Sinha	CMPS 24
<i>Applying Graph Neural Networks to Improve the Data Resolution of Stream Water Quality Monitoring Networks</i> Melinda Yuan	CMPS 25
<i>Cross-Species Word Recognition Using SVM-Based Cochlear Implant Coding Strategies</i> Aria Barve	CMPS 26
<i>Development of a Human-Mouse Chimera to Study the Toxic Effects of HIV Antiretroviral Drugs</i> Aarushi Das	CMPS 27
<i>CARENET—A Clinical Analysis and Reporting Enhancement Network</i> Shashi Salavath	CMPS 28
<i>Single-cell segmentation and fluorescent intensity quantification pipeline</i> Alexander Sorescu	CMPS 29
<i>Optimization of Measurement Scheme for Neutral Atom Quantum Computers</i> Aadi Desai	CMPS 30

<i>Heterogenous Multi-Agent Reinforcement Learning for Last-Mile Delivery Optimization</i> Aaditya Shah	CMPS 31
<i>Custom Optimizations of Quantum Gate Reductions with ZX-Calculus</i> Nishna Aerabati	CMPS 32
<i>Neural Network Compression and Storage using Linear Feedback Shift Registers (LFSRs)</i> Anmol Singh	CMPS 33
<i>Investigating Environmental Justice through Urban Data Visualization</i> Carissa Chen	CMPS 34
<i>Implementing Mixed Memorization-Based Inference Recurrent Models of Visual Attention Using Thresholds for Energy Efficiency</i> Jeremiah Suarez	CMPS 35
<i>A Case Study of Unfair Discrimination within Auto Insurance Pricing Models</i> Zhaoer Cai	CMPS 36
<i>Physically Based Simulation for Real-World Scenes</i> Michael Meng	CMPS 37
<i>Using Monte Carlo Simulations of Retinoblastoma Progression to Model Mutation Rates and Genetic Variability</i> Vidyoot Senthilvenkatesh	CMPS 38
<i>Effectiveness of AprilTags: Tracking Objects through Mixed Reality Environments</i> Kavin Venkat and David Weng	CMPS 39
<i>MMWave Reflections for Object Detection</i> Jeffery Yao	CMPS 40
<i>Using NLP and models like TF-IDF, GloVe, Open AI's GPT, and Sentence-BERT to sort through and organize the search queries to prevent question repeats in StackOverflow</i> Yaalini Lakhani	CMPS 41
<i>Multi-Input Image-to-Image Diffusion Model for Font Style Translation</i> Georgi Panchev and Advayth Pashupati	CMPS 42
<i>DynaLab: a Google Colab Notebook making Molecular Dynamics</i> Vidyoot Senthilvenkatesh	CMPS 43

Engineering | ENGN

Hydrogen Combustion in Industrial Decarbonization for energy and Emissions-Intensive Sectors ENGN 01

Samuel Biruduganti

An Optimal Control Framework for Influencing Human Driving Behavior in Mixed- Autonomy Traffic ENGN 02

Anirudh Chari

Using Infrared Image Analysis to detect 3D Printing errors ENGN 03

Fiyinfoluwa Akinyemi

Experimental Paradigm for Studying Abnormal Hip Torque Coupling During Gait Initiation After Stroke ENGN 04

Nashra Younus

Carbon Fiber Instrument Crafting ENGN 05

Carter Poskozim and Max Schwartz

Reducing the Load of the Haptic Brain Stimulator ENGN 06

Hunter Mathews

Deploying Sensorless V2V Communication for Enhanced Driver Awareness: A C-V2X and GNSS-Based System Utilizing OBD Ports for Broad Vehicle Integration ENGN 07

Alea Ritchie

Energy Consumption Study for Multi-Axis Robot Additive Manufacturing ENGN 08

Keegan Balow

Turning a Passive Exosuit Active ENGN 09

Laura Cervantes

Silver-infused Egg Albumin for Water Purification ENGN 10

Patrick Cahill, Joshua Solone and Megan Vanhoof

Techno-Economic Analysis of Capacitive Deionization (CDI) Use for Separations of Biofuels in the Production Process ENGN 11

Zuyu Liu

An Investigation in the Rat Whisking System in the Context of Mechanical Engineering ENGN 12

Ebba Kaulas

Environmental Science | ENVR

The effects of sublethal concentrations of nanoparticles on E.coli cells in simulated environmental conditions ENVR 01

Nandini Budithi

Examining the feasibility of manganese oxide sorbents for cobalt and nickel recovery ENVR 02

Ian Chung

Temporal Dynamics of Water Stable Aggregates and Carbon Sequestration in Continuous Corn and Corn-Soybean Rotation Systems in Illinois ENVR 03

Joshua Lee

Effects of Sunscreen Chemicals on Freshwater Algae ENVR 04

Aleksandra Duda, Myra Mensah, Eliana Nungaray and

Gwendolyn Olney

Evaluating the Recycling Practices of Leading E-Cigarette Companies: A Focus on Philip Morris International and British American Tobacco ENVR 05

Shivani Chirumamilla

Analysis of Nachusa Grasslands Restoration Progress through Geochemical Data ENVR 06

Katherine Ge and Joseph Hernandez

Earth and Space Sciences | ERSP

The Search for CH₃OH Transitions and Water Masers in High-Mass Star-Forming Regions ERSP 01
Atharva Kapale

Radio Observation During Total Eclipse ERSP 02
Tae Geon Eom, Jaykrish Ganesan, Krish Konda and Charles Ludwig

Broadband Spectral Survey of CH₃OH Emission toward Hyper-Compact and Ultra-Compact HII Regions ERSP 03
Robert Mandell

History | HIST

The "Progress" of Medicine: Late-Nineteenth Century Positivist Attitudes towards Indigenous Mexican Medicine in Francisco Flores' Historia de la Medicina en México HIST 01
"

Aldo Magana

Independent Study | IND ST

John Rawls : Foundation of Modern Liberal Political Thinking IND ST 01
Karla Sanchez

Intersession | INTRSSN 01

"Geochemistry and Microbiology of Cenotes With Different Levels of Tourism in the Yucatán Peninsula" INTRSSN 01
(poster only)
Yucatan Travel Group

Mathematics | MATH

Characterizing the H-Orbit Decomposition of the Symmetric Spaces for the Special Orthogonal Group over a Finite Field in Dimension 3

MATH 01

Andrew Katson

Medical and Health Sciences | MEDH

Epidemiological trends of SARS-CoV-2 infections during pregnancy in Chicago

MEDH 01

Kavya Reddy

Improving Clinical Accuracy and False Alarm Sensitivity of Tonic-Clonic

MEDH 02

Rhea Shah

Experimental Paradigm for Studying Impairments in Bilateral Reaching and Grasping after Stroke

MEDH 03

JaeJun Park

Measuring Proliferation of Keratinocyte Skin Cells

MEDH 04

Anjali Ali and Sarah Kumar

B7-H3 Specific CAR T-Cell Three-Dimensional Killing Assay on Synovial Sarcoma Cell Lines

MEDH 05

Ayesha Bobat

Measuring the Vital Function of the Skin Barrier

MEDH 06

Sindhu Chalasani and Aarna Patel

The Effects of Different Prosthetic Foot and Ankle Stiffness Combinations on Transfemoral Prosthesis Users

MEDH 07

Rachel Coutinho and Yoonseo Kim

Neonatal Mesenchymal Stem Cells Seeded Scaffold Support Tissue Regeneration

MEDH 08

Brooke Hilderbrant and Arnav Patel

Visual Tests as a Proxy for Top-Down Processing Evaluations in Cochlear Implant Patients

MEDH 09

Kannan Ilamparithi

DDX18 Plays a Functional Role in the Association of Centromeres and Heterochromatin to the Nucleolus

MEDH 10

Cara Jacob, Josephine Kim and Vignesh Tiruvannamalai

Monobenzene Nanoparticles for The Treatment of Melanoma Tumor Cells

MEDH 11

Jongwoo Kim

<i>Impact of Malate Dehydrogenase 2 Skin Epithelial Knockout on Basal Keratinocyte Proliferation</i> Anisha Kolambe	MEDH 12
<i>Machine Learning to Predict Next-Day Dialysis in Critically Ill Patients</i> Manhitha Mamillapalli	MEDH 13
<i>Exploring the Impact of Ceramide Synthesis Enzymes on Atopic Dermatitis Severity</i> Mikaella Moraga	MEDH 14
<i>The Effects of XBP1 Agonist IXA4 on Hepatic and Serum Bile Acid Levels of FXRKO vs. C57BL/6 Mice</i> Neev Patel	MEDH 16
<i>Characterizing Neonatal Human Epidermal Keratinocytes-Derived</i> Devarsh Shah	MEDH 17
<i>Investigating the Effects of Light Exposure During Sleep and Circadian Rhythm in Adolescents and Young Adults</i> Andrew Wong	MEDH 18
<i>Development of a Human-Mouse Chimera to Study the Toxic Effects of HIV Antiretroviral Drugs</i> Aahana Das	MEDH 19
<i>The role of the protein tyrosine phosphatase SHP-1 in TRPV1-mediated pain behavior</i> Kaylee Hwang	MEDH 20
<i>Temporal aspects of novel thioredoxin glutathione reductase inhibitors</i> Joseph Paras	MEDH 21
<i>Meta Analysis of multifactorial Etiology, Epidemiology, and Implications of Orofacial Clefts</i> Emerson Blair	MEDH 23
<i>Evaluation of Y2O3:Eu@SiO2 Nanoparticles as Photosensitizer for X-Ray Activated Photodynamic Therapy in Cancer</i> Divya Brahmhatt	MEDH 24
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Session I - 8:15a.m. – 8:30a.m.

Project ID: CHEM 01

8:15a.m. – 8:30a.m.

Title: Atomically Precise Cobalt Nanoclusters with Nickel Dopants

Presenter(s): Audrey Miller

Mentor(s): Shana Havenridge, Liu Cong; Argonne National Laboratories

Abstract/Project Intention:

Atomically precise nanoclusters have numerous applications throughout many fields of chemical science, mostly because of their tunability and relative ease of synthesis. However, clusters that have non-noble metal cores are less stable, and therefore harder to synthesize. Despite this, working with transition metals is a promising avenue because of their wider tunability and increased applications in catalysis. Considering that the stability of the cores is compromised, making a dopant addition to the system highly desirable. In this work, cobalt cluster systems are doped with nickel in atom-by-atom substitution to find the most favorable orientation and therefore the most likely amount of nickel dopants in the system. The data, once ascertained, is used to fuel experimental research and understand properties within the cluster. Based on the observations made from ground state optimizations, absorption and frequency calculations, properties of the system can be determined and used to both inform and explain experimental research. Absorption spectra, orientation, reaction energies and molecular orbital data are just a few of such data points used to further understand these systems and therefore their applications within wider scientific fields.

Project ID: BIO 03
8:15a.m. – 8:30a.m.

Title: The Effects of Chemotherapeutic Stress on NAT10 Expression in U937 Cells

Presenter(s): Haoran Shi

Mentor(s): Dr. Sweta Raikundalia, Dr. Daniel Arango, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

The efficacy of chemotherapeutic drug regimens has been a longstanding concern for cancer treatments, highlighting the need for research on how they could become more effective. A possible answer could lie in the field of epitranscriptomics, in which chemical modifications are made to RNA to affect gene expression. In this study, we aimed to find the effects of drug treatment duration on the expression levels and subcellular location of N-acetyltransferase 10 (NAT10), an enzyme that has been associated with poor prognosis in multiple cancer types. We observed an increase in NAT10 levels as the duration of Daunorubicin treatment increased, yet our results with Cytarabine were inconclusive, leaving room for further experimentation. Additionally, we found that there was increased NAT10 expression in the cytoplasm when treated with Daunorubicin, but decreased expression when treated with Cytarabine. While our results put NAT10 as a promising drug target for AML patients, further research is needed to validate these findings. Doing so will help us uncover the implications of NAT10 expression and localization in drug resistance and cancer progression.

Project ID: BIO 05
8:15a.m. – 8:30a.m.

Title: Nuclear Speckles as a Mediator of Dynamic Intron Retention in Developing Neuron Cells

Presenter(s): Joshua Mu

Mentor(s): Dr. Xinqi Fan, Dr. Jingyi Fei, University of Chicago

Abstract/Project Intention:

Alternative splicing is crucial for the genetic complexity of mammalian systems, allowing for the creation of numerous mRNA sequences and therefore protein isoforms from a single transcript. While introns are typically excluded from the final sequence, they may be dynamically retained to facilitate intron-mediated gene expression via protein production and RNA stability. In mouse embryonic cells, retained intron regulatory schemes switch between brain development stages, indicating the role of retained introns in brain development. We hypothesize that intron-mediated gene expression is mediated by the nuclear speckles, one type of membraneless organelles enriched in splicing factors that play an important role in gene expression. Reads obtained from mouse neuron and progenitor cells via Illumina NGS were mapped to the mouse genome and counted using STAR Featurecounts. Differential analysis of counts via DESeq2 indicates differential transcript localization to speckles in these two types of cells.

Project ID: ENVIR 01

8:15a.m. – 8:30a.m.

Title: The effects of sublethal concentrations of nanoparticles on E.coli cells in simulated environmental conditions

Presenter: Nandini Budithi

Mentor(s): Kimberly A. Gray, Shushan Wu, Northwestern University

Abstract/Project Intention:

Engineered nanomaterials (ENMs) are widely used across commercial sectors, yet their effects on environmental systems have not been examined thoroughly, especially at environmentally relevant concentrations. They are known to be harmful at lethal doses, but their effects on natural environmental systems at sublethal doses, the examples primarily seen in real life, have only recently been studied. Previous studies have shown that ENMs like TiO₂ nanoparticles (n-TiO₂) and Ag nanoparticles (n-Ag) increase the outer cell membrane permeability of E.coli cells under light and exhibit amplified toxicity when mixed, making cells more vulnerable to other assaults. In this project, the sublethal effects of ENMs on bacteriophage infection of E.coli cells were investigated. For this experiment, E.coli cells were suspended in Lake Michigan Water (LMW) and exposed to different concentrations of n-TiO₂ under simulated sunlight and dark before being exposed to phage f1 and phage lambda, respectively. Our results showed that low concentrations of n-TiO₂ (0.1-0.5 mg/L) promoted phage f1 infection significantly under light, which could be attributed to the increased outer membrane permeability and enhanced expression of pilus-related genes.

Project ID: BHVSO 02

8:15a.m. – 8:30a.m.

Title: Implementing Social-Emotional Learning Programming into School Curriculum through Creative Writing Workshops

Presenter(s): Sahil Veeravalli

Mentor(s): Dr. Valerie San Juan, Bradley University

Abstract/Project Intention:

Recent trends in state legislators and school districts across the United States to remove social-emotional programs from schools (Information, 2022) threaten to undermine the learning of empathy and prosocial skills that are fundamental to both social and cognitive development. To date, several studies have demonstrated the efficacy of Social Emotional Learning programs at increasing both social-emotional skills and academic achievement (Caprara, et al., 2000; Low et al., 2015; Malecki & Elliot, 2002). However, not all school districts and state legislatures believe these programs are necessary due to the cost of the programs (Hunter et al., 2018). We aim to find ways in which Social Emotional Learning (SEL) programming could be integrated with existing curriculum objectives such as literacy and writing to possibly decrease spending costs and to keep class time for core curriculum courses. We chose 25 (N=25) children between the ages of nine to ten (9:0-10:0 years) at St. Jude Catholic grade school. We developed a curriculum which integrates SEL components into creative writing instruction which is being administered throughout the year. Currently, we are gathering the data and the data will be analyzed after the school year is over.

Project ID: BHVSO 17

8:15a.m. – 8:30a.m.

Title: Feasibility of a Regional Rail Model for Chicago's Metra based on station-level analysis

Presenter(s): Stephen Walsh

Mentor(s): Dr. Ian Savage, Northwestern University

Abstract/Project Intention:

In recent years, Chicago's commuter rail service, Metra, has spoken of moving to a regional rail model, characteristics of which are more train service throughout the day as opposed to schedules centered around AM and PM peaks associated with commuters, and more frequent service overall.

Reasons for this shift include the pandemic and the shifts to virtual work it caused, as well as an increase in non-work-related and "reverse commute" trips. For this model to succeed, Metra will need to determine which stations are most conducive to such a model, based on several factors, including total ridership, ratio of off-peak to total ridership, and change in ridership from 2006 to 2018, as determined by variables such as population density, total population, and median income.

Project ID: PHYS 01

8:15a.m. – 8:30a.m.

Title: Exploring Proton and Muon Energy Distributions from Simulated Neutrino Interactions in LArTPC

Presenter(s): Navya Dixit

Mentor(s): Dr. Zelimir Djurcic, Argonne National Laboratory

Abstract/Project Intention:

The main objective of this project is to study neutrino interaction in the Liquid Argon Time Projection Chamber (LArTPC), mainly those between muon neutrinos or antineutrinos and argon targets, producing final state particles in the detector. Event simulation software based on GENIE and GIANT4 are used to simulate the neutrino interactions that would take place in the ArgonCube 2x2 Demonstrator, the novel type of LArTPC for DUNE experiment. These interactions will then be identified using reconstruction-based machine-learning techniques. From these data sets, we observe the final state particles and characterize their energy using Python application code. We focused on a special case of muon and proton final states. By looking at dQ/dx and dE/dx distributions, we were able to observe important features of energy deposits by protons and muons. Summing up the individual energy deposits along the particle tracks gave us their total energy. Using these calculations, we were also able to determine the total energy of the incoming neutrino that is ultimately the required input to neutrino oscillation measurements with the goal of determining CP violation. These observations will aid the preparations for the future Deep Underground Neutrino Experiment (DUNE) set to start in the next decade.

Project ID: MEDH 10

8:15a.m. – 8:30a.m.

Title: DDX18 Plays a Functional Role in the Association of Centromeres and Heterochromatin to the Nucleolus

Presenter(s): Cara Jacob, Josephine Kim, Vignesh Tiruvannamalai

Mentor(s): Sui Huang, MD, PhD, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

Centromeres and heterochromatin play significant roles in gene expression regulation. We hypothesize that DDX18, a protein that localizes in the nucleolus, may play a role anchoring centromeres to the nucleolus and organizing perinucleolar heterochromatin. Investigating its role in these processes would allow us to better understand the mechanism and purpose behind the centromere-nucleolus and heterochromatin-nucleolar associations, and broader implications for gene expression regulation in malignant cells.

HeLa cells were transfected siRNA against DDX18 mRNA to reduce its expression. Immunofluorescence was then used on DDX18 knockdown and control cells to evaluate centromere association with nucleoli, Pol I transcription machinery, and heterochromatin organization. A Nikon Eclipse Ti microscope was used with Elements software to image and quantify the results of immunofluorescence. Two sample t-tests were used to verify significance.

Knocking down the expression of DDX18 gene in HeLa cells did not significantly affect Pol I transcription machinery or nucleolar structure. However, the knockdown caused a significant decrease in heterochromatin clusters around nucleoli and centromere-nucleoli association compared to the control ($p < 0.05$), supporting the hypothesis that DDX18 plays a role in anchoring centromere and heterochromatin to the nucleolus. In the future, we seek to investigate the mechanisms by which DDX18 regulates the nucleolar association with centromere and heterochromatin, and their role in cancer cells.

Project ID: BIO 17
8:15a.m. – 8:30a.m.

Title: Single-Cell Analysis of ChP-BAM Co-Cultured Organoids

Presenter: William Yu

Mentors: Matti Lam, Tristan Philippe, Yanling Wang, RUSH University, Alzheimer's Disease Center

Abstract/Project Intention:

The choroid plexus (ChP) is a part of the blood-brain barrier that is responsible for cerebrospinal fluid (CSF) secretion, which washes out toxins and enables nutrient transport. Correspondingly, the ChP serves as a niche for immune cells (e.g. Border Associated Macrophages (BAMs)). Studies suggest that ChP and immune dysfunction increases the incidence of Alzheimer's Disease (AD), however, in vitro models are limited to induced microglia (iMGs). The human cell modeling group at the Rush Alzheimer's Disease Center therefore created an in-vitro organoid ChP-iMG co-culture model to more accurately model BAMs.

Single nuclei RNA sequencing (10X genomics kit) was used to characterize this new model. I performed data analysis within R using the Seurat package to clean, normalize, cluster, and visualize the data. I used proteintlas.org and other scientific articles to identify unique cell types based on gene expression. We observed marked changes in gene expression (e.g. SPP1, CTSD, POSTN LPL) in immune cells that were co-cultured with the ChP (henceforth: iBAMs) compared to iMGs. These findings suggest that iBAMs are a better model to study the interaction between the ChP and immune system in Alzheimer's disease and future treatments.

Project ID: MEDH 19

8:15a.m. – 8:30a.m.

Title: Development of a Human-Mouse Chimera to Study the Toxic Effects of HIV Antiretroviral Drugs

Presenter(s): Aahana Das

Mentor(s): Dr. Jennillee Wallace, RUSH University

Abstract/Project Intention:

The course of treatments for HIV has been revolutionized by the development of antiretroviral drugs. However, in many instances, these drugs induce toxicity via mitochondrial dysfunction and the release of neurotoxins, and long-term toxicity remains an area of worry for people living with HIV. Our objective is to develop a humanized mouse model to study the toxic effects of HIV antiretroviral drugs on tissue monocyte-derived macrophages. First, immune-compromised mice were engrafted with human immune cells and we then verified whether these cells migrated to different tissues. To assess human cell trafficking to tissues, DNA was isolated from the brain, lungs, liver, heart, kidney, and spleen. We performed qRT-PCR using human and mouse-specific primers to determine the human: mouse DNA ratio, and quantify human DNA in the mouse tissues. Ongoing and future studies will utilize this model to further assess the toxic effects on monocyte-derived myeloid cells and their subsequent impact on brain tissue.

Project ID: CMPS 06

8:15a.m. – 8:30a.m.

Title: LSTM-Based Classification of Time Series Data for Predicting Thermoacoustic Instability Regimes

Presenter(s): Shrishant Hattarki

Mentor(s): Dr. Debolina Dasgupta, Dr. Chandrachur Bhattacharya,
Argonne National Laboratory

Abstract/Project Intention:

In this research project, predictive capabilities of Long Short-Term Memory (LSTM) models for identifying thermoacoustic instability within combustion systems are explored. LSTMs, a subset of Recurrent Neural Networks, are particularly effective in overcoming the vanishing gradient problem, thus enhancing their ability to learn from and classify time series data. As a part of this project, a machine learning model will be developed that employs LSTMs for time series based- classification. This will be used to distinguish between time series data of different types, or “classes”. The initial approach employs these networks to classify hand-crafted datasets that emulate the conditions indicative of stable behavior and instability. This approach will focus on 3-4 types of time series data, using the LSTM model to distinctly classify them. This year's work lays the groundwork for applying the methodology to actual experimental and numerical data in the following year. As a part of this project, a machine learning model employing LSTMs for time series- classification will be developed to distinguish between time series from different classes. The expected outcome is a robust model capable of accurately classifying the stability regime of the Rijke tube, thereby contributing to the design and optimization of safer, more efficient combustion systems.

Project ID: CMPS 21

8:15a.m. – 8:30a.m

Title: Monte Carlo Evaluation of Dynamic Spectrum Allocation Techniques for Bandwidth Optimization in Wireless Communication Systems

Presenter(s): Eduardo Gutierrez, Aidan Kim, Ankit Walishetti, and Colin Ward

Mentor(s): Dr. Randall Berry, Dr. Igor Kadota, Northwestern University

Abstract/Project Intention:

The heightening demand for spectrum from wireless communication services has necessitated the development of more effective frequency allocation methods. Leveraging Dynamic Spectrum Allocation (DSA) techniques, we generated and modeled data from several allocation algorithms to understand trends in optimal performances. In wireless networks, transmitters with overlapping coverage must be assigned different frequencies to avoid harmful interference, posing complex frequency allocation problems and tradeoffs as the density of transmitters increases. For example, a tradeoff between prioritizing many smaller transmitters or a few prominent transmitters is studied. Transmitter characteristics such as signal propagation range and bandwidth requirement were considered for priority-based allocation. Simulations based on Monte Carlo methods were developed to run allocation algorithms tackling complex allocation methods. Parameters such as the available bandwidth, geographical area, transmitter coverage, and the number of transmitters were changed individually to gauge their effect on the performance of various scenarios. Performance was evaluated using metrics including feasibility (ability to allocate all transmitters), coverage, bandwidth usage, and transmitter capacity (number of transmitters successfully allocated). Applying the more efficient Left-to-Right Spectrum Allocation (LRSA) algorithm, the highest-degree sorting algorithms performed best in terms of feasibility, coverage, and bandwidth usage while lower-degree methods had higher transmitter capacities.

Project ID: CMPS 16

8:15a.m. – 8:30a.m

Title: Using Single-Cell Analysis and Machine Learning to Predict Gastroesophageal Reflux Disease (GERD) and Systemic Sclerosis (SSc)

Presenter(s): Himani Musku and Rhea Shah

Mentor(s): Dr. Deborah Winter, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

Our project utilized various computational techniques, including machine learning, to address an existing issue with diagnosing esophageal diseases, specifically Gastroesophageal Reflux Disease (GERD) and Systemic Sclerosis (SSc). In the early stages of both diseases, symptoms such as chest pain, heartburn, and regurgitation are similar, potentially causing one to be mistaken for the other. Additionally, both of their current diagnoses are complicated as they are a cumulative decision based on multiple tests. Using single-cell data from thirty-three patients, our project focuses on gaining a better understanding of GERD and SSc on a single-cell level while using machine learning models to diagnose and differentiate between both diseases. We performed exploratory data analysis and tested four different models on the dataset: K-Nearest Neighbors, Support Vector Machine, Logistic Regression, and Random Forest. After evaluating the accuracy of the models on six independent samples, Logistic Regression had the highest accuracy of 78%. These results are promising and provide hope for future applications of machine learning in efficiently diagnosing and differentiating between GERD and SSc.

Project ID: CMPS 04

8:15a.m. – 8:30a.m

Title: The Application of Federated Learning in the Detection of Heart Arrhythmias

Presenter: Manya Davis

Mentor: Dr. Ravi Madduri, Argonne National Laboratory

Abstract/Project Intention:

This study aims to address the pressing need for accessible and accurate detection of heart irregularities amidst the rising prevalence of cardiovascular diseases. Leveraging machine learning's capability to process extensive datasets, the research proposes the development of predictive models for identifying heart rhythm irregularities. However, a significant challenge in healthcare persists: ensuring the security and privacy of patient data. To mitigate this concern, the study adopts Privacy-Preserving Federated Learning, specifically utilizing the Argonne Privacy-Preserving Federated Learning (APPFL) framework. This approach enables collaboration among multiple entities while safeguarding sensitive information. By harnessing Federated Learning, the research seeks to construct a robust model for heart irregularity detection, evaluating its accuracy, efficacy, and scalability. Through this methodology, the study hopes to enhance early detection and intervention for individuals at risk, thereby contributing to proactive healthcare interventions and improved patient outcomes in the realm of cardiovascular health.

Project ID: CMPS 43

8:15a.m. – 8:30a.m

**Title: DynaLab: a Google Colab Notebook making Molecular Dynamics
Researchers Accessible to Everyone**

Presenter(s): Vidyoot Senthilvenkatesh

Mentor(s): Nick Bayhi, University of Chicago

Abstract/Project Intention:

Molecular dynamics simulations (MD) sits at the interface of two fields, computer programming and biology, using the skills of the former to explore concepts and test hypotheses in the latter. MD elucidates protein motions that are vital to understanding a protein's function and can be used to examine its interactions with its substrates in ways that are not obvious from the structures alone. MD is especially significant in the field of protein engineering, allowing researchers to explore how candidate mutations alter protein functionalities. While MD typically requires supercomputer access and extensive programming knowledge to implement, this barrier can be lowered using Google's Colaboratory Notebooks, which provide free computational resources to anyone with browser access. We have developed Dynalab, a plug-and-play Colab notebook that makes running and analyzing coarse-grained and all-atom simulations possible with minimal training or institutional resources. To showcase Dynalab's abilities, we used it to examine potential destabilizing mutants of enhanced Green Fluorescent Protein (EGFP) – mutations that make it easier to pull the protein apart, losing its fluorescence. These mutants provide a theoretical basis for developing a ladder of force-sensitive GFP mutants to explore the strength of pulling forces in mechanosensitive protein systems.

Project ID: MEDH 28

8:15a.m. – 8:30a.m

Title: Developing a Questionnaire to Measure the Efficacy of a Multiomic Detection Model for Colorectal Cancer Screening

Presenters: Ava Gonzalez, Ashwin Nair

Mentors: Dr. Jennifer Herbert, Ms. Katherine Goscilo,
University of Chicago

Abstract/Project Intention:

The U.S. Preventive Services Task Force (USPSTF) states that adults aged 45 to 75 not at increased risk for colorectal cancer (CRC) should be screened once every ten years. Literature shows three out of ten adults don't adhere to CRC screening guidelines due to socioeconomic status, fear of screening methods, affordability, and other inhibitors. Insufficient information is available on improving screening adherence—however, new screening methods bring newer benefits. A newly developed blood-based detection model for CRC screening offers equivalent or better sensitivity and specificity, and we are developing a questionnaire assessing these potential benefits. The new model would offer alternatives to CS or other screening methods. The questionnaire aims for insights on the benefits of the new screening method and increased knowledge of factors of screening adherence; it identifies disparities with CR screening access so healthcare providers aim efforts toward under screened populations. The survey measures adherence to the CRC screening methods, collects information to record variance in screening opportunities, and assesses barriers to screening, respondents' screening knowledge, and whether a practitioner encouraged screening. On implementing this questionnaire, we'll see benefits of the new detection method—such as improved accessibility—and will give us a guide for resource allocation to improve adherence.

Project ID: ERSP 02

8:15a.m. – 8:30a.m

Title: Radio Observation During Total Eclipse

Presenter(s): Taegeon Eom, Jaykrish Ganesan, Krish Konda, Charles Ludwig

Mentor(s): Dr. Eric Hawker, Illinois Mathematics and Science Academy

Abstract/Project Intention:

During the total solar eclipse crossing North America on April 8, 2024, the moon will completely cover the sun's bright photosphere, allowing for unique observations of the faint outer atmosphere of the sun called the corona. While eclipses have traditionally been studied at optical wavelengths, observing at radio wavelengths can provide insights into the sun's magnetic fields and energetic particle flows.

Under the supervision of Dr. Hawker, a radio telescope was designed and constructed to measure the sun's radio waves during the upcoming total eclipse. A dish will be used to reflect the analog waves coming off of the Sun to an LNBF, converting them to a digital signal that will then be collected.

Radio waves from the sun before, during, and after the eclipse will be observed, and the amount of radio power coming in using a signal meter at any given time will be collected as data. This has been done beforehand, successfully collecting radio power. By observing the sun's radio waves during the total eclipse, valuable information pertaining to electromagnetic radiation and heliophysics could be gained.

Project ID: PHYS 16

8:15a.m. – 8:30a.m

Title: An Analysis into Multivariate Lepton Jet Recognition

Presenter(s): Sreevardhan Atyam

Mentor(s): Dr. Peter J. Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Dark photons are useful indicators to explain important phenomena beyond the Standard Model of particle physics, namely in the context of many experiments. Dark photons can interact with Standard Model particles through a process called kinetic mixing, which allows them to decay into Standard Model leptons, from which lepton jets are produced. However, classification of such particles becomes challenging when introducing background effects, systematic errors, and cut values that are difficult to calibrate. Therefore, we propose a methodology in which a multivariate analysis is used to produce a neural network that differentiates true signal events from fakes. Machine learning analyses can aid in fixing this issue; moreover, several neural net methods for cut efficiency and optimal cut values were employed: specifically, Boosted Decision Trees (BDT), Multi-Layer Perceptrons (MLP), and Deep Neural Networks (DNN)'s. In summary, the most successful method of separation was through the use of BDT, where we observed optimal signal acceptance and through efficiency ROC curves; we also concluded that the current efficiency for our BDT experiment was maximized at around 92% signal acceptance, and 93% background rejection. MLPs also had remarkably similar background rejection and signal efficiency, but were generally outperformed by BDTs.

Project ID: MEDH 50

8:15a.m. – 8:30a.m

Title: Drug Discovery on Tropical Disease

Presenter(s): Aditya Kumar

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis, a tropical disease, poses significant challenges due to the unreliability, toxicity, and cost of current treatments. Addressing this, a novel treatment approach is under investigation, focusing on 5-chloro-1,3-benzoxazol-2-amine, a promising compound identified through the Drugs for Neglected Diseases Initiative's Open Synthesis Network. This molecule is undergoing rigorous testing, including Proton Nuclear Magnetic Resonance and Infrared Spectroscopy, to verify its structure. To synthesize the intended molecule, the 5-chloro-1,3-benzoxazol-2-amine was reacted with one of three carboxylic acids: Fluorophenylacetic acid, p-Tolylacetic acid (Methylphenylacetic acid). Both acids resulted in some mine yield; however, neither yielded enough to be considered a final product that would work.

Project ID: PHYS 11

8:15a.m. – 8:30a.m

Title: Impact of the Parton Distribution Function on the Signal of the Doubly Charged Higgs Boson

Presenter(s): Robert Mandell, Jayram Palamadai

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The possible existence of the doubly charged Higgs boson necessitates the existence of a beyond Standard Model extension. Models that include the doubly charged Higgs boson are dependent on other particle interactions that redefine the current understanding of Standard Model particles. Determining constant factors of the doubly charged Higgs boson allows limits or cuts to be placed, reducing background in search of the particle at a particle accelerator. Through the use of Monte Carlo simulations, we analyze the impact of the parton distribution function, which determines the parton interactions in a collision, on the signal of the doubly charged Higgs boson. In particular, we compare the invariant mass of events generated by different parton distribution functions.

Project ID: ENGN 08

8:15a.m. – 8:30a.m

Title: Energy Consumption Study for Multi-Axis Robot Additive Manufacturing

Presenter(s): Keegan, Balow

Mentor(s): Suyog Shivajirao Ghungrad, Azadeh Haghighi,
University of Illinois at Chicago

Abstract/Project Intention:

As additive manufacturing (AM) develops into a more mature manufacturing technology, the scope of experimentation with its limits and use cases has broadened. With the increasing implementation of these technologies, the energy usage of these machines is gaining significance, particularly in the context of climate change and conscious material consumption. The potential of AM in space exploration and colonization, where resource limitations are extreme, necessitates a careful balance. The use of multiple mobile or stationary robots to print models larger than the printer's capacity while maintaining energy efficiency and strength presents a solution. However, this approach also introduces challenges such as robot interference, placement, energy usage, decomposition of large parts, and quality. This study delves into the impact of variables such as model/part position, orientation, speed, and infill on the energy consumption of the robot. A data-driven energy surrogate model for robotic AM, which is trajectory-dependent, is utilized to calculate energy consumption. Two case studies, i.e., door structure and fuel tank models, printed with different print settings for traditional fused deposition modeling (FDM), wire arc additive manufacturing (WAAM), and concrete 3d printing, are studied. Factors such as changing the location and orientation of parts impact these more than factors like the velocity and acceleration of the print head, which have a change in energy efficiency. However, these saving in energy consumption may result in a less structurally sound item.

Project ID: CHEM 14

8:15a.m. – 8:30a.m

Title: Design and Synthesis of Potential Treatments for Leishmaniasis

Presenter(s): Semi Campos Gonzalez, Dael Garzon Torres, Shanya Yang

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a parasitic disease that mainly infects mammals through bites from sandflies. Not only is it primarily seen affecting people in low-income areas, but also people with other infections that debilitate the immune system, like HIV. Immunosuppressed people get infected more easily, which in turn gives the disease more hosts to spread. Medicinal treatments for Leishmaniasis are extremely lacking in efficiency and accessibility. Some treatments that have been used before to fight Leishmaniasis have been proven to be toxic to humans, overly expensive, ineffective, or take too long to begin its effect. The corresponding carboxylic acids were reacted with amine, DIPEA, and HATU solution to create three new compounds. Column chromatography was used to work up and purify the compounds. The products were then subjected to IR and NMR testing. The objective is to develop a leishmaniasis treatment that is affordable, efficient in less than ten days, and safe for people with immunosuppressive diseases like HIV.

Project ID: CMPS 29

8:15a.m. – 8:30a.m

Title: Single-cell segmentation and fluorescent intensity quantification pipeline

Presenter(s): Alexander Sorescu

Mentor(s): Yogesh Goyal, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

Pancreatic cancer has less than a 10% survival rate after 5 years of treatment. Drug resistance, among other issues, is one of the main reasons for tumor relapse. One of the main mutations in pancreatic cancer is in the protein KRAS, which controls cell proliferation and when mutated sends signals continuously for the cell to divide. Recently, a new FDA-approved drug called Sotorasib was released to treat cancers with the mutation KRAS G12C.

The project aimed to identify whether the treated cells' KRAS signaling pathway was on or off. To do this, we want to locate and quantify the presence of the protein ERK 1/2 downstream of KRAS in the signaling pathway.

This was accomplished by creating an image sequencing pipeline, within the pipeline we created a segmentation model with an accuracy of ~97.8%. The model produced masks that we then performed quality control methods to rectify any inaccuracies in the segmentation process. The pipeline then calculated the fluorescence intensity of the cells via the mask's region. Ultimately, the Sotorasib-treated cells consistently exhibited low intensity readings of ERK 1/2 compared to both gemcitabine-treated and untreated cells, suggesting resistance to Sotorasib in the context of KRAS G12C mutation.

Session I - 8:35a.m. – 8:50a.m.

Project ID: BHVSO 06

8:35a.m. – 8:50a.m.

Title: A Feasible Approach to Cubane Synthesis and Functionalization

Presenter(s): Tate Schneider

Mentor(s): Dr. Laura Kopff, Illinois Mathematics and Science Academy

Abstract/Project Intention:

In the 60 years since cubane's synthesis, the hydrocarbon cube has displayed considerable practicality within medicinal chemistry as a bioisostere to benzene. However, modern synthesis procedures of cubane call for known carcinogenic compounds, namely benzene, which can be a limitation for laboratories looking to synthesize cubane for research. In this study, researchers looked at a synthesis of cubane that substitutes a less toxic reagent, toluene, for benzene. Furthermore, functionalization of cubane using standard aromatic reactions was attempted in order to look at the efficiency of adding substituents to the compound. Prior to functionalization, the product obtained from the synthesis was analyzed using IR, NMR, and TLC and compared against the literature to confirm the presence of cubane. All derivatives of the cubane compound were similarly analyzed using NMR and IR spectroscopy to confirm structure. The researchers of this study hope that the synthesis used allows accessibility to more laboratories looking to synthesize cubane, and the results from functionalization attempts contribute to a basis for further research in cubane derivatives.

Project ID: BIO 04
8:35a.m. – 8:50a.m.

Title: Hyolingual Kinematics and Biplanar Videoradiography Reveal Hydrostatic Deformation of the Tongue Base

Presenter: Riya Gumidyala

Mentors: Peishu Li and Dr. Callum Ross, University of Chicago

Abstract/Project Intention:

Tongue base retraction (TBR) is the action of the tongue being pulled backwards and shortened and is vital to swallowing in mammals. Compromised TBR performance leads to patients having more food residue in the pharynx, posing more risks for choking. However, the biomechanical mechanisms driving TBR remain poorly understood. The muscular hydrostat hypothesis posits that the hydrostatic deformation related to the contraction of intrinsic muscles lengthens the tongue base. The extrinsic muscle shortening hypothesis suggests that structures surrounding the tongue, the hyoglossus and styloglossus, pull the tongue base. In this study, we evaluated the role of intrinsic and extrinsic structures in TBR through nine swallows of one opossum, a model system for mammalian feeding physiology. We measured tongue and hyoid movement during swallowing using biplanar videoradiography following the XROMM workflow. Using CT scans to visualize the hyolingual anatomy of opossums, we found that opossums do not have a styloglossus. In vivo observation of marker movement falsifies the hypothesis that extrinsic muscles shorten to produce TBR. Our data supports the intrinsic muscle hypothesis as in vivo tongue base deformation pattern is consistent with the muscular hydrostat model. Our findings may facilitate new treatment exercises during rehabilitation for poor tongue base retraction.

Project ID: BIO 12
8:35a.m. – 8:50a.m.

Title: Cloning Plasmids for Gene Editing in Human Lung Cells

Presenter(s): Shatakshi Chatterjee

Mentor(s): Preetish Kadur Lakshminarasimha Murthy,
University of Illinois at Chicago

Abstract/Project Intention:

The purpose of gene editing is to manipulate the expression levels of a gene of interest. The focus of this experiment was to manipulate TP63 expression levels between proximal and distal epithelial airway cells. Gene cloning was performed through restriction enzyme digest cloning, in which the non-region of interest is cut off and substituted with the gene sequence of interest selected by software. Three different cloning techniques were used: CRISPR Cas9, Open Reading Frame, and short hairpin RNA. From each cloning technique two sets of plasmids were made, one for control and one to change gene expression levels. A virus was made using each of the different gene editing techniques and introduced to human epithelial cells. Transduced cells were sorted and had their RNA extracted to determine if gene cell expression levels were changed after virus introduction. Based on preliminary data, we can transduce primary human cells with high efficiency using the Open Reading Frame method and have seen a change in gene expression, but further replicates have to be performed to show significance. Future steps include infecting more than three samples and exploring how the cell integrity has changed by differentiating infected cells into different cell types.

Project ID: ENVR 02

8:35a.m. – 8:50a.m.

Title: Examining the feasibility of manganese oxide sorbents for cobalt and nickel recovery

Presenter: Ian Chung

Mentor: Jean-Francois Gaillard, Northwestern University

Abstract/Project Intention:

Technological advancements in batteries and electric cars have increased global demand for critical metals like cobalt and nickel. These metals are essential to these emerging technologies' functions; however, the majority of these technologies are disposed of with minimal effort to reuse or recycle their components. These metals are also subject to unstable supply chains and problematic mining processes, and so being able to reclaim critical metals from waste products is paramount to maintain this vital resource. One method of metal recovery is adsorption, which involves the attachment of metal ions onto the surface of a solid material. Our project examines the use of manganese oxide nanomaterials distributed on a cellulosic substrate to combine these features. Metal ions naturally form surface complexes with manganese oxides, and the cellulosic material provides a high surface area for the nanomaterial to cover. Our project aims to understand, and will present results about, adsorption capacity, kinetics, and reusability of manganese oxide sorbents for cobalt and nickel recovery.

Project ID: BHVSO 03

8:35a.m. – 8:50a.m.

Title: Luminosity Data as a Proxy for Evaluating Different Carbon Tax Systems

Presenter(s): Avyay Duggirala

Mentor(s): Dr. Viswanath Pingali, Indian Institute of Management, Ahmedabad

Abstract/Project Intention:

In addressing the increasingly urgent issue of climate change, policymakers around the world turn to carbon taxes as a primary initiative. However, in the status quo, the effectiveness of these various carbon tax systems is extremely contested, largely due to the variety of methods used to measure the effectiveness of said taxes and the high error rates associated with these methods. This paper utilizes the new approach of looking at luminosity data, which is the brightness of artificial light to provide more data on how carbon tax systems change the rate of emissions in various countries. By offering more data on the effectiveness of these important kinds of policies, this paper hopes to offer some guidance to policymakers seeking to implement a carbon tax.

Project ID: BHVSO 08
8:35a.m. – 8:50a.m.

Title: Delineating Perceived Chicago Neighborhood Boundaries Using Crowdsourced Geospatial Data

Presenter(s): Keyan Dunmore

Mentor(s): Dr. Crystal Bae, University of Chicago, Center for Spatial Data Science

Abstract/Project Intention:

Acknowledging the limitations of the formal designations of the 77 Community Areas identified over a century ago in Chicago, this research aims to close the gap between these outdated definitions and the dynamic perceptions of the city's residents. This project investigates the complex urban landscape of Chicago, a city renowned for its diverse and multifaceted neighborhoods, through a novel crowdsourced approach. Utilizing a web-based interactive tool, data was collected on residents' perceived neighborhood boundaries all throughout Chicago in the form of polygons, a method previously explored but not thoroughly analyzed for its research and policy implications. Crowdsourced polygons were analyzed utilizing R for advanced data analysis and visualization, while the application of QGIS facilitated detailed geospatial analysis and mapping, enabling the transformation of subjective perceptions into quantifiable, visual maps. Different mapping methods were employed as well, the most prominent being a raster-based method for evaluating polygon agreement. Through this novel approach, the research aims to offer a more accurate and resident-informed delineation of neighborhood boundaries that provides more of a contemporary urban landscape.

Project ID: PHYS 08

8:35a.m. – 8:50a.m.

Title: Analysis of the Optical and Physical Properties of Samarium Oxide doped Lead Borate Glasses

Presenter(s): Jose Florenzano, Andre Mendez

Mentor(s): Dr. P. K. Babu, Dr. Saisudha B. Mallur, Western Illinois University

Abstract/Project Intention:

We prepared a series of lead borate glasses doped with rare earth ions and with varying PbO content and studied their refractive index, optical band gap, fluorescence, and density. Using a Brewster's angle setup, we measured the refractive indices. The optical band gaps were determined by locating the edge of the optical absorption spectra recorded using an absorption spectrometer. When the amount of PbO increased in each sample, the refractive index also increased. The composition of 40mol% PbO resulted in the highest optical band gap; with further increase in PbO concentration resulting in its decrease. We were able to measure the density of our glass samples using Archimedes' method. In comparison to our independent variable, PbO content, we observed a positive correlation between density and increasing levels of PbO content. Fluorescence measurements were carried out using a fluorescence spectrometer. From the fluorescence intensity of the rare earth ions at different wavelengths, we were able to conclude that there is a red shift in the fluorescence peak with increasing Pb concentration. This observation indicates that the rare earth ion covalent bonds become stronger and more symmetrical in their chemical environment as PbO concentration is increased.

Project ID: MEDH 11

8:35a.m. – 8:50a.m.

Title: Monobenzene Nanoparticles for The Treatment of Melanoma Tumor Cells

Presenter(s): Jongwoo Kim

Mentor(s): Dr. Caroline Le Poole, Mr. Rohan Shivde,
Northwestern University, Feinberg School of Medicine,
Dr. SonBinh Nguyen, Dr. Kelly Conger, Northwestern University

Abstract/Project Intention:

Melanoma is a highly malignant form of skin cancer originating from melanocytes, cells responsible for pigment production, and there exist limited treatments for the disease. Monobenzyl ether of hydroquinone (MBEH), approved as a treatment for Vitiligo, targets the melanogenic pathway of melanin synthesis through its conversion into a toxic product by tyrosinase. Due to its toxicity at concentrations to get therapeutic effects, a better application of MBEH is needed. We hypothesize that MBEH nanoscale particles can be used as a systemic, therapeutic application for the treatment of melanoma. Both nanoparticle and free MBEH and its derivatives were applied to the B16 F10 cell in which nanoparticles proved to be more cytotoxic at the same drug concentration and eliminated 85 to 95% of the cells in 48 hours compared to the untreated control cells. The same nanoparticles were further tested on mTyr, mTRP-1, mTRP-2, mgp-100, and mMART melanoprotein-expressing HEK293 cells which showed less cytotoxicity to these cells compared to HEK293 cells without melanoproteins. Future opportunities include additional assays to test the effectiveness of the drug on differing strains of melanoma namely A375 and 888 cells. The makings of a promising systemic treatment for metastatic melanoma are visible through this experiment.

Project ID: MEDH 23
8:35a.m. – 8:50a.m.

Title: Meta Analysis of multifactorial Etiology, Epidemiology, and Implications of Orofacial Clefts

Presenter(s): Emerson Blair

Mentor(s): Dr. Russel Reid, University Of Chicago

Abstract/Project Intention:

Orofacial clefts (OFCs), including cleft lip (CL) and palate (CP), are common birth defects with significant impacts on speech, nutrition, and psychosocial development. This review discusses the diverse manifestation and classification of OFCs, the latest genetic findings, and advancements in management. Genetic factors, particularly those associated with syndromic and nonsyndromic OFCs, are explored, alongside environmental contributors such as smoking, alcohol, and nutrition. Various classification systems and diagnostic modalities are examined, emphasizing the importance of early detection and interdisciplinary care. Surgical interventions, including cleft lip and palate repairs, are discussed, highlighting the need for tailored approaches and ongoing dental and orthodontic care. Overall, successful management of OFCs requires a comprehensive, multidisciplinary approach to optimize both function and aesthetics, ultimately improving the quality of life for affected individuals.

Project ID: MEDH 20
8:35a.m. – 8:50a.m.

Title: The role of the protein tyrosine phosphatase SHP-1 in TRPV1-mediated pain behavior

Presenter: Kaylee Hwang

Mentor: Dr. Adrienn Markovics, Rush University Medical Center

Abstract/Project Intention:

The capsaicin receptor TRPV1 is expressed in pain-sensing neurons and has been an attractive drug target for pain control. However, its physiological function such as regulating normal body temperature and heat sensation made TRPV1-targeting drug development challenging. Previous studies showed that the protein tyrosine phosphatase enzyme SHP-1 can modulate TRPV1 in the dorsal root ganglion (DRG). Our aim was to investigate the effect of genetically increased SHP-1 activity on capsaicin-induced neuronal responses and pain behavior in mice. First, capsaicin-induced responses of cultured DRG neurons from wildtype (WT) and SHP-1 overexpressing (Shp1-Tg) mice were compared. Second, capsaicin paw injection was performed, and the time spent with paw licking, and paw withdrawal threshold to mechanical stimulation were evaluated as measures of pain behavior. Interestingly, capsaicin-induced neuronal responses in the DRG of Shp1-Tg mice were reduced. While paw licking time and paw thickness were not significantly different after capsaicin injection, mechanical allodynia was significantly reduced in Shp1-Tg mice compared to WTs. Our results suggest that TRPV1 modulation by increased SHP-1 activity might represent a novel approach to control pain without the limiting side effects of TRPV1 blocking drugs and warrant further investigation into the SHP-1/TRPV1 pathway.

Project ID: CMPS 07

8:35a.m. – 8:50a.m.

Title: Knowledge Graph Assisted Large Language Models

Presenter(s): Sohum Kashyap

Mentor(s): Dr. Tarak Nath Nandi, Argonne National Laboratory

Abstract/Project Intention:

Transformer-based large language models (LLMs) have gained prominence over the last few years, with their ability to generate human-like content. One of the biggest issues with LLMs is “hallucination” where they generate factually incorrect output in response to queries that don’t have much support from the data that was used to train the model. Previous methods for mitigating hallucinations, such as retrieval augmented generation (RAG) provide direct relationships between entities, leaving out high-level connections. Graph RAG (GRAG) is a technique utilizing knowledge graphs (KGs) to incorporate information from large corpora in a structured format that enables context-based LLM response. For this work, we are using SPOKE, a KG (created by researchers at the University of California San Francisco) constructed of 41 million nodes (entities) and 148 million edges (relationships) representing the interconnected pathways relevant to human biology (e.g., connecting genes, diseases, and drugs). The goal of my project is to utilize SPOKE to provide structured relationships for context-aware and fact-based LLM responses given user queries like, “What are some diseases that involve the BRCA1 gene, and what proteins are affected?”, or “What are some drugs for someone suffering from Crohn’s disease?”. We anticipate having results to present by IMSAloqium.

Project ID: CMPS 25
8:35a.m. – 8:50a.m.

Title: Applying Graph Neural Networks to Improve the Data Resolution of Stream Water Quality Monitoring Networks

Presenter: Melinda Yuan

Mentor: Kaize Ding, Northwestern University, Department of Statistics

Abstract/Project Intention:

In most US watersheds, surface water quality observations are scarce, making it challenging to assess goals, advise management, and calibrate high-resolution models. Popular statistical techniques, such as USGS's LOADEST and WRTDS, estimate daily pollution load using regression methods and the link between flow and pollutant concentrations. However, they do not consider upstream-downstream relationships. We suggest using Graph Neural Network (GNN) to improve spatial and temporal resolution of water quality data, considering the river network connections and the spatial-temporal inputs simultaneously. Using a physical flow direction graph, the GNN builds up numerical relationship edges among river monitoring stations. It then wraps up the time steps using spatiotemporal encoders. After imputations with multiple solvers, the GNN decodes the spatial connections and results in continuous monitoring data at each station. We test this method in the Maumee River Basin because of its prolonged records on river water quantity and quality.

Project ID: CMPS 14
8:35a.m. – 8:50a.m.

Title: Utilizing a Framework to Evaluate the Performance of Explainable AIs on Deepfake Detection Models

Presenter(s): Kavya Uppal

Mentor(s): Dr. Yan Yan and Mr. Junyi Wu, Illinois Institute of Technology

Abstract/Project Intention:

As the number of deepfake image generators has skyrocketed, so has the number of deepfake detection models. However, explainability in these models remains underexplored, which is the key to building trust with users, and these are black box models. To address this issue, we studied how humans can understand the model's justification behind its decision by integrating explainable AIs (XAI) with a deepfake detection model. We tested the model on deepfaked images of human faces by integrating it with 2 XAI methods - Gradient-weighted Class Activation Mapping (Grad-CAM) and Local Interpretable Model-Agnostic Explanations (LIME). In our research, we noted that the XAI commonly identified deepfakes by picking on lighting differences in deepfakes. Furthermore, we wanted to understand which XAI method offers clearer insights to users on a deepfake detection model's outputs. To this end, we developed a framework to evaluate the two widely used XAI methods: Grad-CAM and LIME. This framework evaluated the XAI methods focusing on interpretability, explainability, clarity, and distraction. Based on the evaluation, we revealed that Grad-CAM yields more effective explainability results than LIME.

Project ID: CMPS 35
8:35a.m. – 8:50a.m.

Title: Implementing Mixed Memorization-Based Inference Recurrent Models of Visual Attention Using Thresholds for Energy Efficiency

Presenter(s): Jeremiah Suarez

Mentor(s): Professor Amit Ranjan Trivedi, Maeesha Binte Hashem,
University of Illinois at Chicago

Abstract/Project Intention:

Rapid advancement of deep neural networks has significantly improved various tasks such as image and speech recognition. However, as complexity of the models increases, computational costs and the number of parameters increase, making it more difficult to be implemented on resource limited devices. This paper proposes a novel memorization-based inference (MBI) model that is compute-free and size-agnostic. Our work capitalizes on the inference mechanism of the recurrent attention model (RAM), where only a small window of input domain (glimpse) is processed in a one-time step, and the outputs from multiple glimpses are combined through a hidden vector to determine the overall classification output of the problem. By leveraging the low-dimensionality of glimpse, our inference procedure stores key-value pairs consisting of glimpse location, patch vector, etc. in a table. The computations are obviated during inference by utilizing the table to read out key-value pairs and performing compute-free inference by memorization. MBI is only accurate to a certain degree and is coupled with standard Deep Neural Networks to improve accuracy. By exploiting Bayesian optimization and clustering, the necessary lookups are reduced, and accuracy is improved.

Project ID: MEDH 29

8:35a.m. – 8:50a.m.

Title: 5-hydroxymethylcytosine and TET Enzymes in Neuroblastoma

Presenter: EmmaLi Isham

Mentors: Kelley Moore, Mark Applebaum, The University of Chicago,
Department of Pediatrics

Abstract/Project Intention:

One of the hallmarks of aggressive neuroblastoma is amplification of the MYCN oncogene which defines groups of patients with poor prognosis. The Applebaum Lab has shown that in MYCN-amplified neuroblastoma, 5-hmC (a DNA modification of open chromatin placed by the Ten-Eleven Translocation (TET) proteins) and H3K27me3, a marker of closed chromatin, co-localize. This co-localization results in the repression of genes that would lead to non-malignant differentiation if expressed. We hypothesized that an improved understanding of these mechanisms would allow us to target pathways that promote aggressive neuroblastoma. To test this, we knocked out TET2 and TET3 proteins in SK-N-BE2 neuroblastoma cell lines using a lentivirus CRISPR vector system to deliver Cas9 and sgRNAs. After confirming knocking out the TET 2/3 proteins, we found a weaker presence of 5-hmC among the cells. We then measured cellular proliferation of three unique clones using the MTT assay and found that the SK-N-BE2 cell lines were extremely confluent. This interfered with the results of our MTT assay and more testing is needed to form a conclusion. Thus, knockout of TET2 and TET3 proteins in MYCN-amplified neuroblastoma cells reduced 5-hmC levels and potential impaired cellular proliferation, suggesting that targeting these proteins may be a promising therapeutic strategy.

Project ID: PHYS 06
8:35a.m. – 8:50a.m.

Title: Mid-Infrared Luminosities of Different Types of Supernovae Using the Spitzer Space Telescope

Presenter(s): Stella Ristic

Mentor(s): Vikram Dwarkadas, University of Chicago

Abstract/Project Intention:

For centuries, most astronomical observations have been conducted using visible light. However, within the last 60 years, astronomers have been exploring other wavelengths, including infrared, ultraviolet, and microwave. Infrared astronomy became more prevalent due to the Spitzer Space Telescope and the new James Webb Space Telescope

This project utilizes mid-infrared (mid-IR) data for supernovae (SNe) obtained with the Spitzer Space Telescope. Using 4.5 μm photometry, we determine the luminosity of various supernova types (II, II-P, IIb, IIn, Ia, Ia-CSM, Ib, Ib/c, Ibn, Ic). Using Python to plot and understand the luminosity of different SNe helps determine luminosity among the different types of SNe. Although the Spitzer telescope is not operational anymore, archival mid-IR data observations are key to understanding dusty SNe. The results of our research indicate that the brightest observed IR SNe type is IIn while the lowest luminosity is observed in Type Ia and II-P.

Project ID: PHYS 17

8:35a.m. – 8:50a.m.

Title: H⁺⁺ Lepton Selection Cuts and ZZ Background Estimation

Presenter(s): Ivan Chen

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

In search for new physics beyond the Standard Model (BSM), theories such as the Left-Right symmetric electroweak model predict the existence of doubly charged Higgs bosons (H⁺⁺) which have the unique decay signature of a pair of same-sign dilepton (SSDL) jets which is unlike anything present in the Standard model. This unique signature makes the H⁺⁺ a promising search candidate to verify the Left-Right Symmetric Model. In order to set higher limits of the H⁺⁺ mass our goal was to reduce the primary Drell-Yan background using electron and muon cuts. After we managed to successfully cut out the large majority of the Drell-Yan background contribution, the next greatest source of background comes from ZZ decays which as an irreducible background must be calculated. Since higher mass same-sign dilepton pair (SSDL) ZZ events are so rare, the Monte Carlo becomes unreliable for predicting ZZ at high masses. Our approach was to fit from SSDL invariant mass regions to higher masses using a power law in order to be able to predict the ZZ contribution at any mass.

Project ID: PHYS 31
8:35a.m. – 8:50a.m.

Title: Same Sign Lepton Jet Filtering for Usage in Control Region Calculation

Presenter(s): Max Chen, Vincent You

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Some current dark sector theories predict the existence of a dark photon that interacts with the Standard Model (SM) particles through kinetic mixing. Searching for the existence of the dark photon could have implications for understanding the nature of dark matter and the legitimacy of the theories predicting it. Dark photons are theorized to primarily decay into lepton jets. Our background comes primarily through Drell-Yan interactions. In both scenarios, the leptons in the jets produced must be of opposite charge. However, since Drell-Yan occurs very rarely at the low energy levels of dark photons, much of the background is caused by factors such as charge mismeasurement, photon fakes, or pileup events. In our analysis, we look into the effects on the sensitivity of our Monte Carlo simulations based on the implementation of an opposite-sign lepton jet filter. We further analyze the properties of same-sign lepton jets to use for a potential control region.

Project ID: ENGN 09

8:35a.m. – 8:50a.m.

Title: Turning a Passive Exosuit Active

Presenter(s): Laura Cervantes

Mentor(s): Myuhnghee kim, University of Illinois at Chicago

Abstract/project intention:

Walking is a crucial part of anyone's everyday life, providing one with the ability to complete tasks and activities individually. However, some people cannot use this ability to its full potential given certain challenges such as the loss of muscle control and a decrease in strength, caused by old age or diseases. Through studies, it has been proven that exosuits can provide a person with enough assistance to reduce metabolic costs and muscle activity, for faster and safer healing. The current passive exosuit used to relieve this stress was derived from a study to enhance the performance and effectiveness of the suit to be more comfortable and effective for users. The benefit of exosuits increases through autonomous assistance. Soft active exosuits aim to autonomously assist the subject through lightweight active actuation by transmitting assistive torque to the subject's joints. Due to this new form of wearing exosuits, the current state-of-the-art passive exosuits must be modified to incorporate Bowden and wire cables. Through the research of old studies and the usage of computer-aided design, we were able to craft a prototype active suit that slightly altered the current state-of-the-art suit.

Project ID: CHEM 08

8:35a.m. – 8:50a.m.

Title: Synthesis of Potential Therapeutics for Mycetoma

Presenter(s): Chinara Caldwell, Alyssa Hernandez, and Nataliya Stewart

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Mycetoma is a prevalent infectious disease commonly found in tropical regions. It has been difficult to find treatment because the current options include things such as limited therapeutic options, prolonged treatment durations, and drug resistance issues. To solve this and synthesize the final products, we added the amine (4-methylpiperidine) to the chloride (3-[chloro(4-chloro-2-fluorophenyl)methyl]pyridine) to make Compound 1. To make Compound 2 we added the amine (4-ethylpiperidine) to the chloride (3-[chloro(4-chloro-2-fluorophenyl)methyl]pyridine). For compound 3 we added the amine (piperidine) to the chloride 3-[chloro(4-chloro-2-fluorophenyl)methyl]pyridine. The compounds then went through a 48-hour reaction, were cooled, and then partitioned between dichloromethane and a saturated aqueous sodium carbonate solution. The organic phases were washed, dried, filtered, and concentrated to obtain a crude product and then purified. Compounds 1, 2, and 3 were successfully synthesized and showed promising data in our tests. Compounds 1, 2, and 3 exhibited favorable physicochemical attributes, warranting sustained inquiry for their potential role in advancing as a novel therapeutic modality for Mycetoma.

Project ID: CMPS 30
8:35a.m. – 8:50a.m.

Title: Optimization of Measurement Scheme for Neutral Atom Quantum Computers

Presenter(s): Aadi Desai

Mentor(s): Dr. Tirthak Patel, Rice University

Abstract/Project Intention:

With the introduction of Quantum Computers, multiple methods have arisen that focus on simulating Quantum Computers. The most common and popular way many of the largest Quantum Computers are built is with superconducting qubits, similar to those built at places such as Google and IBM. Neutral Atom Technology is a quantum computer that utilizes neutral atoms as qubits. By shining lasers at the atom, the energy level of an atom can be increased, allowing the atom to enter a state of excitement. Since each atom has a wide range of excited states, this is a great medium to store and process quantum information. However, this method isn't popular due to the computational costs it brings. To address this computational challenge, 5 policies were created to help assess which method allowed for the most accurate results while costing the least computational power. By running simulations of each of these policies and comparing the statistical data with the results, we are able to assess and find the best heuristics for running simulations on Neutral Atom Quantum Computers.

Session I - 8:55a.m. – 9:10a.m.

Project ID: CHEM 02

8:55a.m. – 9:10a.m.

Title: Examining the Pervasiveness of COVID-19 Pharmaceuticals in the Environment

Presenter(s): Blaise Jones

Mentor(s): Dr. Christopher Mulligan, Illinois State University

Abstract/Project Intention:

During the recent pandemic, many people began to take different pharmaceuticals hoping to prevent the contraction of COVID-19 and to alleviate symptoms. After use, these pharmaceuticals can make their way in the environment through waste streams. Little research has been done to look at the prevalence of these pharmaceuticals in soil when used for their intended purpose, but the uptick in use over the several years increased the potential impacts on the environment. This work examines the following pharmaceuticals: Ivermectin, Oseltamivir Phosphate, Hydroxychloroquine Sulfate, Lopinavir, Chloroquine Phosphate, Dexamethasone, Ribavirin, Remdesivir, and Oseltamivir Acid Methyl Ester. High resolution mass spectrometry (HRMS) was used to collect initial spectral data to later compare to later compare with soil samples. Further research is currently underway to determine how these chemicals potentially alter in these systems.

Project ID: ENVR 06
8:55a.m. – 9:10a.m.

Title: Analysis of Nachusa Grasslands Restoration Progress through Geochemical Data

Presenter(s): Katherine Ge, Josefh Hernandez

Mentor(s): Dr. Wesley Swingely, NIU

Abstract/Project Intention:

Prairie restoration is an important strategy to recover biodiversity and ecosystem services, especially in the North American Midwest where many prairie sites have been destroyed or degraded due primarily to intensive agriculture. Restored prairies have microbial diversity and soil organic carbon (SOC) that serves as a carbon storage, absorbing the carbon in the atmosphere and decreasing CO₂ levels. Analyzing the soil microbiome's response to restoration efforts provides insight to the extent and progress of restoration efforts taking place in the Nachusa Grasslands. We analyzed the microbial communities and geochemical content in soil samples from the Northern Illinois Nachusa grasslands to assess how these factors interrelate through the progress of restoration. We will present the results of our analysis on the soil microbiome and geochemical data and relate them to past studies to provide a report on restoration progress in the Nachusa Grasslands.

Project ID: BIO 13
8:55a.m. – 9:10a.m.

Title: FAV Intake's Effect on Kidney Filtration

Presenter: Ria Cherukuri

Mentor: Dr. Santosh Saraf, MD, University of Illinois at Chicago

Abstract/Project Intention:

This study analyzes the connections between reported diet, in terms of fruit and vegetable (FAV) intake, observed serum carotenoid values, and kidney function in people with sickle cell disease. An adequate FAV intake has a beneficial impact on kidney health, and people with sickle cell disease are at much higher risk of medical complications and early mortality if they also develop kidney disease. This study examines the possible effect of FAV intake on kidney health, confirmed by carotenoid levels. Carotenoids, pigments found in fruits and vegetables which are not easily digestible by the human body, are good biomarkers for measuring FAV intake. The self-reported FAV intake is compared with measured carotenoid values to validate the FAV intake and better understand if there is a knowledge gap between perceived and actual FAV intake. We will then compare FAV intake and measured carotenoid values with measures of kidney function (urine albumin concentration and estimated glomerular filtration rate). This study analyzes 3 levels of data from 20 participants with sickle cell disease in the Chicago area. The data collected includes self-reported surveys of FAV intake completed by each participant, blood samples to measure carotenoid concentrations, and measures of their kidney function.

Project ID: ENVR 05
8:55a.m. – 9:10a.m.

Title: Evaluating the Recycling Practices of Leading E-Cigarette Companies: A Focus on Philip Morris International and British American Tobacco

Presenter(s): Shivani Chirumamilla

Mentor(s): Dr. Robert K. Jackler, Stanford University

Abstract/Project Intention:

This study investigates the recycling practices of Philip Morris International (PMI) and British American Tobacco Company (BAT) in relation to their e-cigarette products, IQOS and VUSE, respectively. The research assesses the effectiveness of the companies' recycling programs by examining factors such as progress towards stated goals, user accessibility and awareness, and their impact on reducing waste. Despite the implementation of the "take back program" by PMI and the "repod" program by BAT, the study reveals several shortcomings in these initiatives. PMI is falling short of achieving its projected recycling goals for 2025 and generates substantial plastic and bioplastic waste that ends up in landfills. Similarly, BAT's recycling rate is consistently decreasing, while the overall waste disposed of by the company continues to rise. The findings suggest that these companies may be exaggerating their environmental efforts, and their recycling programs appear to be instances of greenwashing. The study concludes that the recycling initiatives of PMI and BAT have more shortcomings than successes, and the companies continue to claim they have effective recycling systems despite evidence to the contrary. Further research and more transparent reporting are necessary to accurately assess the environmental impact of these e-cigarette companies.

Project ID: BHVSO 01

8:55a.m. – 9:10a.m.

Title: Analyzing and Predicting Concussion Reporting Behaviors of student athletes

Presenter(s): Charles Conner

Mentor(s): Dr. Katherine Brown, Augustana College

Abstract/Project Intention:

Sports related concussion reporting is an area of study with high interest, as rates of concussion reporting are estimated to be around 50% for collegiate student athletes. Several factors are believed to contribute to underreporting of concussions among collegiate athletes. Some variables that have been studied are sport played, concussion education, sex, concussion attitudes and beliefs, pressure from teammates or coaches, symptom severity, and year in college. This study aims to study student athletes from a small, private college to understand the factors and variables that affect their concussion reporting behaviors.

A multinomial logistic regression model with cross validation was created to predict the probability of different levels of reporting outcomes: n reporting (reporting no head injuries), some reporting (reporting only some head injuries), and all reporting (reporting all head injuries) based on predictor variables. The purpose of this study is to understand the behavioral reasons why student athletes report or do not report concussions or other head injuries.

Project ID: BHVSO 09
8:55a.m. – 9:10a.m.

Title: Analyzing the Correlation Between the Absence of Linguistically Aligned Mental Resources and Adverse Teen Outcomes in Chicago Southside Neighborhoods

Presenters: Ashley Hernandez, Chiamaka Okoli

Mentor: Dr. Riley Tucker, University of Chicago

Abstract/Project Intention:

Chicago southside neighborhoods are systemically underfunded which limits opportunities for youth. The youth in these neighborhoods face the reality of having improper educational resources and the trauma that comes from gang violence within these neighborhoods. We have developed the following research question: Do Chicago neighborhoods have more negative teen outcomes when mental health resources aren't offered in the main language of the neighborhood?

A properly funded neighborhood offers individuals support that will set them up for success. As lower-income neighborhoods lack mental health resources among other inequities such as language barriers, this may lead to negative teen outcomes. In the current work, we created maps to visually examine whether there is a correlation between the areas where Latino adolescents reside in Chicago and the negative outcomes experienced by teens.

Additionally, publicly available data on current mental health resources will be analyzed, focusing on the languages offered. The anticipated results include insights into how language diversity influences a teen's access to services. In the future, survey data on teens ages 12 to 19 aiming to attain information on language prevalence within their neighborhoods would help us further understand the linguistic landscape and mental health support systems within communities.

Project ID: MEDH 12

8:55a.m. – 9:10a.m.

Title: Impact of Malate Dehydrogenase 2 Skin Epithelial Knockout on Basal Keratinocyte Proliferation

Presenter(s): Anisha Kolambe

Mentor(s): Ayasa Michii, Rui Yi, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

As a barrier to the external environment, the skin serves as the body's primary mechanism for physical and chemical defense, thermoregulation, and fluid retention. In both tissue homeostasis and wound repair, layers of skin form as cells migrate upward following proliferation and differentiation in the basal layer. Metabolism maintains physiological activity, with inhibited function in diseases such as diabetes leading to conditions like chronic wound healing. Malate dehydrogenase is the final enzyme in the citric acid cycle that converts malate to oxaloacetate, restarting the cycle. Utilizing Cre-Lox recombination, conditional knockout mice lacking epidermis expression of Malate Dehydrogenase 2 were compared to wild type mice for 30 days. Knockout mice expressed a severe impaired phenotype, notably smaller size, wrinkly skin, and damaged hair formation. Mouse back skin slide samples from P5, P7, P14, P20, and P30 were prepared in OCT compound for immunofluorescence utilizing EdU, Ki-67, and Phospho-histone H3 markers costained with Keratin 5 to investigate how impaired metabolism may affect stages of the cell cycle in the basal layer over time. Initial findings indicate higher levels of proliferation in knockout mice, with future work required concerning application and analysis with other techniques such as single- cell RNA sequencing.

Project ID: MEDH 24

8:55a.m. – 9:10a.m.

Title: Evaluation of Y2O3:Eu@SiO2 Nanoparticles as Photosensitizer for X-Ray Activated Photodynamic Therapy in Cancer

Presenter(s): Divya Brahmabhatt

Mentor(s): Chin-Tu Chen, Hannah Zhang, University of Chicago,
Department of Radiology

Abstract/Project Intention:

We are developing an innovative nanoparticle-based photosensitizer aimed at enhancing photodynamic therapy (PDT) for cancer, addressing key challenges such as low light penetration and oxygen deficit in tumors. We synthesized a new photosensitizer, Y2O3:Eu@SiO2, featuring a europium-doped yttrium oxide core within a silica shell, and assessed its properties and functionality through transmission electron microscopy (TEM) and dihydroethidium (DHE) assays. Our evaluation focused on the nanoparticles' ability to generate reactive oxygen species (ROS) and their impact on tumor growth, particularly in CAOV3 human ovarian cancer xenografts, using 18F-fluorothymidine positron emission tomography (18F-FLT PET). Findings highlighted a correlation between synthesis conditions—specifically incubation time and urea concentration—and the nanoparticles' size and capabilities of dispersing. We noted that adding cetyltrimethylammonium bromide (CTAB) during synthesis improved particle distribution, subsequently enhancing ROS generation. Our in vivo experiments in mice with intra-tumorally injected nanoparticles and radiation therapy of 2 Gy/day for 4 days demonstrated that Y2O3:Eu@SiO2 significantly limited tumor growth compared to the controls, emphasizing the nanoparticles' potential in targeting cancer cells more effectively. Our research shows the promise of Y2O3:Eu@SiO2 nanoparticles in overcoming conventional PDT limitations, offering a new direction in cancer treatment strategies.

Project ID: MEDH 21

8:55a.m. – 9:10a.m.

Title: Temporal aspects of novel thioredoxin glutathione reductase inhibitors

Presenter(s): Joseph Paras

Mentor(s): Dr. David L. Williams, Rush University

Abstract/Project Intention:

Despite being one of the most influential parasitic diseases in developing countries, schistosomiasis has historically been treated as an orphan disease. To date, one drug, praziquantel, exists for its treatment. However, praziquantel sees faults in its effects on juvenile worms and has been proven to be susceptible to developed resistance in schistosomes. Most current developments towards new treatment for schistosomiasis focus on the enzyme thioredoxin glutathione reductase (TGR) as a target, which is responsible for the majority of the parasite's redox defenses. This enzyme is responsible for the reduction of both thioredoxin and glutathione, processes usually performed by distinct enzymes in mammals.

Progress on developing a drug that targets TGR has produced several novel compounds. These compounds can be split into the categories of fast and slow inhibitors, with the former being active in vitro after 15 minutes of incubation and the latter taking upwards of 6 hours to show similar activity in vitro. In vivo, however, these slow inhibitors often act just as quickly or even more effectively than their fast counterparts. This paper attempts to address this inconsistency and utilize samples from schistosomes to create an environment in vitro to imitate this in vivo effect for ease of future testing.

Project ID: CMPS 08

8:55a.m. – 9:10a.m.

Title: Using Machine Learning to Determine Peptide Sequences with High Heme Binding Propensity

Presenter(s): Nathan Laud

Mentor(s): Dr. Chris Fry, Dr. Henry Chan, Argonne National Laboratory

Abstract/Project Intention:

Self-assembling peptides, or chains of amino acids that form various structures in response to environmental conditions, have a variety of uses in material science as well as biomedicine. These uses include drug delivery, or as drugs themselves. In material sciences, self-assembling peptides can be used to create materials with a variety of properties. Our work hopes to utilize machine learning to find patterns in peptide sequences to streamline material discovery.

Spectroscopy data was collected of 100+ synthesized peptide sequences on both visible and infrared spectra. These spectra were used to calculate values for heme-binding propensity and alpha-helix propensity. This data was organized, processed by smoothing and baselining the spectrograph graphs, and a dataset was created. A neural network was created which takes in the sequence of peptides as an input, and predicts the values for alpha helix propensity and heme binding propensity. This model was used to create new sequences with high predicted values of alpha helix propensity and heme binding propensity. We will synthesize these sequences and determine their true alpha helix and heme binding propensities using their spectra, to determine if a machine learning approach is viable for this application, or other material science applications in the future.

Project ID: CMPS 26
8:55a.m. – 9:10a.m.

Title: Cross-Species Word Recognition Using SVM-Based Cochlear Implant Coding Strategies

Presenter(s): Aria Barve

Mentor(s): Dr. Claus-Peter Richter, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

This study investigates the feasibility of using support vector machine (SVM) algorithms and other advanced classification techniques to decode neural responses from the guinea pig auditory system (inferior colliculus) while aiming to discern a spoken word processed by the animal. Utilizing multi-channel electrodes to record neural response patterns from the inferior colliculus of four guinea pigs, we develop SVM models to infer the uttered words. While our results are preliminary auditory signals. Integrating insights from this approach could inform the optimization of cochlear implant coding strategies for human recipients with hearing disorders. Future research endeavors will further refine and validate these SVM models and collect more neural response data from the guinea pigs, which will, indicating ongoing experimentation, initial findings suggest potential for SVM-based decoding of guinea pig ultimately contribute to advancements in cross-species neural communication and auditory prosthetic technologies.

Project ID: MEDH 18
8:55a.m. – 9:10a.m.

Title: Investigating the Effects of Light Exposure During Sleep and Circadian Rhythm in Adolescents and Young Adults

Presenter(s): Andrew Wong

Mentor(s): Phyllis Zee, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

This research investigates the impact of light on sleep and circadian rhythm in adolescents and young adults. Light serves as a primary regulator of circadian rhythms, influencing sleep-wake cycles and overall health. By synthesizing findings from various studies, we explore the effects of light intensity, duration, and wavelength on sleep patterns and circadian timing. Studies demonstrate a gradual shift towards later bedtimes during adolescence, potentially linked to changes in circadian timing. Furthermore, research highlights the differential sensitivity to light between pre- to mid-pubertal and late to post-pubertal adolescents, with shorter wavelengths of light exerting a more significant impact on circadian rhythm and sleep architecture.

Understanding these dynamics is crucial for designing interventions to promote healthy sleep habits and overall well-being in adolescents and young adults. To investigate our meta-analysis of prior studies, we distributed 50 actigraphy watches to Northwestern students, which tracked their sleep schedule and daily light exposure, in order to identify any variable conclusions or patterns. This investigation aims to contribute valuable insights into the role of light in shaping sleep patterns and circadian rhythms during critical developmental stages.

Project ID: CMPS 11
8:55a.m. – 9:10a.m.

Title: Human Body Detection with Occlusion

Presenter(s): Aditya Prashanth

Mentor(s): Dr. Changliu Liu, Mr. Rui Chen, Carnegie Mellon University,
Robotics Institute, Intelligent Control Lab

Abstract/Project Intention:

The purpose of this design experiment was to attempt to determine the accuracy/possibility of using extended Kalman filters (EKFs) to approximate a human's shoulder's location when occluded in a depth camera's point of view. The project was conducted entirely through code and avoided any human involvement/error. The outcome of this research project may result in more accurate measurements for human-body detection, potentially allowing robots to contribute to human goals without interference in real human-robot interaction environments.

This project consists of the following two different procedures: 1) design steps of solution, 2) testing final design iteration. To construct the solution to the project, the first procedure must be followed, but to test the solution, the second procedure must be followed. Each procedure is extremely descriptive, detailing the several steps to building, programming, and analyzing the design solution.

In conclusion, the problem statement was ultimately supported. Throughout all the data collected and graphs constructed, the extended Kalman filter's average mean-squared errors were consistently and significantly lower than those of the simulated observation (camera- perceived) data. The project's findings reveal the potential for the extended Kalman filter in real-world environments and its application to keypoints across the human body.

Project ID: CMPS 40
8:55a.m. – 9:10a.m.

Title: MMWave Reflections for Object Detection

Presenter(s): Jeffrey Yao

Mentor(s): Zihan Zhou, Matthew Caesar, University of Illinois
Champaign Urbana

Abstract/Project Intention:

This project explores the potential applications of millimeter-wave (mmWave) radar technology for object and activity recognition. Using a Texas Instruments radar wave card and several cases, the data retrieved demonstrates the capability of mmWave radar to distinguish between different objects. Mmwave is unique in the sense that it uses the reflection points of wifi-waves which are more adverse in their nature to collect data. The methodology feeding this into neural network models to interpret the unique "signatures" of various subjects. By analyzing the point cloud data generated by mmWave radar, which includes spatial coordinates, velocity, range, intensity, and bearing angle algorithms capable of recognizing eleven distinct object classes and several human activities, future research can be done for advanced applications in cyber-security, through device and keyboard recognition, and in automotive and pedestrian safety, by accurately identifying and tracking moving objects. MmWave radar technology is unique in its ability to penetrate adverse weather conditions and other obstacles yet still offer detailed spatial information, which presents a promising alternative to conventional imaging and sensing methods like other waves such as X- ray, ultrasonic, or magnetic.

Project ID: MEDH 30
8:55a.m. – 9:10a.m.

Title: Electron Paramagnetic Resonance Nanoradicals for quantitative intracellular tumor oximetric images

Presenter(s): Justina Kostiv

Mentor(s): Dr. Chin-Tu Chen, University of Chicago

Abstract/Project Intention:

In large solid tumors, a hypoxic core often indicates malignant progression, metastasis, and reduced responsiveness to chemotherapy and radiation. Personalized treatments can benefit from precise measurements of tumor oxygenation and reoxygenation of the tumor. Electron Paramagnetic Resonance Imaging (EPRI) along with an oxygen-measuring paramagnetic probe were used to assess tumor oxygenation in vivo. Triarylmethyl (trityl) radical has been known for its specificity, sensitivity, and resolution in quantifying oxygen concentration, but previous in vivo applications faced challenges from high dosage requirements, short half-life, and poor intracellular permeability. To overcome this, fluorescein isothiocyanate-labeled mesoporous silica nanoparticles (FMSNs) were developed as carriers. Their structure allows for efficient targeted delivery of the trityl radicals while providing protection against environmental degradation and dilution. The tumor-targeted nanoplatfrom was successfully designed and synthesized, without compromising oxygen-sensing capacity due to self-relaxation or broadening effects. FMSN-trityl exhibited high sensitivity to oxygen within a partial oxygen pressure range of 0 to 155mmHg. MSN-trityl demonstrated outstanding intracellular oxygen mapping in both in vitro and in vivo studies. The highly sensitive nanoformulated trityl spin probe enables real-time and quantitative profiling of intracellular tumor oxygen distributions using in vivo EPRI. MSN-trityl provides high-value oxygenation information for in-situ diagnostic imaging in potential clinical applications.

Project ID: PHYS 07

8:55a.m. – 9:10a.m.

Title: Analyzing the reactions $\bar{\nu}$ (cosmic ray) + ν (relic) \rightarrow $e^+ e^-$ and p (cosmic ray) + $\bar{\nu}$ (relic) \rightarrow $e^+ + n$ on their effects to the energy spectrum of cosmic ray neutrinos and protons

Presenter(s): Richard Chen

Mentor(s): Dr. Jen-Chieh Peng, University of Illinois Urbana Champaign

Abstract/Project Intention:

Relic neutrinos are some of the oldest particles in the universe, produced around 1 second after the big bang. Locating these relic neutrinos may help answer fundamental questions about the universe such as how it began. There have been attempts to study these relic neutrinos, with one proposed method being the KATRIN experiment. In our work, we hope to use high-energy cosmic rays as probes to detect relic neutrinos. We propose to analyze the reactions $\bar{\nu}$ (cosmic ray) + ν (relic) \rightarrow $e^+ e^-$ and p (cosmic ray) + $\bar{\nu}$ (relic) \rightarrow $e^+ + n$ on their effects on the energy spectrum of cosmic ray neutrinos and protons. We aim to investigate the effects of these two reactions on altering the energy spectra of cosmic neutrinos and cosmic protons. Through this study, we analyzed the feasibility of detecting relic neutrinos through a precise measurement of the energy spectrum of high energy cosmic rays. While the cross sections are extremely small, they will increase with increasing energy from cosmic rays. This provides that the highest energy cosmic rays will give the best chance at producing observable signals of relic neutrinos. By using high-energy cosmic rays, we might be able to detect a relic neutrino.

Project ID: PHYS 18

8:55a.m. – 9:10a.m.

Title: Parametrization of Doubly Charged Higgs Signal for Use in Unbinned Likelihood Fits

Presenter(s): Albert Han

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The doubly charged Higgs boson is part of a Beyond Standard Model theory that aims to explain the left-right asymmetry of the Standard Model through the introduction of a right-handed gauge group. The doubly charged Higgs boson arises from the spontaneous symmetry breaking caused by the right-handed gauge group. Pair-produced doubly charged Higgs bosons decay to two same-sign dilepton pairs, our signal for this analysis which we will be searching for in the CMS detector at the LHC. The purpose of this study is to determine a parametrization that models the observed distribution of the invariant mass doubly charged Higgs. A separate parametrization was created for each decay channel. In addition, an unbinned likelihood fit was created that is able to determine the most likely value of the invariant mass of the doubly charged Higgs using signal and background parametrizations to fit the data. The generated parameterizations will be used in the unbinned likelihood fit that will be able to determine the most likely invariant mass of the doubly charged Higgs or set a limit on the mass of the doubly charged Higgs.

Project ID: CHEM 12

8:55a.m. – 9:10a.m.

Title: Synthesis of amide derivatives as preclinical drug candidates for Visceral Leishmaniasis

Presenter: Mila Wolkowitz

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Visceral Leishmaniasis (VL) is a lethal protozoan disease caused by numerous species of the Leishmania genus, manifesting symptoms like fever, spleen and liver enlargement, progressive weight loss, and anemia. In this experiment, three potential VL drug amide derivatives were synthesized using multiple coupling agents and methods. The objective of each trial was to isolate a compound effective in treating Leishmaniasis caused by the species Leishmania (L.) dovani and L. infantum, which will be tested by the Drugs for Neglected Diseases Initiative (DNDi) organization. The first two trials utilized DMAP and EDCI coupling agents and physical homogenization, while the third trial necessitated pyridine and a heated homogenization process. The first two trials reacted 3-fluorobenzoic acid with 2-amino-5-chlorobenzoxazole, and 3(trifluoromethyl)phenylacetic acid with 2-amino-5-chlorobenzoxazole, respectively—the third trial employed pyridine-2-carbonyl chloride HCL and 2-amino-5-chlorobenzoxazole. After synthesis, products were isolated through a separatory funnel and dried over sodium sulfate. Purity testing using thin-layer chromatography with a 1:1 hexane and ethyl acetate solvent ratio was conducted, followed by silica gel column chromatography with a 3:1 hexane to ethyl acetate ratio for product determination and isolation. Infrared spectroscopy confirmed the presence of each compound. The synthesized compounds will be delivered to DNDi's laboratory for efficacy, based on surface area polarity, cytotoxicity, and Leishmania activity.

Project ID: PHYS 27

8:55a.m. – 9:10a.m.

Title: Analyzing PDF Uncertainties of Doubly Charged Higgs Boson Backgrounds

Presenter(s): Shrikar Dulam, Cameron Eddington

Mentor(s): Dr. Peter J. Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Parton distribution functions (PDFs) inform the behavior of particle interactions, but since they are experimentally determined, understanding their impact on simulation is crucial to take into account.

In this experiment, we focus on how PDFs impact the background estimates of particle simulations. We analyzed 100 different PDF weight sets on the background involved in doubly charged Higgs interactions, such as ZZ decay and Drell-Yan. By adjusting the weights of the same-sign lepton mass histograms, we can better understand the impact of PDF uncertainties, enhancing the precision of simulated backgrounds and boosting sensitivity in searches for the doubly charged Higgs boson. This relationship underscores the importance of merging theoretical frameworks with innovative analysis techniques for advancing particle physics research.

Project ID: ENGN 05

8:55a.m. – 9:10a.m

Title: Carbon Fiber Instrument Crafting

Presenter(s): Carter Poskozim, Max Schwartz

Mentor(s): David Hernandez, Illinois Mathematics and Science Academy

Abstract/Project Intention:

This experiment seeks to determine whether carbon fiber is a viable alternative to brass, wood, or nickel in woodwind construction. The benefits of using carbon fiber include weight reduction, rigidity, and price reduction when mass-produced, resulting in access to affordable instruments for the underprivileged. The primary downside and reason that this is the first saxophone of its kind is that carbon fiber does not shape or tune like its brass or wood counterparts. We constructed a conical tube with a bell and a tone hole, and when paired with a tenor saxophone neckpiece, the instrument should be capable of playing four notes, two down the octave and two up. Many different mold types were tested, with the best solution being an interior 3D-printed mold that chips away when exposed to high temperature and pressure, applied during the second phase of production: autoclaving the instrument. Autoclaving also removes impurities from the resin coating on the carbon fiber. Post autoclave, excess resin and fiber are filed off of the horn, also forming the tone hole that is strategically placed during the molding process. The result is a functioning instrument capable of playing four notes.

Project ID: CHEM 07

8:55a.m. – 9:10a.m.

Title: Synthesis of Novel Medicinal Compounds Against Leishmaniasis

Presenter(s): Hagen Arriaga, Daniel Cano

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a parasitic disease primarily affecting poverty-stricken tropical and subtropical regions, including Africa, Latin America, the Middle East, and southern Asian countries. It is the second most prevalent and deadly parasitic disease after Malaria. Current treatments and therapies are becoming ineffective, causing a high demand for safe and low-cost oral treatments. A recent development for such treatment comes from a new HIT molecule, OSN Project 5 (DNDI0003202883) or 5-chloro-1,3-benzoxazol-2-amine. Our research uses the benzoxazole chemotype to develop new medicinal compounds suitable for biological testing. Our synthesizing of compounds helps target/eliminate potential/faulty medicinal compounds that we can then communicate through our research the results for more experienced chemists to work from and help develop the steps for a global medical movement to aid against NTDs. Our collective aim is to create a low-cost, easy-to-manufacture, and effective cure for Visceral Leishmaniasis that cuts through the inequity of current treatments and is easily accessible to the globe.

Project ID: CMPS 42
8:55a.m. – 9:10a.m.

Title: Multi-Input Image-to-Image Diffusion Model for Font Style Translation

Presenters: Georgi Panchev, Advayth Pashupati

Mentor: Dr. Ashwin Mohan, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Many attempts have been made to use generative artificial intelligence—neural networks that create new text or images given inputs of the same type—to synthesize characters or entire fonts from a few characters. Previous studies have used glyph (individual strokes that make up characters) detection and conjunction to create these characters but fell short in connecting the glyphs to reproduce characters. A few recent studies have used AI diffusion models to try and accomplish the same. However, these models could only input Scalable Vector Graphics (SVG) images, leaving raster image formats such as Portable Network Graphics (PNG) images unusable. Additionally, these models were unable to create characters that look like lowercase letters, like the symbol for the Vietnamese dong, when given single-case fonts. Here, we have developed an image-to-image diffusion model, with a structure based on the one in IIDM: Image-to-Image Diffusion Model for Semantic Image Synthesis, to bypass the issues of glyph joining and file type limitations. Our model takes into account both a style input and a structure input, which enables us to create lowercase characters unhindered. We will present results about how accurate our model is and how it compares to other models, both diffusion and non-diffusion.

Session II - 9:20a.m. – 9:35a.m.

Project ID: CHEM 04

9:20a.m. – 9:35a.m.

Title: Chemical Synthesis of a Lysyl Oxidase-Based Probe for Positron Emission Tomography Imaging of Tumors

Presenter(s): Rushina Patel

Mentor(s): Dr. Satish Chitneni, Dr. Atchimnaidu Siriki, University of Chicago

Abstract/Project Intention:

The Lysyl oxidase family of enzymes (LOXF) plays a critical role in tumor progression by promoting extracellular matrix remodeling, epithelial-mesenchymal transition, and angiogenesis. Upregulation of LOXF, particularly lysyl oxidase (LOX) and lysyl oxidase-like 2 (LOXL2), is observed in hypoxic tumor microenvironments and is associated with increased invasiveness and metastasis. In this study, we report the chemical synthesis of a probe, termed "LOXi," for non-invasive imaging of LOXL2 expression in tumors using positron emission tomography (PET). The compound is designed to selectively bind to the active site of the LOXL2 enzyme in tumors. We hypothesize that radiolabeling the compound with a positron-emitting radioisotope, such as carbon-11 (^{11}C , half-life = 20 min) or fluorine-18 (^{18}F , half-life = 110 min), will enable PET imaging of LOXL2 expression levels in cancers in living subjects non-invasively, thereby providing a valuable tool for monitoring tumor progression and response to LOXF-targeted therapies. Further development of radiolabeled derivatives of LOXi could enable clinical translation for imaging and therapeutic targeting of LOXF in cancer patients.

Project ID: BIO 11
9:20a.m. – 9:35a.m.

Title: Mechanism Exploration and Screening for Drug Resistance Induced by SAM-RNA in Breast Cancer

Presenter(s): Lily Zhang

Mentor(s): Hui Zhang, Tong-Chuan He, University of Chicago
Biological Science Division

Abstract/Project Intention:

Some patients who are initially sensitive to such chemotherapy and endocrine therapy quickly develop acquired drug resistance. We aim to explore the molecular changes and potential regulatory mechanisms during the acquisition of chemotherapy and endocrine therapy resistance in breast cancer, or further to find molecular indicators that can be used to early predict the occurrence of drug resistance or efficacy evaluation. Various biological assays, such as crystal violet staining, flow cytometry, Hoechst staining, and real-time PCR will be utilized to comprehensively evaluate the effects of Sam RNA overexpression on cellular processes and functions associated with breast cancer cell lines. Signal pathways involved in tamoxifen-resistant and paclitaxel-resistant will be analyzed by Exon sequencing and Transcriptome sequencing. In vivo tests will be done by using mouse tumorigenesis models. Molecular cloning was used to construct a retroviral expression library containing 19 random bases (N19), namely short artificial modulatory RNA (SAM-RNA) synthesized by chemical approach and amplified by PCR. The library diversity and properties were evaluated by PCR, whole genome sequencing. Based on N19 library results, stable cell lines expressing SAM RNA1 and SAM RNA7 were constructed by pseudotyped retroviral vectors. Tamoxifen-resistant and paclitaxel-resistant cell lines expressing SAM RNA1 and SAM RNA7 were constructed.

Project ID: BIO 16
9:20a.m. – 9:35a.m.

Title: The Interactions Between Proteins and Automating Predictions with Mass Spectrometry

Presenter(s): Vedanti Joshi

Mentor(s): Dr. Kevin Drew, University of Illinois at Chicago

Abstract/Project Intention:

This research aims to explore the impact of local geometric constraints on the conformations of amino acid side-chain dihedral angles in proteins. The understanding of the fundamental principles that govern protein structure is essential for the development of new proteins and the analysis of mutations in natural proteins. Our specific objective is to quantify the influence of geometric and physicochemical properties on the selection of dihedral angle combinations by amino acid side chains in peptides and proteins. Despite significant progress in structural biology, the reasons behind the prevalence of certain side-chain dihedral angle combinations and the scarcity of others remain unclear. Through the use of computational methods and the analysis of protein structures, we aim to unravel the intricate relationship between local geometry and side-chain conformations. This research contributes to the ongoing efforts to enhance our knowledge of protein structure and function, potentially benefiting protein engineering and drug design endeavors.

Project ID: ENVR 03
9:20a.m. – 9:35a.m.

Title: Temporal Dynamics of Water Stable Aggregates and Carbon Sequestration in Continuous Corn and Corn-Soybean Rotation Systems in Illinois

Presenter(s): Joshua Lee

Mentor(s): Pei-Chen Lee, Andrew J. Margenot, University of Illinois
Champaign Urbana, Department of Crop Sciences,

Abstract/Project Intention:

Aggregates are an important indicator of soil fertility, playing a crucial role in stabilizing soil structure and sequestering soil organic carbon (SOC). Research indicates that factors such as crop rotation and cultivation years can impact aggregate stability and SOC sequestration. However, there has been a lack of information on how these factors could influence the stability and SOC concentration of aggregates under long term cultivation. While some studies have found corn- soybean system reduced the aggregates stability and carbon sequestration compared to continuous corn system, other studies shown higher aggregate stability when incorporating soybeans into young cropping system. These findings suggest that while corn-soybean system may initially increase aggregate stability, the carbon sequestration may not sustain over the long term.

To further explore aggregates stability and SOC sequestration, this study employs aggregate fractionation and stable isotope ^{13}C analysis to compare the distribution and temporal changes of water-stable aggregates in paired continuous corn and corn-soybean systems soils. Additionally, using isotopic measurements, this study aims to quantify soybean-derived carbon storage in stable aggregates over time in corn-soybean systems, contributing to estimating soil carbon sequestration.

Project ID: BHVSO 05
9:20a.m. – 9:35a.m.

Title: Transgender and Gender-Diverse Youths' Fertility knowledge in the context of Pubertal Suppression Treatment

Presenter(s): Luke Mauk

Mentor(s): Diane Chen, PhD, Anna Rose Peck-Block, LCSW
Ann & Robert H. Lurie Children's Hospital,
Northwestern University, Feinberg School of Medicine,
Briahna Yuodsnukis, PhD, University of Illinois at Chicago

Abstract/Project Intention:

Gonadotropin-releasing hormone agonists (GnRHa), also known as “puberty blockers”, are used in early pubertal transgender youth who are looking to pause puberty as treatment for gender dysphoria. With pursuing GnRH agonists, the maturation of germ cells does not occur. Without germ cell maturation, future fertility is impaired. Earlier studies have focused on an older cohort of transgender and gender diverse (TGD) adolescents and their parents, but no studies have focused on what the younger cohort of TGD youth know about GnRHa and their effects on fertility. We conducted 10 interviews of TGD youth ages 9-13 to answer 4 major questions: (1) what do TGD youth understand about fertility?; (2) what do TGD youth understand about how pubertal suppression treatment works?; (3) what do TGD youth understand about how pubertal suppression treatment affects fertility?; and (4) what do TGD youth think about future family planning? Interviews were analyzed using directed content analysis. Findings suggest participants lacked a comprehensive understanding of fertility. Youth presented a basic understanding of pubertal suppression but demonstrated variable knowledge of how pubertal suppression treatment affects fertility. Participants generally knew what types of families they wanted in the future. Our findings suggest that there is a need for developmentally informed education and decision-making resources for TGD youth and their parents.

Project ID: BHVSO 10
9:20a.m. – 9:35a.m.

Title: Effects of Gender on Persistence and Performance in STEM Classes at the Illinois Math and Science Academy

Presenter: Laasya Nagumalli

Mentor: Dr. Yana Gallen, University of Chicago

Abstract/Project Intention:

Research into the gender gap in STEM achievement at the collegiate and high school level has shown peer groups to substantially impact performance and retention in advanced STEM classes, particularly affecting the uppermost echelon of achievement groups. This project uses records of student grades from 2009 to 2018 to determine what factors significantly influence the performance of female students in mathematics, physics, computer science, and chemistry courses when measured against their male peers at the Illinois Mathematics and Science Academy. Regression analysis of student grade points based on course subject, gender proportions of course make up, performance in relevant introductory level courses, and comparative performance in English courses were run, producing statistically significant results. Female students perform worse than male students in advanced courses overall, but this difference is largely driven by course selection. Controlling for course name and year, female students perform similarly to male students. However, when controlling for introductory math and English grades, the gender gap in advanced course grades re-emerges, suggesting that female students of higher overall initial ability take advanced courses relative to male students. These patterns are driven by mostly male courses where the gap is three times as large as the overall gap.

Project ID: IND ST 01

9:20a.m. – 9:35a.m.

Title: John Rawls : Foundation of Modern Liberal Political Thinking

Presenter: Karla Sanchez

Mentor: Dr. Lee Eysturlid, Illinois Mathematics and Science Academy

Abstract/Project Intention:

This poster delves into the seminal contributions of John Rawls to modern liberal political thought. Rawls' works, particularly "A Theory of Justice," significantly shapes contemporary political philosophy, creating the foundation for discussions on justice, equality, and the role of the state. Through an examination of Rawls' principles of justice, the veil of ignorance, and original position, this poster will explain the enduring impact of his ideas on political theory and practice.

Project ID: RISE 01
9:20a.m. – 9:35a.m.

Title: Utilizing Artificial Intelligence and Single-Cell RNA-seq Data for the Investigation and Discovery of Novel Genetic Biomarkers in Age-Related Macular Degeneration

Presenter: Ibrahim Arif, 10th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Mr. Will DeGroat, Rutgers Institute of Health,
Mr. Safdar Zaman, Microsoft
Dr. Linsey Mao Ph.D, Benedictine University

Abstract/Project Information:

Age-related macular degeneration (AMD) is a progressive neurodegenerative eye disorder characterized by eventual degeneration of the retinal pigment epithelium (RPE) leading to permanent vision loss. Artificial intelligence (AI) and machine learning (ML) have revolutionized healthcare by advancing clinical diagnosis leveraging its ability to analyze vast amounts of patient data and accurately predict future outcomes. With no definitive treatment for AMD, this experiment located novel genetic biomarkers, utilizing *Hygieia*, an open-source AI/ML pipeline to more comprehensively understand AMD's etiology for potential treatments and assess the performance of this model in diagnosing AMD. A gene expression dataset was downloaded from the Gene Expression Omnibus (GEO) database. Differential gene expression analysis was performed to identify significant differentially expressed genes (DEGs) between case and control retinal samples. AI/ML analysis was performed using *Hygieia* to identify statistically significant genes. Gene ontology analysis was performed and a classifier was constructed to analyze the prediction performance of the genes in diagnosing AMD. Results were compared with current literature. The data from this experiment supported earlier findings linking RPE dysfunction and concurrent inflammatory mechanisms in AMD's pathogenesis. Low p-values were obtained from the Chi-Square test for *SLC1A4* ($p < 0.001$), *BCS1L* ($p < 0.001$), and *SNHG17* ($p < 0.001$) which were proposed as novel biomarkers that, with further research, may contribute to a more complete understanding of AMD's etiology for treatment, and lead to earlier diagnosis of AMD. This experiment elucidated that AI/ML technologies can contribute significantly to identifying biomarkers and predicting disease.

Project ID: RISE 06 (poster only)

Title: The Effect of Various Fin Designs on the Stability, Apogee, and Drag of Model Rockets to Maximize Efficiency

Presenter: Varun Nagaraj, 10th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Mr. Gary Kawabata, Tripoli Rocketry Association,
Dr. Sachin Gogate (PhD), Pratt & Whitney,
Dr. Vivek Krishnan (PhD), 3M Co.

Abstract/Project Information:

The purpose of this experiment was to ascertain if different fins for model rockets impact their stability, apogee and drag in order to provide an optimal design for new rockets. This experiment addresses a current gap, a lack of research into the physical components of rockets. Using the OpenRocket software, three different model rockets were designed. These were then built physically and were launched multiple times, both physically and in simulations, to collect data. Then, the data were analyzed to find the differences between the performances of each of the fins, and determine which fins maximized the efficiency of the rocket. Overall, the data showed fairly consistent results with clear differences in the experimental and control groups. In the data from simulated launches, the Analysis of Variance (ANOVA) showed statistically significant results with p values below 0.0001, meaning that the null hypothesis is rejected and that the experimental hypothesis is supported. The null hypothesis is rejected due to the higher reliability of the data from the simulated data set. This shows that there is significant difference in the performance of the three fin models and that the control group's fins can be used to optimize the performance of rockets today.

Project ID: MEDH 09
9:20a.m. – 9:35a.m.

Title: Visual Tests as a Proxy for Top-Down Processing Evaluations in Cochlear Implant Patients

Presenter(s): Kannan Ilamparithi

Mentor(s): Claus-Peter Richter, Northwestern University

Abstract/Project Intention:

Cochlear implants have benefited hearing-impaired patients by providing a medium through which they can perceive sound. However postoperative dissatisfaction remains an issue amongst a significant proportion of patients. Studies suggest that patient dissatisfaction may be attributable to a lower top-down processing ability amongst certain patients with cochlear implants. However testing their processing ability is difficult considering that patients with cochlear implants are hearing impaired, and therefore cannot reliably take a hearing test to measure processing ability. This study aims to determine if a series of visual tests designed to test individuals ability to interpret scrambled information are a potential method that could be utilized to determine patients top-down processing ability in relation to auditory stimuli. These tests will be administered to subjects with and without cochlear implants to determine whether visual top- down processing ability can accurately assess auditory top-down processing capabilities amongst patients.

Project ID: CMPS 12
9:20a.m. – 9:35a.m.

Title: Random Forest In Options Pricing

Presenter: Shruthi Vasudevan

Mentor: Ellen Taylor-Lubrano, CBOE Global Markets

Abstract/Project Intention:

The main objective of this research was to explore the integration of machine learning algorithms, particularly the Random Forest Regressor model utilizing decision trees, in enhancing the Black-Scholes Model for options pricing within the financial industry. Machine learning is becoming more prevalent in the financial sector, so this research gives more insight into how it is directly applicable in the derivative market. Once the model was trained and tested on a 2013 data set, the random forest model yielded a residual squared value of 0.97. This indicates that the model is mostly accurate in predicting the options price from that data set. The quality of the model depends entirely on the quality of its data, so the next steps would be to collect more real time data and train the model. This model offers the advantages of the traditional Black-Scholes equation while also addressing its limitations. Unlike the Black-Scholes model, it considers various factors such as both European and American options, doesn't assume constant volatility, and could provide flexibility with cash flow by incorporating dividend values from additional datasets as input.

Project ID: CMPS 28
9:20a.m. – 9:35a.m.

Title: CARENET—A Clinical Analysis and Reporting Enhancement Network

Presenter(s): Shashi Salavath

Mentor(s): Theresa L. Walunas, PhD, Northwestern University

Abstract/Project Intention:

In recent years, immune checkpoint inhibitors (ICIs)—developed primarily from the knowledge of T- cell immunoreceptor (TCR) signaling—have revolutionized the treatment of various cancers, offering newfound hope to patients. However, their usage is associated with a considerable incidence of immune-related adverse events (irAEs). While ICI-induced blockage of TCR inhibitory signaling pathways can successfully bolster anti-tumor immune response, it remains that as much as 40% of patients suffer irAEs in some capacity during treatment. These adverse effects range from manageable conditions like gastrointestinal irregularity to severe, life-threatening complications such as colitis and pneumonitis. With the delay of immunotherapy occurring in up to 73% of patients as a result of irAEs, accurate phenotyping and early detection of these adverse effects are critical for timely intervention. To rise to this pursuit, we introduce the Clinical Analysis and Reporting Enhancement Network, or CARENET. A HIPAA-compliant proactive monitoring aid in clinical environments, CARENET utilizes advancements in Natural Language Processing (NLP) and knowledge representation to provide electronic health record (EHR) data-driven insights for commencing or in-progress ICI treatments. By utilizing vast repositories of data and providing answers to practitioner inquiries via powerful, detailed human-computer interaction (HCI), CARENET improves patient outcomes by enabling faster, more informed clinical treatment decisions.

Project ID: CMPS 18
9:20a.m. – 9:35a.m.

Title: Media Influence and Public Opinion in the 2023 Israel-Hamas Conflict

Presenters: Michael Granger, Ryan Li

Mentors: Courtland VanDam, Rohan Leekha, MIT Lincoln Laboratory

Abstract/Project Intention:

Following the Hamas invasion of Israel on October 7th, 2023, there has been a significant increase in media coverage of the Israel/Hamas conflict. Given the risk of extreme polarization and the inherent unpredictability of the internet, the aim of this research is to perform a detailed examination of how media influences public perception and reaction in the context of a recently intensified conflict. We utilize various Natural Language Processing (NLP) techniques, including topic modeling, sentiment analysis, and bias detection, to analyze news articles surrounding the conflict, as well as user comments on said news articles.

Our analysis reveals a difference in topic, sentiment, and bias of news media following the October 7th invasion of Israel. Results suggest a modest correlation between media content sentiment and public sentiment, particularly with negative emotions, suggesting a deeper psychological engagement with such content. We also find that media with a negative tone garners the most engagement from users, which further supports a potential negativity bias for individuals consuming media. Lastly, we find that media which discusses violent topics, such as terrorism/Hamas activities, evokes significantly more negative user responses as opposed to media discussing more civilized topics, such as foreign policy and protests.

Project ID: CMPS 20
9:20a.m. – 9:35a.m.

Title: Enhancing Stroke Rehabilitation through a Deep Learning-Enabled Wearable Sensor and a User-Friendly GUI

Presenter: Ethan Remedios

Mentor: Dr. Hongchul Son

Abstract/Project Intention:

Stroke rehabilitation faces significant hurdles in providing continuous, real-time care, particularly outside clinical settings. Traditional approaches, while beneficial, are hampered by their intermittent nature and lack of personalized, real-time monitoring. Addressing this gap, this research is the introduction of a wearable sensor technology, designed as a user-friendly bracelet. This device leverages advanced cross-modal deep learning techniques, including variational auto-encoders and training-data augmentation, to offer precise, real-time estimations of joint kinematics, thereby facilitating continuous monitoring and personalized care for stroke survivors.

The sensor's integration with a custom Graphical User Interface (GUI) enables patients and healthcare providers to effortlessly interact with the device, monitor progress, and adjust rehabilitation strategies accordingly. This novel approach not only promises to enhance the accuracy and reliability of patient monitoring outside clinical environments but also aims to significantly improve the quality of life for stroke survivors by ensuring ongoing support and care. The potential societal and economic benefits derived from reducing the impact of stroke-related disabilities further underscore the value of this research. By bridging the existing gaps in stroke rehabilitation, this project paves the way for a new era of patient-centered care, marked by enhanced recovery outcomes and greater accessibility to effective rehabilitation methods.

Project ID: MATH 01

9:20a.m. – 9:35a.m.

Title: Characterizing the H-Orbit Decomposition of the Symmetric Spaces for the Special Orthogonal Group over a Finite Field in Dimension 3

Presenter: Andrew Katson

Mentor: Ellen Ziliak, Benedictine University

Abstract/Project Intention:

In this paper, we characterize the General and Extended Symmetric Spaces of the Special Orthogonal Group of 3 by 3 matrices over a finite field. Specifically, we use the fixed point group H to partition the sets of matrices that are unipotent, semisimple, or both in the Generalized Symmetric Spaces of $SO(3, F_q)$.

Project ID: MEDH 31

9:20a.m. – 9:35a.m.

Title: Assessing the Impact of Glasgow Coma Scale (GCS) Score Transitions in the First 24 Hours on Clinical Outcomes in Patients with Traumatic Brain Injury (TBI)

Presenter(s): Haley Shah

Mentor(s): Ali Mansour, University of Chicago

Abstract/Project Intention:

Traumatic Brain Injuries (TBI) pose a substantial global health threat, representing a significant contributor to mortality rates worldwide. TBI is brain damage caused by external force, with varying severity from mild to severe, which can be classified using the Glasgow Coma Scale (GCS). This study aims to investigate the impact of GCS score transitions of penetrating and severe TBI patients from time of admittance to after 24 hours. Data from the Medical Information Mart in Intensive Care (MIMIC)-IV V2.2, at Beth Israel Deaconess Medical Center, was used to run analysis on admission characteristics of TBI patients. Two separate logistic regression models were fitted: one for mortality and one for dispositional outcome. Each model compared data of various patient variables such as Glasgow Coma Scale (GCS), ICU length of stay (LOS), age, gender, and race on the mortality and dispositional outcome of traumatic brain injury (TBI) patients. The data analysis supported that the odds of unfavorable conditions of dispositional outcome and mortality decreased by a factor of 0.136866 and 0.397105 respectively for every one unit increase of GCS. These findings provide crucial insights for enhancing clinical strategies and optimizing care for TBI patients within hospital settings.

Project ID: ENGN 10
9:20a.m. – 9:35a.m.

Title: Silver-infused Egg Albumin for Water Purification

Presenter(s): Patrick Cahill, Joshua Solone, Megan Vanhoof

Mentor(s): Dr. Mark Carlson, Illinois Mathematics and Science Academy

Abstract/Project Intention:

According to the World Health Organization, approximately 2 billion people are at risk of disease and death due to waterborne bacteria. Existing purification methods are costly, unreliable, or intended only for emergencies. We seek an affordable system that reduces bacterial contamination by 90%, provides 40 liters per day, and costs less than \$20 annually. Biological proteins with disulfide linkages allow Ag⁺ to intercalate yet remain germicidal. Disks of egg albumin and intact bone marrow were investigated with the egg showing promise. A fine mesh constrained the egg patty at one end of a PVC tube while a gravity-fed solution of E. coli percolated through. Timed volume collection and colony counts were performed to assess performance. The flow rate from our current prototype, 600 ml/hr, is below the target. Work is ongoing to increase the flow using greater reservoir height without compromising the structural integrity of the egg patty and the killing efficiency, currently greater than 90%. Although the unit production cost is reasonable, it remains to be annualized. Before the device could be deployed in the developing world, its longevity would have to be assessed.

Project ID: PHYS 19

9:20a.m. – 9:35a.m.

Title: H⁺⁺ electron cuts and Z veto

Presenter(s): Catherine Jenks

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The doubly charged Higgs boson is a Higgs-like scalar particle that arises in certain extensions of the Standard Model. In a search for the H⁺⁺ particle at the CMS experiment at the Large Hadron Collider (LHC) we investigate the decay of the H⁺⁺ particle in the context of the left-right symmetric model (LRSM) so that we might reconstruct collected data to set mass limits on the Higgs. For Higgs reconstruction we test a minimum p_T cut for electrons from 5 to 35 GeV and find that the 10 GeV cut yields the highest efficiency. We test this minimum p_T cut against 12 different electron cuts and find none of these cuts to have a better performance. We also test a Z veto cut for same sign lepton pairs with invariant mass between 76 and 106 GeV which we find to boost performance.

Project ID: CHEM 10

9:20a.m. – 9:35a.m.

Title: Leishmaniasis and its Potential Treatments Through Synthesis and Computation

Presenter(s): Brayden Lindstrom, Torin Schroeder, Dylan Xianto

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

We are investigating a series of potential cures for the neglected tropical disease Leishmaniasis through both lab-synthesized compounds and computationally derived molecules. Leishmaniasis is a disease endemic to much of the developing and undeveloped world and caused an estimated 30,000 to 50,000 deaths in the past year alone. Despite its widespread nature, current Leishmaniasis treatments are not fully effective, with toxic side effects or inability to counter certain strains of the disease. Thus, our aim is to follow leads from the Drugs for Neglected Diseases Initiative (DNDi) and develop potential cures for Leishmaniasis based on these leads. To do so, we both synthesize molecules labeled as potential treatments to send to a lab associated with the DNDi for further clinical trials and discover more treatments through the creation of molecules and calculate their ability to inhibit Leishmania proteins using the SeeSAR program. Our group has synthesized seven unique compounds from the DNDi lead and discovered two other potential leads computationally.

Project ID: PHYS 28

9:20a.m. – 9:35a.m.

Title: Analyzing Charge Measurement Rates of Higgs Events to Estimate Systematic Uncertainty on a Search for the Doubly Charged Higgs Boson

Presenter(s): Maya Kannan, Anwita Kasturi

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Charge flips occur due to mismeasurement of electrical charge of a particle by a particle accelerator. The doubly charged Higgs boson needs to decay into two leptons with the same charge and therefore, it is crucial that the charge of the leptons is measured accurately. Utilizing data from CMS at the LHC, a program was written which counts the number of charge flips of a specific interaction. The algorithm analyzes pairs of electrons and pairs of muons and checks if there was any change in the electric charge. The algorithm outputs the number of charge flips in electron pairs and muon pairs, the number of pairs that did not have any charge flips, as well as the total number of events.

Project ID: ENGN 01
9:20a.m. – 9:35a.m.

Title: Hydrogen Combustion in Industrial Decarbonization for energy and Emissions-Intensive Sectors

Presenter(s): Samuel Biruduganti

Mentor(s): Joochan Kim, Argonne National Laboratory

Abstract/Project Intention:

The research aimed to characterize hydrogen as a potential sustainable energy source for decarbonization. The first phase involved conducting a literature review that outlined the chemical and physical properties of the fuel and its end-use applications in emissions-intensive industries. The second phase involved conducting zero-dimensional and one-dimensional flame simulations through Python scripts using Cantera software to understand the characteristics of hydrogen fuel in combustion compared to natural gas. The phase was then expanded to utilize three-dimensional computational fluid dynamics simulation to characterize a four-stroke hydrogen engine combustion. The CONVERGE software was used for the simulation. Based on the simulation results, the hydrogen engine combustion characteristics were analyzed. Through the one- to three- dimensional simulations, the feasibility of hydrogen engines has been comprehensively investigated from fuel properties to combustion characteristics. The research concludes that hydrogen as a carbon-free fuel has an advantage in terms of carbon emissions and energy efficiency. However, it poses challenges through its low density, high diffusivity, and high laminar flame speed, potentially leading to leakage and explosion, necessitating safety measures like compression, leakage detection, and valve reinforcement.

Project ID: CHEM 17

9:20a.m. – 9:35a.m.

Title: Developing Novel Therapeutics for Leishmaniasis

Presenter(s): Pruschothum Sureshkumar

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a parasitic disease endemic to tropical and subtropical regions around the world, and can cause severe harm or even death if untreated. Due to a lack of effective and affordable therapeutic methods, development of a treatment that fulfills both of these criteria is of the utmost importance.

Due to the disease's variability, many species, and treatment resistance, a potent cost-effective treatment is difficult to develop, leading to our research focus. Our experiment focused on synthesizing the analogs of the hit compound DNDI0003202883. The analogs incorporate crucial modifications around the aromatic ring, allowing the analysis of the compound's SAR. The compounds identified in this study retained the advantageous physicochemical properties of the hit compound. These analogs add to the knowledge toward the development of a novel leishmaniasis treatment and the compound class as a whole warrants further research.

Project ID: CMPS 32
9:20a.m. – 9:35a.m.

Title: Custom Optimizations of Quantum Gate Reductions with ZX-Calculus

Presenter(s): Nishna Aerabati

Mentor(s): Dr. Robert Rand, University of Chicago

Abstract/Project Intention:

Quantum circuit gate and depth optimization is important for improving accuracy and reducing errors when running quantum computations on quantum computers. Current quantum optimization uses a number of algorithms, and heuristic brute force methods to find equivalent circuits for quantum gates. Gate reduction minimizes the chance of quantum states deteriorating into mixed states, leading to better performance and fidelities. ZX-calculus is a graphical language that utilizes linear maps to represent circuits. ZX Calculus has applications in surface codes, quantum verification, and graph state descriptions. ZX-calculus includes rewrite rules that cause gate decompositions, leading to further optimization.

This research aims to benchmark and analyze the differences in quantum gate reduction for different ZX Calculus optimization algorithms and implement custom ZH rules for Toffoli decomposition. ZH-calculus is similar to ZX-calculus, and focuses on the Z and the H gates. In ZH-calculus, Z and H gates are represented as graphical elements with specific rules that describe how they can be combined and manipulated. The circuits analyzed are classical circuits. These optimizations are meant to characterize the performance of ZX rewrite rules, for quantum and classical.

Session II - 9:40a.m. – 9:55a.m.

Project ID: CHEM 05

9:40a.m. – 9:55a.m.

Title: Spreading a Slurry Layer

Presenter(s): Arjun Brahmandam

Mentor(s): Dr. Alexander L. Yarin, University of Illinois at Chicago

Abstract/Project Intention:

This project studies the spanwise spreading of gypsum slurry with a foaming agent under a rotating roller, a process employed by many wallboard manufacturers. Different parameters are experimented on, such as roller speed, rotation, and foam concentration. A high-speed camera records the interaction between the slurry and the roller from the side and the top. A particle imaging velocimetry software uses these videos to create velocity fields of the spanwise spreading of the slurry. While the side views yielded insignificant differences, the top view experiments suggested that numerous confounding variables could impact the spreading of gypsum slurry. One such example is the atmospheric air. As foam concentration increases, the amount of air entrapped within the slurry also increases, allowing inconsistencies in the magnitude and direction of the spanwise spreading. The change in roller direction also changes the spread due to the roller pushing the slurry closer or farther from the center. As the roller speed increases, the spanwise spreading of the gypsum slurry becomes less predictable due to parts of the substance being thrown to other locations, disrupting the overall flow direction. These additional variables should be further studied to determine exactly their impacts on the slurry's spanwise spreading.

Project ID: BIO 06
9:40a.m. – 9:55a.m.

Title: Development of a Baculovirus-based Packaging System for Efficient Recombinant Retrovirus Production

Presenter: Rachel Qi

Mentor: Dr. Tong-Chuan He, University of Chicago

Abstract/Project Intention:

Retroviral vectors are commonly used for generating stable cells to express transgenes. However, packaging high-titer retroviruses is technically challenging due to variations in co-transfecting the packaging cells with multiple plasmids that express genes essential for retrovirus production, leading to inefficient and inconsistent virus production and dramatic virus titer fluctuations. The objective of this study is to investigate whether or not baculovirus (BV)-mediated delivery of gag-pol-env and VSV-G would produce high-titer retroviruses. If successful, such a system would significantly simplify retrovirus-making, which is crucial for effective stable transgene expression in biomedical research. Experimentally, the gag-pol-env and VSV-G expression cassettes were first cloned into BV transfer vectors, the resultant constructs verified by DNA sequencing. The BV transfer vectors were transformed into DH10Bac bacterial cells, which harbor the BV genome that expresses Tn7 transposases. After the Tn7 transposition reaction, positive (white) clones were selected from X-gal/IPTG blue-white agar plates. The BV vectors for gag-pol-env (pBV-gag-pol-env) and VSV-G (pBV-VSV-G) were obtained. After verification, these BV vectors were transfected into Sf9 insect cells to produce BV viral particles. We have successfully obtained BV-gag-pol-env and BV-VSV-G baculoviruses, and are working on amplification to create high titer BV viruses for function tests and retrovirus production.

Project ID: ENVR 04
9:40a.m. – 9:55a.m.

Title: Effects of Sunscreen Chemicals on Freshwater Algae

Presenter(s): Aleksandra Duda, Myra Mensah, Eliana Nungaray, Gwendolyn Olney

Mentor(s): Dr. Jessica Amacher, Ms. Sarah O’Leary-Driscoll,
Illinois Mathematics and Science Academy,
Dr. Melissa Lenczewski, Northern Illinois University

Abstract/Project Intention:

An estimated 229.76 tons of sunscreens are used annually. While the active ingredients in sunscreens are effective in blocking harmful UV irradiation, they have recently been found to be harmful to coral reefs. Sunscreen active ingredients are released into bodies of water via direct human contact, runoff from beach sand, and effluent from wastewater treatment facilities. These chemicals have been found in cenotes of the Yucatan Peninsula, presenting a potential ecological hazard to marine and freshwater ecosystems in the area. The cenotes are also a source of drinking water and if contaminated, may pose significant health risks to human populations. *Chlorella vulgaris* algae is a species of green freshwater algae common in cenotes of the Yucatan peninsula. In this study, *C. vulgaris* was grown with varying concentrations of Oxybenzone and Octocrylene, two sunscreen active ingredients known to be harmful to aquatic life. The algae was allowed to grow for one week with a range of sunscreen concentrations. Algal growth was measured by spectrophotometry and compared to a control set containing no sunscreen. In this study, it was shown that the concentration of oxybenzone and octocrylene were statistically significant predictors of absorbance values, reflecting algal growth.

Project ID: BHVSO 06

9:40a.m. – 9:55a.m.

Title: The Influence of Undergraduate University's Prestige on Top Firm Executives

Presenter(s): Michael Capriotti, Danica Sun

Mentor(s): Carola Frydman, Northwestern University, Kellogg School of Management

Abstract/Project Intention:

In current times, attaining a college degree has become a required step for pursuing a wide array of career opportunities. However, beyond simply obtaining a diploma, the choice of university where a person pursues their higher education can influence their future path. Guided by Dr. Carola Frydman at Northwestern University's Kellogg School of Management, this paper addresses the question of how the types of undergraduate universities attended by executives at top firms have changed from 1960 to 2005. The universities are specifically separated by prestige through the use of past university ranking lists. The list of executives of the top firms is formed from the amount of personnel employed, which together, employ 56% of the American workforce excluding the military and agriculture. Our study has implications which highlight trends regarding how the choice of university influences an individual's trajectory toward becoming a top executive, offering insights into the evolving patterns of college education as a whole over time. The study also possesses the potential to determine what factors determine this influence, and what additional factors may influence the individual's trajectory toward becoming a top executive.

Project ID: BHVSO 11

9:40a.m. – 9:55a.m.

Title: Evaluating Access to Healthcare In Chicago's Chinatown

Presenter(s): Yicole Ng

Mentor(s): Crystal Bae, University of Chicago

Abstract/Project Intention:

Historically, minority populations in the U.S. have experienced disparities in access to healthcare and their corresponding health outcomes. To find out how ethnicity and location are connected to accessibility to healthcare, this paper connects geospatial data and the social determinants of health in the predominantly Asian community in the Chinatown neighborhood of Chicago. Using ChiVes, Chicago Health Atlas, the census tract, and the Chicago Data Portal, I apply spatial analytic approaches such as determining distances between central areas in Chicago and primary care facilities to create a healthcare accessibility index. This could provide more information on how to determine neighborhoods in Chicago, help find potential solutions to healthcare disparities, and determine the role of ethnicity in healthcare accessibility.

Project ID: ERSP 01
9:40a.m. – 9:55a.m.

Title: The Search for CH₃OH Transitions and Water Masers in High-Mass Star-Forming Regions

Presenter(s): Atharva Kapale

Mentor(s): Dr. Esteban Araya, Western Illinois University

Abstract/Project Intention:

Methanol transitions and Water Masers can be found in high-mass star-forming regions that are in the ionized gas. This ionized gas lets off electrons that interact with other atoms which emits photons that are then detected by radio telescopes such as the Very Large Array (VLA) on Earth.

Data from this telescope was able to be accessed by connecting to a virtual machine and using Jupyter Notebook and CASA (Common Astronomy Software Applications) to analyze the data. From the data, it is possible to look for these Methanol transitions and Water Masers. For the source analyzed during this process, there were no Methanol transitions found while there were two Water Masers found. This method is going to be used to continue a Water Maser search from different sources.

Project ID: RISE 02 (poster only)

Title: Mathematical Modeling of the Optimal Light Wavelength for Increasing Biomass and Cell Size of *Chlorella vulgaris* as a Basis for Enhancing Biofuel Production

Presenter: Sidharth Brahmandam, 9th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy
Dr. Srikanth Ammu (Ph.D), STERIS,
Dr. Sri Sankar Chinta (Ph.D), Medical College of Wisconsin,
Dr. Jun Du Wahl (Ph.D), Clipper Corporation,
Mr. Drew Mitchell, Wahl Clipper Corporation,
Mrs. Elizabeth Bruker, Naperville North H.S.

Abstract/Project Information:

The pressing need for eco-friendly fuel sources due to limited fossil fuels and rising population elucidates microalgae including *Chlorella vulgaris* (*C. vulgaris*) as a sustainable biofuel. Yet, high production costs hinder their commercial viability, which can be addressed by optimized lighting. However, a gap exists concerning the optimal wavelength of light to enhance biomass growth and cell size in *C. vulgaris*. This experiment investigated the impact of varying light wavelengths (400-650 nm) on biomass growth and cell size to develop a predictive mathematical model aimed at increasing productivity of commercial units. Separate containers were established for four groups that were each exposed to different light wavelengths: blue (400-490 nm), green (510-530 nm), red (630-650 nm), and control (no light), and a 12hr:12 hr light-dark cycle was used. Biomass concentration was measured using a spectrophotometer over 10 days and the data for each condition was regression fitted to a logistic growth curve. Cell size was measured on the last day using a light microscope. *C. vulgaris* exposed to blue light (400-490 nm) had the largest positive change in biomass, followed by red (630-650 nm) and green (510-530 nm). *C. vulgaris* exposed to red light had significantly smaller cell sizes, while other groups had comparably larger cell sizes. The derived mathematical model can be extrapolated to large-scale plants. Overall, the null hypothesis can be rejected, as One Way ANOVA $p < 0.001$. This has implications for reducing the cultivating and harvesting costs of *C. vulgaris*.

Project ID: RISE 07

9:40a.m. – 9:55a.m.

Title: FlaviExplore: An Integrated Bioinformatics Platform for West Nile Virus Research

Presenter: Aarav Patel, 10th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Dr. Priyanka Patel (PhD), APEX Clinical Labs,
Dr. Shivani Agrawal (PhD), Vanqua Biotech,
Dr. Amit Rahi (PhD), Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

This experiment developed the FlaviExplore platform with a main goal of making gathering West Nile virus (WNV) data simpler for researchers and extending phylogenetic knowledge about WNV. Currently, many researchers have to spend an excessive amount of time gathering sequences and converting them to fasta files, which could slow down the process of gaining new insights about the virus. This platform, comprising an integrated database and website, centralizes WNV genetic information and enables simple extraction and analysis of WNV sequences. The phylogenetic analysis done also extends knowledge related to WNV genetic diversity across multiple regions. The project involved collecting WNV DNA sequences from both the ViPR and the BVBRC databases and converting them into csv files for storage in a Cosmos database. The fasta sequences were utilized in developing the FlaviExplore website, a platform that made WNV sequences easily accessible for analysis. The sequences were then analyzed using a multitude of bioinformatics software, leading to the construction of a phylogenetic tree and the study of genetic variants among WNV strains. The universally negative Tajima's D values point to significant expansion or new evolutionary pressures in WNV populations, highlighted by considerable genetic diversity, which contradicts the null hypothesis of the experiment. This genetic diversity provides valuable insights into its population structures. Such knowledge is crucial for understanding the essential for controlling WNV spread and developing effective antiviral treatments. FlaviExplore provides an efficient method for gathering WNV fasta files for WNV researchers, further increasing WNV knowledge.

Project ID: MEDH 39

9:40a.m. – 9:55a.m.

Title: Quantification of Cells with Modifications Relating to the RB1 Pathway

Presenter: Jeanmyung Yu

Mentor: Elizaveta Benevolenskaya, University of Illinois Cancer Center

Abstract/Project Intention:

The retinoblastoma tumor suppressor(RB1) is a vital tumor suppressor gene. It prevents the cell from transitioning to the S phase from G phase by inhibiting E2F activity which limits cell proliferation and facilitates a stable exit from the cell cycle. Inactivation of RB1 thus allows for the expression of genes necessary for the cell cycle to progress and results in the production of proteins and DNA. RB1 also regulates KDM5A which is a direct repressor of metabolic regulatory genes. Therefore a lack of RB1 causes dysregulation of KDM5A which can lead to downregulation of H3K4me3 levels, effectively silencing the metabolic genes. The EGFR pathway leads to the activation of CDK4/6, which inactivates the RB1 tumor suppression by initiating the phosphorylation of RB1. We raised multiple cell lines which were modified for the presence of RB1 and EGFR TKIs, then added ki67(a marker for proteins) and EdU(a marker for DNA). By using Zeiss Microscopy Software to quantify the cell images, this project gave insight into the correlation between the expression of KDM5A and E2F within the RB1 pathway.

Project ID: BIO 07
9:40a.m. – 9:55a.m.

Title: Effects of Initial Domain Packing in Lipid Monolayer Shear Banding Collapse

Presenter(s): Deepanjali Samal

Mentor(s): Anna Gaffney, Dongxu Liu, Luka Pocivavsek, Nhung Nguyen
University of Chicago, Program in Biophysics

Abstract/Project Intention:

Found in alveoli in the form of lung surfactants, the structure of a lipid monolayer is composed of hydrophobic tails surrounded by air and hydrophilic heads that assimilate with water. As we breathe in and out, lung surfactants expand and contract to optimize air intake volume and pressure, causing collapse under high compressive stresses and strains during exhalation. We can experimentally observe the compression and collapse of lipid monolayers using fluorescence microscopy images on a Langmuir trough. The lipid dyes visualize coexisting phases during compression and collapse, including condensed domains and the matrix surrounding them. Depending on the starting conditions collapse can take different forms, such as out-of-plane collapse, or in-plane. Shear banding is a type of collapse where the lipid domains shift from a hexagonal organization into horizontal condensed rows under high compression. In this study, elastic continuum mechanics is used to model the collapse of lipid monolayer systems computationally. Previous experimentation has studied shear banding from hexagonal packing, but in this finite element experiment, characteristics of the domains are manually altered to determine the impact of the initial structure on the final configuration. By studying lipid monolayer collapses, we can open gateways into the field of respiratory diseases.

Project ID: CMPS 13
9:40a.m. – 9:55a.m.

Title: Artificial Intelligence's Role in Cybersecurity and Global Dynamics

Presenter: Nethra Shanbhag

Mentor: Dr. Maurice Dawson, Illinois Institute of Technology

Abstract/Project Intention:

The exponential expansion of Artificial Intelligence (AI) in cybersecurity has gained significant attention, especially in information warfare, leading to substantial apprehensions about national security. Although AI was previously considered insignificant, its rapid advancement has completely changed this viewpoint. Moreover, the paper examines the European Union's (EU) strategic approach to AI, explicitly analyzing its emphasis on standards instead of market power. The research examines EU policy texts to reveal the EU's efforts to position itself as a Normative Power in Europe. It also highlights the EU's pursuit of market dominance by enacting appropriate legislation and making strategic investments, as seen in the EU's AI Act. This legislative framework aims to guarantee the safety, adherence to ethical norms, and safeguarding of fundamental rights in AI systems. This study explores the changing terrain of AI in the field of cybersecurity, with a focus on its potential advantages in detecting and reducing cyber risks. However, it also acknowledges the difficulties posed by computational complexity and potential biases in the data used for training AI systems.

Project ID: CMPS 31
9:40a.m. – 9:55a.m.

Title: Heterogenous Multi-Agent Reinforcement Learning for Last-Mile Delivery Optimization

Presenter(s): Aaditya Shah

Mentor(s): Ankit Agrawal, Saint Louis University

Abstract/Project Intention:

The surge of e-commerce demands innovative solutions to streamline last-mile delivery logistics. Autonomous delivery vehicles (ADV) offer a promising avenue, also combatting the lack of delivery drivers. However, their success hinges on effectively managing the complexities arising from diverse delivery modes (e.g., aerial and ground-based) in obstructed or constrained environments. Traditional Multi-Agent Reinforcement Learning (MARL) approaches may not optimally coordinate heterogeneous agents, impacting delivery efficiency and cost. This research addresses this gap by investigating Heterogeneity-aware MARL (H-MARL) techniques to optimize delivery routes and resource allocation for mixed-fleet ADVs. Through computational benchmarking, we hypothesize that H-MARL algorithms can significantly outperform traditional MARL algorithms in delivery speed and cost reduction due to their ability to consider the aerial and land agents' unique capabilities and constraints. This work has the potential to revolutionize urban goods delivery by informing the design of intelligent, multi-modal autonomous logistics systems.

Project ID: CMPS 33
9:40a.m. – 9:55a.m.

Title: Neural Network Compression and Storage using Linear Feedback Shift Registers (LFSRs)

Presenter(s): Anmol Singh

Mentor(s): Prof. Yanjing Li, University of Chicago

Abstract/Project Intention:

This research paper explores the application of Linear Feedback Shift Registers (LFSRs) to enhance the compression of neural networks. LFSRs, which employ a linear function to determine input bits based on previous states, are commonly used for generating bit sequences and pseudo-random numbers that can be used to generate pseudo-random weight approximations. Compressed neural networks offer a transformative solution by significantly reducing memory demands. The study looks at weight visualizations of neural networks and explores possible LFSR approximation with it which could potentially improve storage efficiency without compromising model performance. We hope to find some patterns that we can use to optimize the compression process, leading to more efficient neural network implementations. By leveraging the properties of LFSRs in conjunction with neural network weight visualization techniques, we aim to uncover novel strategies for enhancing neural network compression while maintaining or even improving model accuracy. This approach has the potential to contribute to the field of neural network compression and pave the way for more streamlined and resource-efficient deep learning applications.

Project ID: CMPS 23
9:40a.m. – 9:55a.m.

Title: Towards Understanding Large Language Models for Multilingual Semantic Encoding

Presenter(s): Diego Nava

Mentor(s): Ermin Wei, Northwestern University

Abstract/Project Intention:

Natural Language Processing (NLP) has witnessed significant advancements with the emergence of large language models (LLM) capable of understanding and generating human-like text. However, there remains a critical need to explore and understand their efficiency and effectiveness, especially in processing languages beyond English. This study aims to evaluate the efficiency of various large language models in capturing semantic meaning across English, German, and Spanish sentences. Principal Component Analysis (PCA) is utilized to identify important weights for understanding semantics. Through further experimentation with various sentence structures, we aim to identify factors contributing to the effectiveness of certain models. By pinpointing the strengths and weaknesses of different models, we aim to advance NLP research for multilingual applications.

Project ID: MEDH 40

9:40a.m. – 9:55a.m.

Title: Effect of a coupled Hypoxia and Exercise treatment on Neuropathic Pain in female rats with Chronic Spinal Cord Injury

Presenter(s): Dashiell Leigh

Mentor(s): Ann M. Stowe, PhD; Daimen Britsch, University of Kentucky

Abstract/Project Intention:

Spinal Cord Injury (SCI), an interruption of spinal axons, impacts millions of people, and can lead to quadriplegia and damage to essential respiratory pathways. To date, it is medically irreversible. Recent animal studies suggest that Intermittent Hypoxia (IH) and exercise training are effective treatments. IH, or exposure to low oxygen levels, has been shown to trigger phrenic long term facilitation (pLTF), an increase in phrenic motor neuron output even at regular oxygen levels. Exercise has been shown to stimulate cortical reorganization that restores function to injured areas. No research to date has explored the impacts of coupling IH and exercise training. To address this gap, we ran an experiment using every combination of the two treatments for eight weeks on four cohorts of female rats with chronic SCI (i.e. seven weeks after SCI). Recovery was measured by changes in neuropathic pain using the Hargreaves test. A lateral C2 hemisection (LC2H) was given to all rats. Results demonstrated that coupling the two treatments had no statistically significant impact on neuropathic pain. Furthermore, interventions started in the chronic phase may not improve all types of recovery. These results further the search for the most effective treatment regimen for SCI.

Project ID: MEDH 32

9:40a.m. – 9:55a.m.

Title: Classifying admission characteristics of TBI patients using K-means Clustering

Presenter(s): Rithik Thekiniath

Mentor(s): Ali Mansour, University of Chicago

Abstract/Project Intention:

Traumatic Brain Injury (TBI) remains a significant health concern that often results in long-term cognitive impairments, coma, or even mortality. Current classification methods are primarily reliant on the Glasgow Coma Scale (GCS) and face limitations in representing the complexity and variability of TBIs. This study utilizes unsupervised learning through a k-means algorithm to cluster TBI patients at Beth Israel Deaconess Medical Center between 2008 and 2019 based on admission characteristics, in order to enhance prognosis and treatment approaches. Analysis of clusters uncovers diverse patient profiles which reveal correlations between age, GCS scores, and post-hospital outcomes. Clusters characterized by extreme age or GCS scores demonstrate varied mortality rates suggesting the ineffectiveness of GCS as a sole classifier. Younger age emerged as a highly expected yet crucial predictor of favorable outcomes. The study establishes the potential of clustering algorithms in patient stratification, offering insights for prognosis and post-hospital outcome prediction. However, there are limitations stemming from a lack of generalizability due to a single-hospital dataset. More validation across diverse datasets is required for broader clinical applicability in critical care settings for TBI patients.

Project ID: ENGN 03
9:40a.m. – 9:55a.m.

Title: Using Infrared Image Analysis to detect 3D Printing errors

Presenter(s): Fiyinfoluwa Akinyemi

Mentor(s): Professor Niechen Chen, Northern Illinois University

Abstract/Project Intention:

This paper investigates a method to detect structural irregularities in 3D prints through infrared image analysis. The study employs an infrared camera, which senses thermal discrepancies in its field of view, to monitor the thread of the material filament as it is deposited during the printing process. Images captured by the camera are processed by Python libraries such as OpenCV and NumPy, using object detection and cropping techniques to differentiate between the hot extrusion material and the hardened plastic for precise error identification. The data collection process involves collecting defective and non-defective prints to train the image processing algorithm. The paper compares various approaches, including cropped and uncropped images, at different zoom levels to determine the most effective method for error detection. Preliminary findings demonstrate promising error detection rates, with varying success based on the image processing strategy. Challenges like false positives are addressed through refined data and algorithmic adjustments. The paper concludes with insights from data analysis and suggests future improvements for 3D printing error detection via image processing and machine learning.

Project ID: PHYS 21
9:40a.m. – 9:55a.m.

Title: Efficiency Calculations and Efficacy of a Displaced Vertex Control Region for Dark Photons Decaying to Lepton Jets

Presenter(s): Claire O’Brien-Dull

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Many different theories of dark matter and the dark sector predict a massive dark photon of GeV scale mass, with an event signature of opposite-sign leptons (in this case, muons) forming a lepton jet (a lepton pair with a very small angle between the leptons). Calculations of lepton jet efficiency under different cuts are needed to determine the potential of a displaced vertex control region for the dark photon. An effective control region is used to select experimental data with very little signal, giving a more realistic picture of our expected background than a Monte Carlo generated background. The control region considered in this study uses a displaced vertex cut, looking at particle tracks originating from points a certain distance from the original proton interaction point. An important part of testing the efficacy of this control region is calculating lepton jet efficiency for generated signal and background data. These results will contribute to future searches for the dark photon at CMS, and help in our understanding of phenomena beyond the Standard Model.

Project ID: CHEM 11

9:40a.m. – 9:55a.m.

Title: Synthesis of New Compounds for Leishmaniasis Treatment

Presenter: Mia Park

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

While progress has been made in the development of treatments for tropical diseases such as malaria, there have been few advancements in the treatment of leishmaniasis. Leishmaniasis is a parasitic disease that can lead to disfigurement or death if not treated. Current medicine is hard to access, and the treatment from these medicines is not effective enough to be taken in a few doses. Additionally, no vaccines exist for the disease. The danger this lack of treatment presents has prompted many scientists and researchers to work towards more effective treatments of the disease. This project was run to discover possible candidates for these new treatments based off of lead compound DNDI0003202833. 5-chloro-1,3-benzoxazol-2-amine was reacted with four different carboxylic acids and characterized using infrared spectroscopy. Final compounds will be sent to a collaborator's lab for biological testing.

Project ID: PHYS 20

9:40a.m. – 9:55a.m.

Title: Creating and Analyzing Opposite Sign Dilepton Lepton Jet Dark Photon Plots and a Dark Photon Validation Plot

Presenter: Marcus Kubon

Mentor: Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The dark photon is predicted in an extension of the standard model to include a dark sector, to account for the mass of invisible dark matter and its lack of interaction with the standard model. This dark sector includes a massive $U(1)'$ gauge boson A' , or the dark photon, which can decay into standard model particles through kinetic mixing. Because of the mass of A' , when it decays into a standard model photon and eventually additional leptons, it produces a lepton jet. This lepton jet is easily detectable by the Large Hadron Collider (LHC). Through analysis of simulated and real data, this project details the creation of histograms through simulated Monte Carlo to plot the invariant mass of lepton jets coming from a fixed mass of a simulated dark photon against the number of said events. We also apply trigger cuts to eliminate consideration of events we know do not come from a dark photon but produce similar lepton jets. These plots show that we can accurately reconstruct events from the accelerator for our analysis. Furthermore, this project tracks the creation of dark photon validation histograms that graph opposite sign dilepton jet mass against the number of events, plotting both data and major background sources. Now, our analysis can compare our background accelerator data with signal events, and thereby evaluate the effectiveness of our triggers.

Project ID: ENGN 11
9:40a.m. – 9:55a.m.

Title: Techno-Economic Analysis of Capacitive Deionization (CDI) Use for Separations of Biofuels in the Production Process

Presenter: Zuyu Liu

Mentor: Dr. Lauren Valentino, Argonne National Laboratory

Abstract/Project Intention:

Biofuels play a critical role in transitioning towards a sustainable energy system. Affordable and low-carbon biofuels are especially important for hard-to-electrify transportation sectors, such as aviation. Cost and efficiency are the main challenges faced in the biofuel production process, with the separation of valuable organic acids from fermented broth accounting for 50% of the total energy use and up to 70% of overall costs. Capacitive Deionization (CDI), an electro-chemical separations method traditionally used in water desalination, is a promising technology that offers lower energy consumption compared to conventional, thermal-based separations. The application of CDI for biofuel production at an industrial scale remains underexplored. This research aims to provide a techno-economic analysis of using CDI for biofuel precursors, evaluating both the technical and economical feasibility of CDI on larger scales. The findings investigate the industrial architecture of CDI modules, and a comprehensive analysis of important costs, enhancing understanding of CDI's potential and utilization in the transition to sustainable biofuels.

Project ID: MEDH 42

9:40a.m. – 9:55a.m.

Title: Metformin Analogs for Diabetes Treatment

Presenters: Iris Amit and Sriya Mudumba

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Metformin is used to treat Diabetes, a disease that plagues people worldwide. Metformin binds to the MF8 ligand, and strengthening that binding affinity indicates that there is less need for more doses of the medication.

Computational drug design was used due to its cost- effectiveness and ability to display certain molecules while also saving time for researchers.

Utilizing the SeeSAR program we designed approximately 750 analogs of metformin. We want the binding affinity value to be as small as possible as it means the drug is able to bind more effectively as the concentration needed for effective binding is a lot less. After designing other analogs, the five molecules that displayed the strongest binding affinities were selected to be analyzed in ADMETlab and admetSAR in order to discern physicochemical properties. Metformin's lower boundary for binding affinity is 3067829 nM, the molecule with the best binding affinity has a lower boundary binding affinity of 0.002008 nM, >1.5 billion times stronger binding, an extreme improvement of the binding affinity.

Project ID: CMPS 34
9:40a.m. – 9:55a.m.

Title: Investigating Environmental Justice through Urban Data Visualization

Presenter(s): Carissa Chen

Mentor(s): Fabio Miranda, University of Illinois Chicago

Abstract/Project Intention:

Urban areas worldwide are bustling with activity and constantly changing. This perpetual motion is a testament to the vibrancy of city life and provides a rich basis for gathering and analyzing data. Visual analytics is crucial in urban settings, and it is supported by many frameworks to investigate urban data more effectively. I used one of these frameworks together with data science methods to investigate the correlation between Chicago community areas' sustainability indicators and income levels. My project explores environmental justice in Chicago using its open data combined with the computational frameworks of Vega-Lite and the Urban Toolkit. We explored the correlation between income levels, the number of green roofs, environmental complaints, and environmental inspections in each community area. These patterns and trends have broader implications concerning environmental justice and can inform urban planning and policymaking in the future.

Session II - 9:40a.m. – 9:55a.m.

Project ID: CHEM 05

9:40a.m. – 9:55a.m.

Title: Spreading a Slurry Layer

Presenter(s): Arjun Brahmandam

Mentor(s): Dr. Alexander L. Yarin, University of Illinois at Chicago

Abstract/Project Intention:

This project studies the spanwise spreading of gypsum slurry with a foaming agent under a rotating roller, a process employed by many wallboard manufacturers. Different parameters are experimented on, such as roller speed, rotation, and foam concentration. A high-speed camera records the interaction between the slurry and the roller from the side and the top. A particle imaging velocimetry software uses these videos to create velocity fields of the spanwise spreading of the slurry. While the side views yielded insignificant differences, the top view experiments suggested that numerous confounding variables could impact the spreading of gypsum slurry. One such example is the atmospheric air. As foam concentration increases, the amount of air entrapped within the slurry also increases, allowing inconsistencies in the magnitude and direction of the spanwise spreading. The change in roller direction also changes the spread due to the roller pushing the slurry closer or farther from the center. As the roller speed increases, the spanwise spreading of the gypsum slurry becomes less predictable due to parts of the substance being thrown to other locations, disrupting the overall flow direction. These additional variables should be further studied to determine exactly their impacts on the slurry's spanwise spreading.

Project ID: BIO 06
9:40a.m. – 9:55a.m.

Title: Development of a Baculovirus-based Packaging System for Efficient Recombinant Retrovirus Production

Presenter: Rachel Qi

Mentor: Dr. Tong-Chuan He, University of Chicago

Abstract/Project Intention:

Retroviral vectors are commonly used for generating stable cells to express transgenes. However, packaging high-titer retroviruses is technically challenging due to variations in co-transfecting the packaging cells with multiple plasmids that express genes essential for retrovirus production, leading to inefficient and inconsistent virus production and dramatic virus titer fluctuations. The objective of this study is to investigate whether or not baculovirus (BV)-mediated delivery of gag-pol-env and VSV-G would produce high-titer retroviruses. If successful, such a system would significantly simplify retrovirus-making, which is crucial for effective stable transgene expression in biomedical research. Experimentally, the gag-pol-env and VSV-G expression cassettes were first cloned into BV transfer vectors, the resultant constructs verified by DNA sequencing. The BV transfer vectors were transformed into DH10Bac bacterial cells, which harbor the BV genome that expresses Tn7 transposases. After the Tn7 transposition reaction, positive (white) clones were selected from X-gal/IPTG blue-white agar plates. The BV vectors for gag-pol-env (pBV-gag-pol-env) and VSV-G (pBV-VSV-G) were obtained. After verification, these BV vectors were transfected into Sf9 insect cells to produce BV viral particles. We have successfully obtained BV-gag-pol-env and BV-VSV-G baculoviruses, and are working on amplification to create high titer BV viruses for function tests and retrovirus production.

Project ID: ENVR 04
9:40a.m. – 9:55a.m.

Title: Effects of Sunscreen Chemicals on Freshwater Algae

Presenter(s): Aleksandra Duda, Myra Mensah, Eliana Nungaray, Gwendolyn Olney

Mentor(s): Dr. Jessica Amacher, Ms. Sarah O’Leary-Driscoll,
Illinois Mathematics and Science Academy,
Dr. Melissa Lenczewski, Northern Illinois University

Abstract/Project Intention:

An estimated 229.76 tons of sunscreens are used annually. While the active ingredients in sunscreens are effective in blocking harmful UV irradiation, they have recently been found to be harmful to coral reefs. Sunscreen active ingredients are released into bodies of water via direct human contact, runoff from beach sand, and effluent from wastewater treatment facilities. These chemicals have been found in cenotes of the Yucatan Peninsula, presenting a potential ecological hazard to marine and freshwater ecosystems in the area. The cenotes are also a source of drinking water and if contaminated, may pose significant health risks to human populations. *Chlorella vulgaris* algae is a species of green freshwater algae common in cenotes of the Yucatan peninsula. In this study, *C. vulgaris* was grown with varying concentrations of Oxybenzone and Octocrylene, two sunscreen active ingredients known to be harmful to aquatic life. The algae was allowed to grow for one week with a range of sunscreen concentrations. Algal growth was measured by spectrophotometry and compared to a control set containing no sunscreen. In this study, it was shown that the concentration of oxybenzone and octocrylene were statistically significant predictors of absorbance values, reflecting algal growth.

Project ID: BHVSO 06

9:40a.m. – 9:55a.m.

Title: The Influence of Undergraduate University's Prestige on Top Firm Executives

Presenter(s): Michael Capriotti, Danica Sun

Mentor(s): Carola Frydman, Northwestern University, Kellogg School of Management

Abstract/Project Intention:

In current times, attaining a college degree has become a required step for pursuing a wide array of career opportunities. However, beyond simply obtaining a diploma, the choice of university where a person pursues their higher education can influence their future path. Guided by Dr. Carola Frydman at Northwestern University's Kellogg School of Management, this paper addresses the question of how the types of undergraduate universities attended by executives at top firms have changed from 1960 to 2005. The universities are specifically separated by prestige through the use of past university ranking lists. The list of executives of the top firms is formed from the amount of personnel employed, which together, employ 56% of the American workforce excluding the military and agriculture. Our study has implications which highlight trends regarding how the choice of university influences an individual's trajectory toward becoming a top executive, offering insights into the evolving patterns of college education as a whole over time. The study also possesses the potential to determine what factors determine this influence, and what additional factors may influence the individual's trajectory toward becoming a top executive.

Project ID: BHVSO 11

9:40a.m. – 9:55a.m.

Title: Evaluating Access to Healthcare In Chicago's Chinatown

Presenter(s): Yicole Ng

Mentor(s): Crystal Bae, University of Chicago

Abstract/Project Intention:

Historically, minority populations in the U.S. have experienced disparities in access to healthcare and their corresponding health outcomes. To find out how ethnicity and location are connected to accessibility to healthcare, this paper connects geospatial data and the social determinants of health in the predominantly Asian community in the Chinatown neighborhood of Chicago. Using ChiVes, Chicago Health Atlas, the census tract, and the Chicago Data Portal, I apply spatial analytic approaches such as determining distances between central areas in Chicago and primary care facilities to create a healthcare accessibility index. This could provide more information on how to determine neighborhoods in Chicago, help find potential solutions to healthcare disparities, and determine the role of ethnicity in healthcare accessibility.

Project ID: ERSP 01
9:40a.m. – 9:55a.m.

Title: The Search for CH₃OH Transitions and Water Masers in High-Mass Star-Forming Regions

Presenter(s): Atharva Kapale

Mentor(s): Dr. Esteban Araya, Western Illinois University

Abstract/Project Intention:

Methanol transitions and Water Masers can be found in high-mass star-forming regions that are in the ionized gas. This ionized gas lets off electrons that interact with other atoms which emits photons that are then detected by radio telescopes such as the Very Large Array (VLA) on Earth.

Data from this telescope was able to be accessed by connecting to a virtual machine and using Jupyter Notebook and CASA (Common Astronomy Software Applications) to analyze the data. From the data, it is possible to look for these Methanol transitions and Water Masers. For the source analyzed during this process, there were no Methanol transitions found while there were two Water Masers found. This method is going to be used to continue a Water Maser search from different sources.

Project ID: RISE 02 (poster only)

Title: Mathematical Modeling of the Optimal Light Wavelength for Increasing Biomass and Cell Size of *Chlorella vulgaris* as a Basis for Enhancing Biofuel Production

Presenter: Sidharth Brahmandam, 9th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy
Dr. Srikanth Ammu (Ph.D), STERIS,
Dr. Sri Sankar Chinta (Ph.D), Medical College of Wisconsin,
Dr. Jun Du Wahl (Ph.D), Clipper Corporation,
Mr. Drew Mitchell, Wahl Clipper Corporation,
Mrs. Elizabeth Bruker, Naperville North H.S.

Abstract/Project Information:

The pressing need for eco-friendly fuel sources due to limited fossil fuels and rising population elucidates microalgae including *Chlorella vulgaris* (*C. vulgaris*) as a sustainable biofuel. Yet, high production costs hinder their commercial viability, which can be addressed by optimized lighting. However, a gap exists concerning the optimal wavelength of light to enhance biomass growth and cell size in *C. vulgaris*. This experiment investigated the impact of varying light wavelengths (400-650 nm) on biomass growth and cell size to develop a predictive mathematical model aimed at increasing productivity of commercial units. Separate containers were established for four groups that were each exposed to different light wavelengths: blue (400-490 nm), green (510-530 nm), red (630-650 nm), and control (no light), and a 12hr:12 hr light-dark cycle was used. Biomass concentration was measured using a spectrophotometer over 10 days and the data for each condition was regression fitted to a logistic growth curve. Cell size was measured on the last day using a light microscope. *C. vulgaris* exposed to blue light (400-490 nm) had the largest positive change in biomass, followed by red (630-650 nm) and green (510-530 nm). *C. vulgaris* exposed to red light had significantly smaller cell sizes, while other groups had comparably larger cell sizes. The derived mathematical model can be extrapolated to large-scale plants. Overall, the null hypothesis can be rejected, as One Way ANOVA $p < 0.001$. This has implications for reducing the cultivating and harvesting costs of *C. vulgaris*.

Project ID: MEDH 39
9:40a.m. – 9:55a.m.

Title: Quantification of Cells with Modifications Relating to the RB1 Pathway

Presenter: Jeanmyung Yu

Mentor: Elizaveta Benevolenskaya, University of Illinois Cancer Center

Abstract/Project Intention:

The retinoblastoma tumor suppressor(RB1) is a vital tumor suppressor gene. It prevents the cell from transitioning to the S phase from G phase by inhibiting E2F activity which limits cell proliferation and facilitates a stable exit from the cell cycle. Inactivation of RB1 thus allows for the expression of genes necessary for the cell cycle to progress and results in the production of proteins and DNA. RB1 also regulates KDM5A which is a direct repressor of metabolic regulatory genes. Therefore a lack of RB1 causes dysregulation of KDM5A which can lead to downregulation of H3K4me3 levels, effectively silencing the metabolic genes. The EGFR pathway leads to the activation of CDK4/6, which inactivates the RB1 tumor suppression by initiating the phosphorylation of RB1. We raised multiple cell lines which were modified for the presence of RB1 and EGFR TKIs, then added ki67(a marker for proteins) and EdU(a marker for DNA). By using Zeiss Microscopy Software to quantify the cell images, this project gave insight into the correlation between the expression of KDM5A and E2F within the RB1 pathway.

Project ID: BIO 07
9:40a.m. – 9:55a.m.

Title: Effects of Initial Domain Packing in Lipid Monolayer Shear Banding Collapse

Presenter(s): Deepanjali Samal

Mentor(s): Anna Gaffney, Dongxu Liu, Luka Pocivavsek, Nhung Nguyen
University of Chicago, Program in Biophysics

Abstract/Project Intention:

Found in alveoli in the form of lung surfactants, the structure of a lipid monolayer is composed of hydrophobic tails surrounded by air and hydrophilic heads that assimilate with water. As we breathe in and out, lung surfactants expand and contract to optimize air intake volume and pressure, causing collapse under high compressive stresses and strains during exhalation. We can experimentally observe the compression and collapse of lipid monolayers using fluorescence microscopy images on a Langmuir trough. The lipid dyes visualize coexisting phases during compression and collapse, including condensed domains and the matrix surrounding them. Depending on the starting conditions collapse can take different forms, such as out-of-plane collapse, or in-plane. Shear banding is a type of collapse where the lipid domains shift from a hexagonal organization into horizontal condensed rows under high compression. In this study, elastic continuum mechanics is used to model the collapse of lipid monolayer systems computationally. Previous experimentation has studied shear banding from hexagonal packing, but in this finite element experiment, characteristics of the domains are manually altered to determine the impact of the initial structure on the final configuration. By studying lipid monolayer collapses, we can open gateways into the field of respiratory diseases.

Project ID: CMPS 13
9:40a.m. – 9:55a.m.

Title: Artificial Intelligence's Role in Cybersecurity and Global Dynamics

Presenter: Nethra Shanbhag

Mentor: Dr. Maurice Dawson, Illinois Institute of Technology

Abstract/Project Intention:

The exponential expansion of Artificial Intelligence (AI) in cybersecurity has gained significant attention, especially in information warfare, leading to substantial apprehensions about national security. Although AI was previously considered insignificant, its rapid advancement has completely changed this viewpoint. Moreover, the paper examines the European Union's (EU) strategic approach to AI, explicitly analyzing its emphasis on standards instead of market power. The research examines EU policy texts to reveal the EU's efforts to position itself as a Normative Power in Europe. It also highlights the EU's pursuit of market dominance by enacting appropriate legislation and making strategic investments, as seen in the EU's AI Act. This legislative framework aims to guarantee the safety, adherence to ethical norms, and safeguarding of fundamental rights in AI systems. This study explores the changing terrain of AI in the field of cybersecurity, with a focus on its potential advantages in detecting and reducing cyber risks. However, it also acknowledges the difficulties posed by computational complexity and potential biases in the data used for training AI systems.

Project ID: CMPS 31
9:40a.m. – 9:55a.m.

Title: Heterogenous Multi-Agent Reinforcement Learning for Last-Mile Delivery Optimization

Presenter(s): Aaditya Shah

Mentor(s): Ankit Agrawal, Saint Louis University

Abstract/Project Intention:

The surge of e-commerce demands innovative solutions to streamline last-mile delivery logistics. Autonomous delivery vehicles (ADVs) offer a promising avenue, also combatting the lack of delivery drivers. However, their success hinges on effectively managing the complexities arising from diverse delivery modes (e.g., aerial and ground-based) in obstructed or constrained environments. Traditional Multi-Agent Reinforcement Learning (MARL) approaches may not optimally coordinate heterogeneous agents, impacting delivery efficiency and cost. This research addresses this gap by investigating Heterogeneity-aware MARL (H-MARL) techniques to optimize delivery routes and resource allocation for mixed-fleet ADVs. Through computational benchmarking, we hypothesize that H-MARL algorithms can significantly outperform traditional MARL algorithms in delivery speed and cost reduction due to their ability to consider the aerial and land agents' unique capabilities and constraints. This work has the potential to revolutionize urban goods delivery by informing the design of intelligent, multi-modal autonomous logistics systems.

Project ID: CMPS 33
9:40a.m. – 9:55a.m.

Title: Neural Network Compression and Storage using Linear Feedback Shift Registers (LFSRs)

Presenter(s): Anmol Singh

Mentor(s): Prof. Yanjing Li, University of Chicago

Abstract/Project Intention:

This research paper explores the application of Linear Feedback Shift Registers (LFSRs) to enhance the compression of neural networks. LFSRs, which employ a linear function to determine input bits based on previous states, are commonly used for generating bit sequences and pseudo-random numbers that can be used to generate pseudo-random weight approximations. Compressed neural networks offer a transformative solution by significantly reducing memory demands. The study looks at weight visualizations of neural networks and explores possible LFSR approximation with it which could potentially improve storage efficiency without compromising model performance. We hope to find some patterns that we can use to optimize the compression process, leading to more efficient neural network implementations. By leveraging the properties of LFSRs in conjunction with neural network weight visualization techniques, we aim to uncover novel strategies for enhancing neural network compression while maintaining or even improving model accuracy. This approach has the potential to contribute to the field of neural network compression and pave the way for more streamlined and resource-efficient deep learning applications.

Project ID: CMPS 23
9:40a.m. – 9:55a.m.

Title: Towards Understanding Large Language Models for Multilingual Semantic Encoding

Presenter(s): Diego Nava

Mentor(s): Ermin Wei, Northwestern University

Abstract/Project Intention:

Natural Language Processing (NLP) has witnessed significant advancements with the emergence of large language models (LLM) capable of understanding and generating human-like text. However, there remains a critical need to explore and understand their efficiency and effectiveness, especially in processing languages beyond English. This study aims to evaluate the efficiency of various large language models in capturing semantic meaning across English, German, and Spanish sentences. Principal Component Analysis (PCA) is utilized to identify important weights for understanding semantics. Through further experimentation with various sentence structures, we aim to identify factors contributing to the effectiveness of certain models. By pinpointing the strengths and weaknesses of different models, we aim to advance NLP research for multilingual applications.

Project ID: MEDH 40

9:40a.m. – 9:55a.m.

Title: effect of a coupled Hypoxia and Exercise treatment on Neuropathic Pain in female rats with Chronic Spinal Cord Injury

Presenter(s): Dashiell Leigh

Mentor(s): Ann M. Stowe, PhD; Daimen Britsch, University of Kentucky

Abstract/Project Intention:

Spinal Cord Injury (SCI), an interruption of spinal axons, impacts millions of people, and can lead to quadriplegia and damage to essential respiratory pathways. To date, it is medically irreversible. Recent animal studies suggest that Intermittent Hypoxia (IH) and exercise training are effective treatments. IH, or exposure to low oxygen levels, has been shown to trigger phrenic long term facilitation (pLTF), an increase in phrenic motor neuron output even at regular oxygen levels. Exercise has been shown to stimulate cortical reorganization that restores function to injured areas. No research to date has explored the impacts of coupling IH and exercise training. To address this gap, we ran an experiment using every combination of the two treatments for eight weeks on four cohorts of female rats with chronic SCI (i.e. seven weeks after SCI). Recovery was measured by changes in neuropathic pain using the Hargreaves test. A lateral C2 hemisection (LC2H) was given to all rats. Results demonstrated that coupling the two treatments had no statistically significant impact on neuropathic pain. Furthermore, interventions started in the chronic phase may not improve all types of recovery. These results further the search for the most effective treatment regimen for SCI.

Project ID: MEDH 32

9:40a.m. – 9:55a.m.

Title: Classifying admission characteristics of TBI patients using K-means Clustering

Presenter(s): Rithik Thekiniath

Mentor(s): Ali Mansour, University of Chicago

Abstract/Project Intention:

Traumatic Brain Injury (TBI) remains a significant health concern that often results in long-term cognitive impairments, coma, or even mortality. Current classification methods are primarily reliant on the Glasgow Coma Scale (GCS) and face limitations in representing the complexity and variability of TBIs. This study utilizes unsupervised learning through a k-means algorithm to cluster TBI patients at Beth Israel Deaconess Medical Center between 2008 and 2019 based on admission characteristics, in order to enhance prognosis and treatment approaches. Analysis of clusters uncovers diverse patient profiles which reveal correlations between age, GCS scores, and post-hospital outcomes. Clusters characterized by extreme age or GCS scores demonstrate varied mortality rates suggesting the ineffectiveness of GCS as a sole classifier. Younger age emerged as a highly expected yet crucial predictor of favorable outcomes. The study establishes the potential of clustering algorithms in patient stratification, offering insights for prognosis and post-hospital outcome prediction. However, there are limitations stemming from a lack of generalizability due to a single-hospital dataset. More validation across diverse datasets is required for broader clinical applicability in critical care settings for TBI patients.

Project ID: ENGN 03
9:40a.m. – 9:55a.m.

Title: Using Infrared Image Analysis to detect 3D Printing errors

Presenter(s): Fiyinfoluwa Akinyemi

Mentor(s): Professor Niechen Chen, Northern Illinois University

Abstract/Project Intention:

This paper investigates a method to detect structural irregularities in 3D prints through infrared image analysis. The study employs an infrared camera, which senses thermal discrepancies in its field of view, to monitor the thread of the material filament as it is deposited during the printing process. Images captured by the camera are processed by Python libraries such as OpenCV and NumPy, using object detection and cropping techniques to differentiate between the hot extrusion material and the hardened plastic for precise error identification. The data collection process involves collecting defective and non-defective prints to train the image processing algorithm. The paper compares various approaches, including cropped and uncropped images, at different zoom levels to determine the most effective method for error detection. Preliminary findings demonstrate promising error detection rates, with varying success based on the image processing strategy. Challenges like false positives are addressed through refined data and algorithmic adjustments. The paper concludes with insights from data analysis and suggests future improvements for 3D printing error detection via image processing and machine learning.

Project ID: PHYS 21
9:40a.m. – 9:55a.m.

Title: Efficiency Calculations and Efficacy of a Displaced Vertex Control Region for Dark Photons Decaying to Lepton Jets

Presenter(s): Claire O'Brien-Dull

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Many different theories of dark matter and the dark sector predict a massive dark photon of GeV scale mass, with an event signature of opposite-sign leptons (in this case, muons) forming a lepton jet (a lepton pair with a very small angle between the leptons). Calculations of lepton jet efficiency under different cuts are needed to determine the potential of a displaced vertex control region for the dark photon. An effective control region is used to select experimental data with very little signal, giving a more realistic picture of our expected background than a Monte Carlo generated background. The control region considered in this study uses a displaced vertex cut, looking at particle tracks originating from points a certain distance from the original proton interaction point. An important part of testing the efficacy of this control region is calculating lepton jet efficiency for generated signal and background data. These results will contribute to future searches for the dark photon at CMS, and help in our understanding of phenomena beyond the Standard Model.

Project ID: CHEM 11

9:40a.m. – 9:55a.m.

Title: Synthesis of New Compounds for Leishmaniasis Treatment

Presenter: Mia Park

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

While progress has been made in the development of treatments for tropical diseases such as malaria, there have been few advancements in the treatment of leishmaniasis. Leishmaniasis is a parasitic disease that can lead to disfigurement or death if not treated. Current medicine is hard to access, and the treatment from these medicines is not effective enough to be taken in a few doses. Additionally, no vaccines exist for the disease. The danger this lack of treatment presents has prompted many scientists and researchers to work towards more effective treatments of the disease. This project was run to discover possible candidates for these new treatments based off of lead compound DNDI0003202833. 5-chloro-1,3-benzoxazol-2-amine was reacted with four different carboxylic acids and characterized using infrared spectroscopy. Final compounds will be sent to a collaborator's lab for biological testing.

Project ID: PHYS 20
9:40a.m. – 9:55a.m.

Title: Creating and Analyzing Opposite Sign Dilepton Lepton Jet Dark Photon Plots and a Dark Photon Validation Plot

Presenter: Marcus Kubon

Mentor: Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The dark photon is predicted in an extension of the standard model to include a dark sector, to account for the mass of invisible dark matter and its lack of interaction with the standard model. This dark sector includes a massive $U(1)'$ gauge boson A' , or the dark photon, which can decay into standard model particles through kinetic mixing. Because of the mass of A' , when it decays into a standard model photon and eventually additional leptons, it produces a lepton jet. This lepton jet is easily detectable by the Large Hadron Collider (LHC). Through analysis of simulated and real data, this project details the creation of histograms through simulated Monte Carlo to plot the invariant mass of lepton jets coming from a fixed mass of a simulated dark photon against the number of said events. We also apply trigger cuts to eliminate consideration of events we know do not come from a dark photon but produce similar lepton jets. These plots show that we can accurately reconstruct events from the accelerator for our analysis. Furthermore, this project tracks the creation of dark photon validation histograms that graph opposite sign dilepton jet mass against the number of events, plotting both data and major background sources. Now, our analysis can compare our background accelerator data with signal events, and thereby evaluate the effectiveness of our triggers.

Project ID: ENGN 11

9:40a.m. – 9:55a.m.

Title: Techno-Economic Analysis of Capacitive Deionization (CDI) Use for Separations of Biofuels in the Production Process

Presenter: Zuyu Liu

Mentor: Dr. Lauren Valentino, Argonne National Laboratory

Abstract/Project Intention:

Biofuels play a critical role in transitioning towards a sustainable energy system. Affordable and low-carbon biofuels are especially important for hard-to-electrify transportation sectors, such as aviation. Cost and efficiency are the main challenges faced in the biofuel production process, with the separation of valuable organic acids from fermented broth accounting for 50% of the total energy use and up to 70% of overall costs. Capacitive Deionization (CDI), an electro-chemical separations method traditionally used in water desalination, is a promising technology that offers lower energy consumption compared to conventional, thermal-based separations. The application of CDI for biofuel production at an industrial scale remains underexplored. This research aims to provide a techno-economic analysis of using CDI for biofuel precursors, evaluating both the technical and economical feasibility of CDI on larger scales. The findings investigate the industrial architecture of CDI modules, and a comprehensive analysis of important costs, enhancing understanding of CDI's potential and utilization in the transition to sustainable biofuels.

Project ID: MEDH 42

9:40a.m. – 9:55a.m.

Title: Metformin Analogs for Diabetes Treatment

Presenters: Iris Amit and Sriya Mudumba

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Metformin is used to treat Diabetes, a disease that plagues people worldwide. Metformin binds to the MF8 ligand, and strengthening that binding affinity indicates that there is less need for more doses of the medication.

Computational drug design was used due to its cost- effectiveness and ability to display certain molecules while also saving time for researchers.

Utilizing the SeeSAR program we designed approximately 750 analogs of metformin. We want the binding affinity value to be as small as possible as it means the drug is able to bind more effectively as the concentration needed for effective binding is a lot less. After designing other analogs, the five molecules that displayed the strongest binding affinities were selected to be analyzed in ADMETlab and admetSAR in order to discern physicochemical properties. Metformin's lower boundary for binding affinity is 3067829 nM, the molecule with the best binding affinity has a lower boundary binding affinity of 0.002008 nM, >1.5 billion times stronger binding, an extreme improvement of the binding affinity.

Project ID: CMPS 34
9:40a.m. – 9:55a.m.

Title: Investigating Environmental Justice through Urban Data Visualization

Presenter(s): Carissa Chen

Mentor(s): Fabio Miranda, University of Illinois Chicago

Abstract/Project Intention:

Urban areas worldwide are bustling with activity and constantly changing. This perpetual motion is a testament to the vibrancy of city life and provides a rich basis for gathering and analyzing data. Visual analytics is crucial in urban settings, and it is supported by many frameworks to investigate urban data more effectively. I used one of these frameworks together with data science methods to investigate the correlation between Chicago community areas' sustainability indicators and income levels. My project explores environmental justice in Chicago using its open data combined with the computational frameworks of Vega-Lite and the Urban Toolkit. We explored the correlation between income levels, the number of green roofs, environmental complaints, and environmental inspections in each community area. These patterns and trends have broader implications concerning environmental justice and can inform urban planning and policymaking in the future.

Session II – 10:00a.m. – 10:15a.m.

Project ID: BIO 01

10:00a.m. – 10:15a.m.

Title: Amyloid- β Oligomer Formations Over Time

Presenter: Maitreyi Pandey

Mentor: Mrs. Kirsten Viola and Dr. William Klein, Northwestern University

Abstract/Project Intention:

Alzheimer's disease is progressive, fatal, and the leading cause of dementia (Chang et. al, 2003). Based on the amyloid- β oligomer (A β Os) hypothesis, the brain damage that leads to Alzheimer's is due to soluble, ligand-like A β Os (Lambert et. al, 1998; Cline et. al, 2018). This experiment aims to understand how time affects the formation of A β Os, specifically at near- physiological concentrations. Understanding this process will enable us to learn more about how the A β protein changes from non-toxic monomers to neurotoxic oligomers. These experiments used A β films to produce samples at a concentration of 1 micromolar. We collected 10 samples, flash-frozen at predetermined time-points. Western blots and SEC were used to separate and identify oligomer structures based on size. WB results suggest that initial protein conformation consists primarily of tetramers, but oligomerize into higher molecular weight structures as the tetramer becomes less abundant. Comparing SEC to WB results suggests that our antibodies are sensitive to structures that are in less abundance than what the SEC can detect and are insensitive to dimers and monomers, which show up prevalently in the SEC. All data should be repeated for confirmation, including a new calibration of the columns being used to improve confidence in results.

Project ID: MEDH 33

10:00a.m. – 10:15a.m.

Title: Genetic Modification of Adenovirus Vectors for Bone Cancer Treatment

Presenter(s): Cindy Xu

Mentor(s): Tong-Chuan He, Yi Zhu, University of Chicago

Abstract/Project Intention:

Adenoviruses are frequently employed in clinical studies for oncolytic virotherapy and gene therapy, as well as for delivering genes to different cell types. The adenovirus family consists of non-enveloped DNA viruses with a linear genome of 30–38 kb. The use of human serotype 5 of species C adenovirus vectors is advantageous for delivering genes into a variety of dividing and non-dividing cells both in vitro and in vivo. These vectors allow for high-titer generation and extremely effective gene transfer. Two recombinant adenovirus lines have been constructed. One line contains a green fluorescent protein (GFP), and the other contains a red fluorescent protein (RFP) cassette. This fluorescence helps with precise titer determination. Multiple rounds of cell infection have been started to create a high-titer stock and establish a virus bank that can be used for virus production. The optimal temperatures for virus preservation and virus titer stability will be determined. By doing the above as well as adjusting parameters such as multiplicity of infection, and cell density, stable genes of interest will be effectively and efficiently delivered into mammalian cells by recombinant adenoviruses will be produced.

Project ID: MEDH 49

10:00a.m. – 10:15a.m.

Title: The Effect of Environmental Toxins on Motor Behavior of *Caenorhabditis Elegans*

Presenters: Manasa Balasubramanian, Johanna Frances Germa,
Brent Phillip Rodrigo, Annabelle Zhang

Mentor: Dr. Nicole Ross, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Amyotrophic lateral sclerosis (ALS) is a rare degenerative neuromuscular disease that affects motor neurons in the brain and spinal cord. Several recent studies have focused on a link between ALS and exposure to environmental toxins such as microplastics and herbicides. To simulate the potential effects of microplastics on a functioning nervous system, we introduced *Caenorhabditis elegans* (*C. elegans*) to the glyphosate-based herbicide Roundup and Polybead® polystyrene microspheres. We recorded the thrashing behavior of *C. elegans* before and after exposure to both Roundup and the polystyrene microspheres, as well as performing one-way ANOVA testing afterwards. Our findings revealed that varied concentrations of glyphosate and polystyrene microspheres significantly correlated with changes in thrashing behavior. From this, we concluded that exposure to varying levels of environmental toxins may lead to a change in motor behavior, typically shown through a decrease in thrashing activity. The insight gained from these experiments will give further insight into the effectiveness of *C. elegans* as a model for ALS and what specific proteins are affected when in the presence of microplastics.

Project ID: MEDH 01

10:00a.m. – 10:15a.m.

Title: Epidemiological trends of SARS-CoV-2 infections during pregnancy in Chicago

Presenter: Kavya Reddy

Mentor: Leena Mithal, Ann & Robert H. Lurie Children’s Hospital of Chicago,
Northwestern University, Feinberg School of Medicine

Co-authors: Mary J. Akel, Ashwin Sunderraj, Ramon
Lorenzo Redondo, Jeffery Goldstein, Ann & Robert H. Lurie
Children’s Hospital of Chicago, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

The COVID-19 pandemic has affected many individuals and the epidemiology of SARS-CoV-2 infections has varied significantly across age groups. Pregnant people were especially vulnerable and at higher risk of more severe infections. We investigated epidemiologic trends of SARS-CoV-2 cases in pregnant people compared to trends in children and adults in Chicago.

We identified positive SARS-CoV-2 pregnancies (March 2020-November 2022) at Prentice Women’s Hospital and SARS-CoV-2 cases in children (0-17 years) and adults (≥ 18 years) from the Chicago Department of Public Health. We then visualized our data using Excel and conducted statistical analysis including negative binomial models, granger causality modeling, and the “decompose()” function to assess seasonality. Our results showed that while all groups shared similar trends with notable seasonality and variant surges, SARS-CoV-2 cases in pregnancy were more statistically associated with adult cases ($p=0.006$) than children ($p=0.2$). Analysis limited to the first year of the pandemic yielded consistent results (adult $p<0.001$, children $p=0.2$). It remains important to study epidemiological trends in order to develop effective and tailored public health mitigation strategies aimed to protect vulnerable populations including pregnant people.

Project ID: MEDH 37

10:00a.m. – 10:15a.m.

Title: Local availability of medications for opiate use disorder across Chicago

Presenter: Diya Kamath

Mentor: Dr. Emma Childs, University of Illinois at Chicago,
Psychiatric College of Medicine

Abstract/Project Intention:

The main public health initiatives to address the pandemic of lethal opiate overdoses have been to increase availability of medications for opioid use disorder (MOUD). Despite expanded access, studies have demonstrated the existence of community-level barriers. To date, none have looked at MOUD availability in Chicago. In this project, we analyzed the availability of suboxone films, Narcan/naloxone, and naloxone standing order (SO) at community pharmacies in Chicago (collected via telephone audit conducted 3/1/23-4/30/23) with relation to local rates of health insurance (Chicago Health Atlas) and neighborhood diversity (American Census Bureau) using hierarchical linear regression. The majority of Chicago zip's have diverse populations (64% have no predominant race or ethnicity). However, rates of uninsured persons varied between zip codes classified as predominantly White (5), Black/AA (11), and Hispanic/Latino (4)(White<Black/AA=Diverse<Hispanic/Latino). At the zip code level, the mean availability of naloxone SO, Narcan/naloxone, and suboxone films was 71%, 94%, and 84%, respectively. Neighborhood diversity and rate of uninsured residents independently predicted the availability of naloxone SO; availability was lowest in zip codes with the highest rates of uninsured residents and those with a predominantly White demographic.

Project ID: HIST 01

10:00a.m. – 10:15a.m.

Title: The “Progress” of Medicine: Late-Nineteenth Century Positivist Attitudes towards Indigenous Mexican Medicine in Francisco Flores’ Historia de la Medicina en México

Presenter(s): Aldo Magaña

Mentor(s): Eric Smith, PhD, Sheila Wille, PhD,
Illinois Mathematics and Science Academy

Abstract/Project Intention:

During Porfirio Díaz’s 1876-to-1910 dictatorship over Mexico (a period referred to as the Porfiriato), the Mexican political scene was dominated by positivism. The effects of positivism on late-nineteenth Mexican politics has been fairly well-studied, but its influence on Mexican medicine—and in particular, on the relationship between the emerging biomedical tradition and the millenia-old medical traditions of Mexico’s Indigenous populations—has not been. This paper seeks to fill that historiographical void.

In 1886, a Mexican medical student named Francisco Flores finished his thesis, entitled *Historia de la medicina en México, desde la época de los indios hasta la presente*. Explicitly influenced by positivism, this text offers a glimpse into the attitudes of a Porfirian biomedical doctor towards Indigenous Mexican medicine. This paper begins by positioning Flores’ *Historia* within the positivist-dominated intellectual climate of late-nineteenth century Mexico. Then, it shows that Flores’ positivist understanding of the “laws of history” led to his characterization of Indigenous Mexican medicine as an obstacle to progress that needed to be overcome by means of legislation and regulation. This paper continues by arguing that Flores’ attitude can be treated as a window into the ways that late-nineteenth century Mexican positivist biomedical doctors perceived Indigenous medicine in general, and concludes by suggesting ways that these perceptions may have influenced the nascent public health programs and biomedical research of Porfirian Mexico.

Project ID: MEDH 13

10:00a.m. – 10:15a.m.

Title: Machine Learning to Predict Next-Day Dialysis in Critically Ill Patients

Presenter(s): Manhitha Mamillapalli

Mentor(s): Nikolay Markov, Catherine A. Gao,
Northwestern University Feinberg School of Medicine,
Division of Pulmonary and Critical Care

Abstract/Project Intention:

Background: Some patients in the intensive care unit (ICU) experience acute kidney injury (AKI) or other conditions requiring dialysis as a treatment to support failing kidneys. Machine learning on electronic health record (EHR) data holds promise for tasks such as helping clinical teams with planning and for prognostic purposes.

Methods: Here we investigate the likelihood of a patient's next-day dialysis status and complications by performing predictive analysis using an XGBoost classification model.

Results: Data from 12,495 patient days in the ICU from 585 unique patients was used. Our best model using XGBoost model achieved excellent predictive performance with an AUROC of 0.89 at predicting next-day dialysis. On transition days, when a patient's dialysis status switched, the model performed poorly with only 0.48 AUROC.

Discussion: A machine learning model was able to predict with high performance next-day dialysis, but had trouble with transition days. Future studies can focus on longer lead windows and optimizing prediction for transition days.

Project ID: CMPS 24

10:00a.m. – 10:15a.m.

Title: How can we use NLP to understand the emergence of network ties?

Presenter(s): Raghav Sinha

Mentor(s): Dr. Noshir Contractor, Jane S. & William J. White,
Northwestern University, McCormick School of Engineering

Abstract/Project Intention:

The study of computer-human natural language interaction is the focus of the artificial intelligence field known as natural language processing (NLP). It entails creating models and algorithms that let computers comprehend, interpret, and produce human language. Language translation, emotion analysis, chatbots, speech recognition, and text summarization are just a few of the many uses for NLP. Natural language processing was founded in the 1940s to find a way to translate text between languages automatically. Since then, NLP has been a fundamental tool for the success of many different kinds of AI. The capacity of Natural Language Processing (NLP) to comprehend, interpret, and produce human language makes it applicable to a wide number of contexts. In machine translation programs like Google Translate, NLP is used to translate text between languages. It provides information, answers queries, and helps consumers through chatbots and virtual assistants like Siri, Alexa, and website chat interfaces. With natural language processing (NLP), organizations may better comprehend social media conversations, reviews, and consumer feedback by analyzing text's sentiment or emotional tone. In this paper, we will summarize research and its impact on the innovation of NLP, as well as identify possible areas of study for the future.

Project ID: MEDH 25

10:00a.m. – 10:15a.m.

Title: Optimizing Memory via Real-Time Monitoring of Neural Data with Adaptive Brain Stimulation Machine Learning Algorithms

Presenter(s): Ryan Cho

Mentor(s): James Kragel, University of Chicago

Abstract/Project Intention:

Aging and neurological disorders lead to neurodegeneration that decreases memory function. Deep brain stimulation (DBS) has emerged as a potential solution by stimulating neurons with electricity to enhance neuronal activity during memory tasks. This study hypothesizes that DBS improves memory when targeted towards deficient memory encoding states due to state-dependent effects by influencing brain networks related to semantic organization.

This study utilized data from 38 patients with implanted electrodes performing free-recall tasks with and without stimulation. The spectral data from recorded electrodes, which were fed into a personalized algorithm, modeled each patient's unique neural data, predicting memory encoding state at an area under the curve (AUC) of 98%. A subsequent DBS success classifier, using pre-stimulus memory encoding state qualities, achieved an 84% AUC for predicting memory outcome following stimulation. This study established that stimulation targeted at memory networks enhances memory by targeting poor encoding states. In addition to state-dependency, it was discovered that stimulation applied to the left lateral temporal cortex (LTC) enhanced the ability to create semantic clusters and recall performance using natural language processing metrics. While non-targeted stimulation leads to multifaceted results, targeted stimulation based on when and where factors introduce a promising treatment for improved episodic memory.

Project ID: MEDH 36

10:00a.m. – 10:15a.m.

Title: Topic Modelling Approaches for Identification of Topics within Clinical Notes of Emergency Department Patients with Opioid Misuse

Presenter(s): Madhav Hota

Mentor(s): Dr. Neeraj Chhabra, University of Illinois Chicago

Abstract/Project Intention:

Opioid misuse is a significant public health challenge in the US, with escalating impacts on emergency medical services and emergency departments. Patients with opioid misuse are often treated as a homogenous population when there are likely subgroups that may influence optimal clinical care. This study aims to investigate and identify these latent groups among patients with opioid misuse. A sample of 1200 UI Health emergency department encounters were retrospectively reviewed and annotated for the presence of opioid misuse using previously published methodology. Of these, 570 cases were positive for opioid misuse. A latent Dirichlet allocation model was then trained on the clinical notes from these patient encounters. Coherence scores for models encompassing 2-19 topics were calculated. The final model was chosen by balancing coherence scores with model complexity. The optimal model was determined to be a 9-topic model with the following topics represented: overdose/altered mental status, skin and soft tissue infection, cardiac disease, limb pain, mental health, critical illness, physical rehabilitation, respiratory conditions, and gastrointestinal/liver disease. These findings highlight the heterogeneity that exists within the population of patients with opioid misuse utilizing the emergency department and suggest that personalized treatment approaches should be investigated to improve patient outcomes.

Project ID: CMPS 27

10:00a.m. – 10:15a.m.

Title: Development of a Human-Mouse Chimera to Study the Toxic Effects of HIV Antiretroviral Drugs

Presenter(s): Aahana Das

Mentor(s): Dr. Jennillee Wallace, RUSH University

Abstract/Project Intention:

The course of treatments for HIV has been revolutionized by the development of antiretroviral drugs. However, in many instances, these drugs induce toxicity via mitochondrial dysfunction and the release of neurotoxins, and long-term toxicity remains an area of worry for people living with HIV. Our objective is to develop a humanized mouse model to study the toxic effects of HIV antiretroviral drugs on tissue monocyte-derived macrophages. First, immune-compromised mice were engrafted with human immune cells and we then verified whether these cells migrated to different tissues. To assess human cell trafficking to tissues, DNA was isolated from the brain, lungs, liver, heart, kidney, and spleen. We performed qRT-PCR using human and mouse-specific primers to determine the human: mouse DNA ratio, and quantify human DNA in the mouse tissues. Ongoing and future studies will utilize this model to further assess the toxic effects on monocyte-derived myeloid cells and their subsequent impact on brain tissue.

Project ID: MEDH 16

10:00a.m. – 10:15a.m.

Title: The Effects of XBP1 Agonist IXA4 on Hepatic and Serum Bile Acid Levels of FXRKO vs. C57BL/6 Mice

Presenter(s): Neev Patel

Mentor(s): Dr. Richard Green, Northwestern University

Abstract/Project Intention:

Bile is essential to digestion because it solubilizes fats for absorption in the intestine. The rate-limiting step in bile acid synthesis is the addition of hydroxyl at the C-7 position of cholesterol by the hepatic enzyme Cholesterol 7-alpha hydroxylase (CYP7A1). The gene CYP7A1 is regulated by the Farnesoid X Receptor (FXR), which activates the Small Heterodimer Partner (SHP) suppressing CYP7A1. Cholestasis occurs when bile secretion is impaired and can injure the liver. This activates the Unfolded Protein Response, including the protein XBP1, which protects the liver from excess bile salts. IXA4 is an XBP1 agonist drug, and we tested the effects of IXA4 on FXR knockout mice. Methods: We treated FXRKO and C57BL/6 mice with 100mg/kg IXA4 for 48 hours. We used quantitative qPCR to measure gene expression of XBP1 downstream targets and using a spectrophotometric assay to measure serum and hepatic bile acid levels. Results: There was a 95% decrease in serum bile acid level ($P < 0.05$) and a 20% decrease trend in hepatic bile acids ($P = 0.1116$) in the treated FXRKO mice as opposed to those injected with vehicle solution. Conclusion: The IXA4 injection decreases serum and possibly hepatic bile acid levels, but further examination is required to determine the specific gene expression changes.

Project ID: MEDH 34

10:00a.m. – 10:15a.m.

Title: A Novel Treatment for Triple-Negative Breast Cancer: NS1643

Presenter(s): Jaden Blankenship

Mentor(s): Richard D. Minshall, Samuel Man Lee, University of Illinois at Chicago

Abstract/Project Intention:

Triple Negative Breast Cancer (TNBC) remains a significant cause of mortality, with 150,000 deaths annually worldwide. To address this staggering statistic, a comprehensive literature review was undertaken to explore TNBC treatments, revealing phosphorylated caveolin-1 (Cav-1) expression as pivotal in breast cancer metastasis. Interestingly, human triple-negative breast cancer cells (MDA-231) uniquely overexpress the K⁺ channel Kv11.1, providing a potential drug target not present in normal breast epithelia. Treatment of MDA-231 cells with Kv11.1 activator NS1643 induced the dephosphorylation of Cav-1 and its resultant dissociation of β -catenin, a crucial regulatory protein for assembly of cell-cell adhesion complexes, towards desmosomal proteins. This experiment aimed to test if MDA-231 cells treated with NS1643 will reduce tumor cell migration and promote contact inhibition via liberation of β -catenin and its resultant interactions with desmosomal proteins. The procedure involved treating MDA-231 cells with NS1643, conducting Western blot analysis of desmosomal proteins, and measuring electrical resistance of cell monolayers grown on gold-plated microelectrodes with an epithelial cell impedance system. Results thus far indicate NS1643 rapidly increases the expression of desmosomal proteins and monolayer resistance within 24 hrs. By uncovering a novel pharmacological approach to inhibit TNBC metastasis, this study aims to not only extend patients' lives but also enhance their overall quality of life.

Project ID: ENGN 04

10:00a.m. – 10:15a.m.

Title: Experimental Paradigm for Studying Abnormal Hip Torque Coupling During Gait Initiation After Stroke

Presenter(s): Nashra Younus

Mentor(s): Honchul Sohn & Mounika Pasavula, Northwestern University

Abstract/Project Intention:

Post-stroke lower limb impairments cause significant challenges in balance during gait initiation. While studies have mainly focused on behavioral impacts of these impairments, the understanding of neural constraints persist a significant gap. This study is aimed to investigate the abnormal hip extension-adduction coupling previously found in individuals with stroke. We hypothesize that when stepping with the non paretic limb, the reduced ability in the paretic standing limb to abduct while extending will impact frontal plane balance. To test our hypothesis, we propose to induce the abnormal hip extension-adduction coupling by increasing hip extension torque demand in the stance limb during gait initiation with a longer step and/or by applying resistance through a passive exosuit. Towards this end, here we present the initial development and validation of the proposed paradigm in one healthy participant, under two (normal and long) steps x (with and without) resistance conditions. Our experimental setup successfully increased hip extension torque demand, which is expected to induce abnormal hip extension-adduction coupling in individuals with stroke. The findings from this experiment will show the effects of neural constraints on the lower limb after stroke during tasks such as gait initiation which may be effective for future therapeutic interventions.

Project ID: PHYS 25

10:00a.m. – 10:15a.m.

Title: Pulse Level Compilation of Parameterized Gates via Neural Networks

Presenter(s): Fredy An, Bikrant Bhattacharyya, Dominik Kozbiel

Mentor(s): Andrew Goldschmidt, University of Chicago

Abstract/Project Intention:

Recently, a class of hybrid quantum-classical algorithms called Variational Quantum Algorithms (VQAs) have been investigated as a promising candidate for practical near term algorithms. VQAs require quantum circuits that consist of parameterized gates, which can then be fine tuned to minimize cost functions. In practice, implementing a quantum gate requires compiling it to a sequence of pulses that can be executed on hardware. However, constructing a new set of pulses for each distinct angle encountered in the optimization loop of a VQA is an impractical approach due to the large classical computation overhead required to do so. In this work, we explore a Neural Network solution to the problem. The network is first pre-trained on pulses obtained by using Quantum Collocation (implemented using the PICO framework) for a set of sampled parameter values, and then trained over all parameter values to minimize gate infidelity. We demonstrate that this neural network approach successfully interpolates between provided pre-trained sample pulses, creating high fidelity gates, while also successfully reducing the pulse schedule time for circuits when compared to the standard basis set decompositions. The latter is important for near term applications, where the effects of finite depolarizing and dephasing times are important considerations.

Project ID: MEDH 41

10:00a.m. – 10:15a.m.

Title: Synthesis of Benzoxazole-based Compounds for Leishmaniasis

Presenter (s): Mesoma Akpuokwe, Kosi Okeke

Mentor (s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a disease caused by parasites of the Leishmania genus. The disease is prevalent in tropical and subtropical regions, such as parts of Asia, Africa, the Middle East, and Latin America. Leishmaniasis is caused by the bite of infected sandflies, which transmit the parasites during their blood-feeding process. It starts out with an infected sandfly biting a mammalian host, introducing the Leishmania parasites into the bloodstream. Once in the host's bloodstream, the parasites invade and replicate within macrophages, the immune system cells. There are treatments present to combat this disease but there are some failures surrounding it. For example, the drugs used to treat this disease such as amphotericin B and miltefosine, can cause toxicity which can lead to gastrointestinal disturbances. There have also been reports of drug resistance against these treatments which means that the disease can fight against the medications made to kill the virus or bacteria. Another failure is that access to effective treatment for Leishmaniasis is limited because drugs can be very costly and there is low availability of healthcare facilities. This contributes to the lack of access to treatment to people affected by this disease. The purpose of our study is to synthesize potential therapeutics for Leishmaniasis. This is performed by combining an amine and an acid to develop new compounds that had not been tested before. Our first reaction was an amine combined with the carboxylic acid called 4-(Methylsulfonyl) Benzoic Acid - C₈H₉O₄S. Our second reaction was an amine combined with a carboxylic acid called m-tolylacetic acid. After developing two compounds by combining acids with amine, we tested them to see how much of a pharmaceutical benefit they can have in battling Leishmaniasis.

Project ID: PHYS 30

10:00a.m. – 10:15a.m.

Title: Determining Lepton Sign Mismeasurement Rate from the CMS detector to Identify Doubly Charged Higgs Boson Decay Background

Presenter(s): Kyler Ponx; Jeremiah Suarez

Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The doubly charged Higgs Boson is a particle predicted by various theoretical models such as the Type II seesaw model. In assisting the search for possible doubly charged Higgs boson decay, we determine the lepton sign mismeasurement rate of lepton pairs reconstructed near the Z-peak mass to calculate expected background in doubly charged Higgs decay signature detection. We use data from the CMS detector at the LHC in collaboration with Fermilab. The Standard Model has no same sign lepton decay channels, thus all same sign events are the result of combinatorial background and sign mismeasurement. Since identification spikes near the z-peak are mostly misidentified sign lepton pairs, it is useful for estimating the overall rate of lepton sign misidentification in CMS. To do this, we fit the peak in the same sign data and the opposite data, fit the data without the peaks, and compare the difference of their integrals to find the rate of mismeasurement for future extrapolation.

Project ID: PHYS 26

10:00a.m. – 10:15a.m.

Title: Analysis of The Charged Track Multiplicity of Neutrinos in The ProtoDUNE-ND Experiment

Presenter: Sebastian Mark

Mentor: Aleena Rafique, Argonne National Laboratory

Abstract/Project Intention:

The ProtoDUNE-ND (aka “2x2”) experiment is a prototype of the Deep Underground Neutrino Experiment (DUNE) that is designed to study properties of neutrinos and their interactions. The goal of DUNE is to uncover the properties of neutrinos to understand the mystery of matter-dominance of the universe. The ProtoDUNE-ND experiment is a smaller scale prototype of the DUNE near detector. We are working on finding the charged track multiplicity of the neutrinos in ProtoDUNE-ND. In the past, experiments rarely found more than 1 interaction every spill (time when the data is captured). However, with a larger detector and being closer to the beam source, ProtoDUNE-ND will start to experience multiple interactions every spill. The ProtoDUNE-ND experiment is set to start gathering data soon. As we need to differentiate the interactions to study the neutrinos, we aim to take a few steps in the direction of understanding the kinematics of different particles.

Project ID: CHEM 09

10:00a.m. – 10:15a.m.

Title: Synthesis of a Benzoxazole Derivative to be Used for the Treatment of Tropical Cutaneous Leishmaniasis

Presenter(s): Aditya Hansoty, Ayan Trivedi, Prabhav Veeramachaneni

Mentor(s): Dr. John Thurmond: Illinois Mathematics and Science Academy

Abstract/Project Intention:

Cutaneous Leishmaniasis is an infectious parasitic disease caused by the bite of infected female sandflies and characterized by disfiguring, slow healing, and re-forming skin lesions that leave lifelong scars. The goal of our effort was to synthesize derivatives of a Benzoxazole to be tested by the Drugs for Neglected Diseases Initiative (DNDi) for their effectiveness in treating cutaneous leishmaniasis. Three final compounds were synthesized from the reaction of carboxylic acids 3-chlorobenzoic acid, 3- (methylthio) benzoic acid, and 3-methoxybenzoic acid with the amine, 2-amino-5-chlorobenzoxazole.

Project ID: CMPS 36

10:00a.m. – 10:15a.m.

Title: A Case Study of Unfair Discrimination within Auto Insurance Pricing Models

Presenter(s): Zhuoer Cai

Mentor(s): Dr. Frank Quan, University of Illinois Urbana Champaign

Abstract/Project Intention:

In the insurance industry, pricing algorithms are often closely guarded as trade secrets. So, when Allstate Insurance publicly disclosed detailed information about its new auto insurance pricing algorithm, it drew significant attention. It is worthwhile to meticulously examine the data, and further uncover if there are disparities that disproportionately affected consumers. Considering the national presence of Allstate Insurance, inspecting its pricing model could provide valuable insights into the broader landscape of auto insurance pricing models. Using the state-of-the-art correlation method, Chatterjee's Correlation Coefficient, and Python programming, we conducted an analysis of Allstate's public data in conjunction with Maryland Census data. This analysis revealed that there is a moderate positive correlation between the race of the consumer, their assigned risk level, and their suggested price increase, as determined by the pricing model. These results suggest that pricing bias is potentially a concern for the auto insurance industry and that greater regulation and oversight should be put into creating pricing algorithms to mitigate bias.

Session III – 10:25a.m. – 10:40a.m.

Project ID: BIO 15

10:25a.m. – 10:40a.m.

Title: Understanding the Disease Progression of Acute Myeloid Leukemia in Murine Models and Identifying Therapeutic Targets for Leukemic Stem Cells

Presenter(s): Sreehaas Chinnala

Mentor(s): Francis Suh, Dr. Hao Wang, Dr. Elizabeth Eklund,
Northwestern University, Feinberg School of Medicine,
Department of Hematology/Oncology

Abstract/Project Intention:

To learn more about the roles of Hox A9/A10 in leukemia development, we use an in-vivo model for myeloid differentiation. Mixed lineage leukemia 1 (MLL1) is a gene rearrangement of Acute Myeloid Leukemia (AML). Ubiquitination, the addition of ubiquitin to proteins, also modifies AML Patients with MLL-1 rearranged variation of AML do not survive for more than six months with standard cancer treatments (surgery, chemotherapy, etc.). We look for the effects of increased activity of the MLL1 gene for drug resistance in leukemia and hope to find new treatments. In addition, bone marrow transplants are performed in murine models to study how different treatments affect leukemia cells and determine how leukemia is caused by Hox proteins. Integrated stress responses (ISRs) are homeostatic responses that help cells adapt to their environment and maintain themselves, working against cancer treatments. Specific doses and combinations of drugs are tested on these murine models, and their effects are measured to determine the future effects of exposing humans to these same drug combinations and dosages.

Project ID: BIO 08

10:25a.m. – 10:40a.m.

Title: The Context-dependent Effects of Fiber Fermentation on *Klebsiella pneumoniae* Suppression

Presenter: Lucinda Stocco

Mentor: Margaret Carroll, University of Chicago

Abstract/Project Intention:

The gut-microbiome is a crucial part of the human digestive system, responsible for the regulation of metabolism as well as the immune system. Fiber and high fiber diets have been researched to understand their correlation with the health of the gut-microbiome. However, recent findings have shown that fiber can have additional health effects, such as inflammation, in certain populations (Wastyk et al., 2021). This unexpected result may stem from variations in individual microbiomes, influencing its interactions with dietary fibers and its resulting gut composition.

The Raman lab investigates creating diverse microbial communities in different metabolic backgrounds to define functional relationships. Their model focuses on engineered bacterial communities targeting the antibiotic-resistant pathogen, *Klebsiella pneumoniae* (Oliveira et al., 2024). I am working to investigate a small part of this process, specifically how dietary fiber influences microbial community function, hypothesizing that fiber fermentation varies based on metabolic background.

In the experiment, *Klebsiella pneumoniae* is cultured in five unique commensal gut strains, with several media conditions supplemented with various fibers. In reviewing the *Klebsiella pneumoniae* abundance and pH levels, the preliminary results indicated context-dependent effects of fiber fermentation on *Klebsiella pneumoniae* suppression. This highlighted the detailed interaction between fiber, microbial communities, and environmental factors.

Project ID: MEDH 06

10:25a.m. – 10:40a.m.

Title: Measuring the Vital Function of the Skin Barrier

Presenters: Sindhu Chalasani, Aarna Patel

Mentor: Dr. Bethany Perez White, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

The epidermal compartment of skin balances proliferation for tissue self-renewal and terminal differentiation for essential barrier function. This study examines how keratinocytes, the cells that comprise the epidermis, build a barrier as they become terminally differentiated. To assess the function of the epidermal barrier, we used an epithelial voltohmmeter (EVOM2) to measure the transepithelial electrical resistance (TEER, $\Omega \cdot \text{cm}^2$) of keratinocyte cultures, where increased resistance indicates a stronger barrier. Keratinocytes were isolated from human skin samples and cultured in M154 media specific for keratinocyte propagation. We directly compared the barrier function of proliferating versus differentiating keratinocytes over the course of seven days. Proliferating conditions were maintained by keeping cultures in low calcium (0.07 mM); differentiation was induced by increasing calcium levels to 1.2 mM (high calcium). We probed each well at three locations within the culture to ensure accurate measurements. Cells were plated at a density of 1.5×10^6 cells/well (well surface area: 4.67 cm^2). We performed TEER over a course of seven days, taking measurements at different time points. We found that cells in a high calcium environment had statistically significantly higher resistance compared to those in low calcium. The results of this assay can help identify what perturbations may affect the barrier positively or negatively.

Project ID: MEDH 03

10:25a.m. – 10:40a.m.

Title: Experimental Paradigm for Studying Impairments in Bilateral Reaching and Grasping after Stroke

Presenter: JaeJun (JJ) Park

Mentor: M. Hongchul Sohn, Northwestern University

Abstract/Project Intention:

After stroke, patients experience significant loss in performing activities of daily living (ADL) such as reach-and-grasp. The paresis mainly affects the side of the body contralateral to the lesion and slight deficits to the ipsilesional side, causing an asymmetry in impairment. However, we lack a comprehensive understanding of how functional reach-to-grasp is impaired following stroke, especially during bi-manual tasks. This project in the long term aims to determine the impact of asymmetric arm impairments due to stroke on unilateral and bilateral reach-to-grasp movements. As a first step, we present the initial development of the proposed approach and feasibility demonstrated in preliminary data from three healthy participants. Participants performed reaching and grasping movements to move a medially positioned engineered cube onto a higher-elevated platform unilaterally and bilaterally. Muscle activity was measured with electromyography (EMG) sensors, while the engineered cube provided insight into participants' physical interactions with the object, measuring force and motion, with an IMU sensor measuring the speed and acceleration of the cube. The quantification of unilateral and bilateral reach was feasible. Trends of similar acceleration profiles and different muscle activity in lateral triceps were found in both participants between unilateral and bilateral grasp. The insights from this study will ultimately lead to the development of better training and intervention methods to mitigate the impact of stroke in performing ADL such as reach-and-grasp.

Project ID: BHVSO 14

10:25a.m. – 10:40a.m.

Title: Investigating the Immigrant Paradox in Alcohol Consumption

Presenter: Ellen Nguyen

Mentor: Dr. Emma Childs, University of Illinois at Chicago

Abstract/Project Intention:

Alcohol use in America remains a complex issue shaped by cultural, historical, and socioeconomic factors, with variations that often highlight the immigrant paradox between immigrants and native-born Americans. It's been ingrained in many social customs, traditions, and religious practices across regions and demographics, making it vital to use those factors to understand differences in consumption rates between these two groups. At the start of the study, we hypothesized that consumption rates would be lower in immigrant populations due to previous studies on the subject having shown this. In this study, we used public access datasets (NSDUH 2018-2019) to compare the past year's alcohol consumption and past month's binge drinking (as a function of immigrant status). We qualitatively describe alcohol use rates in the origin countries of the largest immigrant populations in the US and discuss social and cultural influences as a basis for the immigrant paradox.

Project ID: BHVSO 12
10:25a.m. – 10:40a.m.

Title: The Role of Dopamine in the Prioritization of Information and Reward in Reinforcement Learning

Presenter: Carolyn Zhang

Mentors: Akram Bakkour, Abby Shivers, University of Chicago

Abstract/Project Intention:

Extant literature suggests that rewards in the environment drive learning. Additionally, older adults have demonstrated an impaired ability to learn from reward feedback. However, recent work indicates that information can be just as, if not more, useful as rewards in reinforcement learning paradigms. The Battleship project aimed to explore how these cues uniquely guide learning about one's environment differently across ages. Participants aged 18-57 completed a hidden shape search task inspired by the game Battleship. Participants had to infer the hidden shape on each trial. There were five shapes possible in the task. The time it took participants to learn the shape set was measured as well as the efficiency by which they searched for shapes. Surprisingly, older individuals learned the shapes faster than younger participants. Furthermore, faster learning was associated with a more efficient search process based on gaining information. Thus, learning in this task is improved by a search process that is based on gaining information from one's choices, which becomes more efficient as age increases. These results have the potential to inform our understanding of the cognitive mechanisms facilitating reinforcement learning and aid in developing interventions that optimize learning.

Project ID: PHYS 03

10:25a.m. – 10:40a.m.

Title: Simulations on pinwheel artificial spin ice on permalloys

Presenter: Ibrahim Bah

Mentor: Dr. Zhili Xiao, Northern Illinois University / Argonne National Lab

Abstract/Project Intention:

In 1820, the correlation between magnetic field and electricity was discovered by physicists and led to the study of electromagnetism. Magnets put charge particles (electrons) in motion, creating magnetic fields that make magnetic forces. This force can be measured through the use of a magnetometer, which requires real magnets and time to put the experiment together. These magnetic fields are not uniform, with their strength varying throughout the magnet from the surface to the core. Another option is running computer simulations to measure the magnetic fields of magnets. In my work, I coded with Python a permalloy magnet in Mumax3 and then ran simulations of varying depths on a permalloy magnet to reveal their magnetic fields. My data supports that the field strength of a permalloy magnet is strongest in the center and is weakest at the surface.

Project ID: RISE 08

10:25a.m. – 10:40a.m.

Title: Meta-Analysis Research to Discover Novel Method for Increasing the Role of NK Cells in LAG-3 Immunotherapy to Increase Efficiency of Melanoma Treatment

Presenter: Anirudh Saravanan, 11th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Dr. Munirathinam Gnanasekaran (Ph.D.),
University of Chicago at Illinois, Biomedical Science,
Dr. Anandaraman Veerapathran (Ph.D), Obsidian Biotherapeutics,
Dr. Krithika Kodumundi (Ph.D.), Iovance Biotherapeutics

Abstract/Project Intention:

The purpose of this meta-analysis was to determine the efficiency and stability of introducing natural killer (NK) cells in the existing immunotherapy for melanoma cancer known as LAG-3 CD223. NK cells are already in use for HIV immunotherapy, however, are not available in current cancer treatments. Including NK cells can allow the body to develop a natural means to attack the cancer cells and use additional immune responses to defend the body. The procedure started by taking the data from existing research done on the LAG-3 checkpoint and the logistics of immunotherapy at this location. The independent variable was the presence or absence of NK cells and the variable being tested was the change in success rate of the immunotherapy. The melanoma treatment which lacks the use of NK cells was compared to HIV immunotherapy which uses NK cells. The change in success rate allows for the true effect of the NK cells in immunotherapy to be analyzed. Overall, the use of NK cells in LAG-3 CD223 demonstrated positive performance and rejection of the null hypothesis based on the statistical significance of the one-way ANOVA test ($p < 0.0001$). The statistical tests also supported the stability of NK cells when being put into an environment to attack cancer cells. Not only were the cells able to be implemented into the immune systems for treatment, the NK cells were also able to increase efficiency by a statistically significant amount, rejecting the null hypothesis.

Project ID: MEDH 14

10:25a.m. – 10:40a.m.

Title: Exploring the Impact of Ceramide Synthesis Enzymes on Atopic Dermatitis Severity

Presenter(s): Mikaella Moraga

Mentor(s): Amy S. Paller, MD, MS; Nihal Kaplan, PhD;
Northwestern University, Feinberg School of Medicine,
Department of Dermatology

Abstract/Project Intention:

Atopic dermatitis (AD; eczema) is a chronic skin disorder characterized by inflammation, itching, and compromised skin barrier function. Pathogenesis involves genetic factors, immune dysregulation, and skin barrier ceramide alterations. This research project explores the relationship between the ceramide de novo pathway and AD severity. Severity was determined serially based on assessing erythema, scaling, edema, and erosion using a 12-point scale (each 0-3) in a mouse model of AD induced by MC903 application on the ear. Ear samples were collected on challenge days 1, 4, and 9. RNA was extracted for quantitative real-time PCR to assess changes in biomarkers. Maximum severity was reached at 4 days in terms of the clinical severity scale and cytokine changes. As found in human AD, expression of Sptlc3, encoding a key enzyme in de novo ceramide synthesis in differentiated skin, was significantly reduced in control mouse skin treated to induce AD. However, mice with the knockout of Sptlc3 did not develop AD spontaneously and, when treated topically with MC903, did not show increased AD severity or skewing of cytokines. These results suggest that other factors involved in de novo ceramide synthesis can compensate for the reduction in Sptlc3 in mouse skin, which deserves further exploration.

Project ID: CMPS 01

10:25a.m. – 10:40a.m.

Title: Microturbine Decarbonization with Machine-Learning Regression Modeling

Presenter: David Biruduganti

Mentors: Dr. Chandrachur Bhattacharya, Dr. Debolina Dasgupta ,
Argonne National Laboratory

Abstract/Project Intention:

Authorities all across the world are trying to minimize carbon dioxide (CO₂) emissions, and this decarbonization step is necessary if the global climate issue is to be resolved. Researchers at Argonne have modified a natural gas-burning microturbine to burn natural gas-hydrogen fuel blends with the aim to reduce CO₂ emissions. Emissions and efficiency data are obtained via experiments performed at Argonne. This research project demonstrates the use of machine learning Gaussian Process Regression (GPR) approaches to build data-driven models of the microturbine system. The collected experimental data is used to train the GPR models. The models are then used to determine the optimal operational parameters of the microturbine that minimize harmful emissions while maximizing efficiency. This study uses multi-output regression and the model confidence intervals to evaluate the performance of the microturbine under the full range of operating parameters. This project also determines the extent to which CO₂, CO, and NO_x emissions are altered when hydrogen is used as a substitute for natural gas and will lead to future decarbonization prospects.

Project ID: PHYS 10

10:25a.m. – 10:40a.m.

Title: The Study of Auto-playing Algorithm for Quantum

Presenter: Aditya Kumar

Mentor: Dr. Kishor T. Kapale, Western Illinois University,
Department of Physics

Abstract/Project Intention:

A popular Artificial Intelligence (AI) algorithm in the gaming world used for the Robo player is called Minimax. This paper presents research aimed at improving the efficiency of minimax algorithms in the context of quantum chess, a variant of traditional chess that incorporates principles of quantum mechanics. Quantum chess introduces additional complexity due to the superposition and entanglement of quantum pieces, leading to a vastly larger game tree compared to classical chess. The traditional minimax method becomes very slow when the depth of an internally simulated gameplay increases. Moreover, the minimax can find a wrong move as it may miss a costly move by the opponent lurking beyond the depth being searched. This is called a Horizon effect. We took an approach called “quiescence search” and applied it to quantum chess. It looks beyond the simulated depth till the end of the game to identify the lurking danger and eliminate those moves from the search space. We compared the quiescence algorithm with the minimax with move ordering. Our simulation results demonstrate the effectiveness of the proposed techniques for quantum chess.

Project ID: CMPS 17

10:25a.m. – 10:40a.m.

Title: Sentiment and Topic Modelling in Tweets and News Articles from the Russia-Ukraine War

Presenter(s): Himani Musku

Mentor(s): Dr. Timothy Reid and Mr. Nour Jedidi,
MIT Lincoln Laboratory

Abstract/Project Intention:

Beginning in February 2022, Russia's invasion in Ukraine marked one of the largest invasions of a European country since World War II and impacted numerous people worldwide. Our project aims to study public opinions and topics of discussion during this international crisis by analyzing daily tweets and news articles from April 2022 to June 2023. For our analyses, we utilized various Natural Language Processing libraries in Python to identify shifts in topics and compute sentiment. We used the BERTopic model to create topics and categorize tweets and news articles by topic. After applying a sentiment model on the tweets, we discovered the sentiment distribution of the tweets was 57% positive, 34% negative, and 9% neutral. Additionally, we investigated the correlation between the location associated with a tweet and its sentiment and found that tweets located in Nigeria and India were predominantly positive, while those in Ukraine were mostly negative. Furthermore, using a hashtag-prediction model, we determined that the majority of tweets and news articles were pro-Ukraine or neutral, while almost none were pro-Russia. These findings share valuable insights into the global perspectives on the Russia-Ukraine war as well as provide a framework for future analyses on other international crises.

Project ID: CMPS 22

10:25a.m. – 10:40a.m.

Title: Using a Framework to Evaluate the Performance of Explainable AIs on Deepfake Detection Models

Presenter(s): Kavya Uppal

Mentor(s): Dr. Yan Yan and Mr. Junyi Wu, Illinois Institute of Technology

Abstract/Project Intention:

As the number of deepfake image generators has skyrocketed, so has the number of deepfake detection models. However, explainability in these models remains underexplored, which is the key to building trust with users, and these are black box models. To address this issue, we studied how humans can understand the model's justification behind its decision by integrating explainable AIs (XAIs) with a deepfake detection model. We tested the model on deepfaked images of human faces by integrating it with 2 XAI methods - Gradient-weighted Class Activation Mapping (Grad-CAM) and Local Interpretable Model-Agnostic Explanations (LIME). In our research, we noted that the XAIs commonly identified deepfakes by picking on lighting differences in deepfakes. Furthermore, we wanted to understand which XAI method offers clearer insights to users on a deepfake detection model's outputs. To this end, we developed a framework to evaluate the two widely used XAI methods: Grad-CAM and LIME. This framework evaluated the XAI methods focusing on interpretability, explainability, clarity, and distraction. Based on the evaluation, we revealed that Grad-CAM yields more effective explainability results than LIME.

Project ID: MEDH 46

10:25a.m. – 10:40a.m.

Title: Synthesis of the Nanoscintillators and Characterization of the Nanoparticles Involved in X-Ray Activated Therapy for Cancer Research

Presenter(s): Jedrael Chintha

Mentor(s): Chin-Tu Chen, Hannah Zhang, University of Chicago
Department of Radiology

Abstract/Project Intention:

In cancer treatment, nano-scintillators have emerged as crucial for advancing X-ray-activated therapy. These innovative materials possess a unique ability to convert X-ray radiation into visible light, enhancing the effectiveness of treatment and reducing damage to healthy tissues. This paper provides an in-depth exploration of the synthesis and characterization of nano-scintillators designed explicitly for this purpose. It delves into various fabrication techniques to create nanoparticles with precise control over their size, shape, and composition, optimizing their light-emitting capacity and ensuring compatibility with the human body. The characterization process involves a multidisciplinary approach, utilizing spectroscopic, structural, and imaging analyses to gain a comprehensive understanding of the properties and performance of the nanoparticles when exposed to X-ray radiation. A thorough grasp of these nanoparticles' physical and chemical characteristics is crucial for their successful integration into cancer therapy protocols. As a result, this study makes a significant contribution to the development of next-generation nanomaterials, ultimately improving targeted and efficient cancer treatment strategies and opening up new avenues for research in the field of oncology.

Project ID: MEDH 35

10:25a.m. – 10:40a.m.

Title: Bi-phasic regulation of miR-17~92 in Pulmonary Arterial Smooth Muscle Cells (PASMC)

Presenter(s): Arjun Cherukuri

Mentor(s): Dr. Tianji Chen, University of Illinois Chicago

Abstract/Project Intention:

We have reported previously that during hypoxia exposure, the expression of mature miR-17~92 was first upregulated and then downregulated in PASMC and in mouse lungs in vitro and in vivo. Here we investigated the mechanisms regulating this bi-phasic expression of miR-17~92 in PASMC in hypoxia. We measured the level of primary miR-17~92 in PASMC during hypoxia exposure and found that short-term hypoxia exposure (3%O₂, 6 hours) induced the level of primary miR-17~92, while long-term hypoxia exposure (3%O₂, 24 hours) decreased its level, suggesting a bi-phasic regulation of miR-17~92 expression at the transcriptional level. We found that short-term hypoxia-induced upregulation of miR-17~92 was HIF1 α and E2F1 dependent. Two HIF1 α binding sites on miR-17~92 promoter were identified. We also found that long-term hypoxia-induced suppression of miR-17~92 expression could be restored by silencing of p53. Mutation of the p53-binding sites in the miR-17~92 promoter increased miR-17~92 promoter activity in both normoxia and hypoxia. Our findings suggest that the bi-phasic transcriptional regulation of miR-17~92 during hypoxia is controlled by HIF1/E2F1 and p53 in PASMC: during short-term hypoxia exposure, stabilization of HIF1 and induction of E2F1 induces the transcription of miR-17~92; while during long-term hypoxia exposure, hyperphosphorylation of p53 suppresses the expression of miR-17~92.

Project ID: ENGN 12

10:25a.m. – 10:40a.m.

Title: An Investigation in the Rat Whisking System in the Context of Mechanical Engineering

Presenter: Ebba Kaulas

Mentor: Mitra Hartmann, Northwestern University

Abstract/Project Intention:

To further understand the neurological process of rat whisking
This study utilizes a combination of projects, both computational and mechanical, in order to better understand the rat whisking system. Rat whiskers display an incredible ability to detect objects through contortion and contact, which send mechanical signals that help the rat process their surroundings. A series of videos of two different rats interacting with circular and square objects were taken by a partner lab, and MATLAB was used to individually track and label the whiskers in the C row. Through a subsequent series of MATLAB programs, the whiskers' movements were tracked and labeled, and forces at the base of the whisker were computed. Additionally, through several stages of mechanical modeling, whisking was simulated and the models' performance was assessed.

Project ID: PHYS 32

10:25a.m. – 10:40a.m.

Title: Exploring Convection in the Vicinity of Localized Decreases in Thermal Diffusivity

Presenter(s): Brandon Rogers

Mentor(s): Liam O'Connor, Northwestern University,
Center for Interdisciplinary Research in Astrophysics

Abstract/Project Intention:

Context Computational convection simulations are a critical tool for understanding the dynamics of a variety of different environments; including the complex interiors of stars. Methods Direct-Numerical-Simulations of Rayleigh-Bernard convection are performed within a periodic rectangular domain. A localized decrease in thermal diffusivity (α) is imparted within the domain at a certain temperature, with a parameterized amplitude (A) of decrease. Runs are performed at a constant Prandtl number ($Pr = 1$), and aspect ratio ($\Gamma = 4$). Simulations are run within a comprehensive set of amplitudes between $A = 0.3$ and $A = 0.9$, and at Rayleigh numbers between $Ra = 10^6$ and $Ra = 10^7$. The vertical heat fluxes of the system, along with globally-averaged Reynolds and Nusselt numbers are also collected as a measure of turbulence and convective efficiency.

Results The convective heat flux showed significant differences between the nominal ($A = 0$) and decreased cases ($0 < A < 1$). No strong change was observed in the Reynolds or Nusselt numbers for various amplitudes, however interesting behavioral changes were found for $Ra = 4 \cdot 10^7$.

Discussion The lack of significant change in for the majority of amplitudes indicates a conservation of convective efficiency in the vicinity of decreases in thermal diffusivity. The work gathered here has far reaching implications on astrophysical systems such as variable stars.

Project ID: CHEM 16

10:25a.m. – 10:40a.m.

Title: Synthesis of Potential Treatments for Leishmaniasis

Presenter(s): Jazmyn Johnson, Alyssa Hernandez, and Raven McKelvin

Mentor(s): Dr. John Thurmond, Illinois Math and Science Academy

Abstract/Project Intention:

Leishmaniasis, caused by Leishmania parasites, poses a significant health burden globally, particularly in tropical regions. Despite its prevalence and impact, current treatments are expensive, often requiring hospitalization, and face challenges such as drug resistance. This study aims to develop more effective and affordable treatments for various forms of leishmaniasis. Using the compound DNDI0003202883 as a starting point, two carboxylic acids were incorporated to enhance its efficacy. N-(5-chloro-1,3-benzoxazol-2-yl)-2-Dimethylphenylacetamide and N-(5-chloro-1,3-benzoxazol-2-yl)-2-Trifluoromethylphenylacetamide were created using a synthetic procedure involving benzoxazole-2-amine and carboxylic acids. TLC, NMR, FTIR, and ADME analytical characterization revealed the compound's effective synthesis and similar qualities to those of the lead compound. Compound 1 (carboxylic acid #3) and Compound 2 (carboxylic acid #11) yielded 25% and demonstrated ADME qualities that were comparable to DNDI0003202883, all without violating Lipinski's Rule. This compound class presents a pathway for further optimization and development of novel treatments for visceral leishmaniasis.

Project ID: PHYS 22

10:25a.m. – 10:40a.m.

Title: Optimal Dark Photon Triggers and the High Mass and Same Sign Dark Photon Control Region

Presenter: Gavin O'Malley

Mentor: Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

The phenomenon of dark matter has perplexed physicists for decades, and, to find it, some physicists hypothesize a dark sector of particles. These particles interact little with Standard Model particles and have an electromagnetism like force carried by dark photons. We find that using one trigger that searches for isolated muons with $p_T > 24 \text{ GeV}$ and another that searches for a muon with $p_T > 27 \text{ GeV}$ and another with $p_T > 37 \text{ GeV}$ works best for distinguishing dark photon events. With enough mass (we use samples of $0.3\text{-}4 \text{ GeV}$), it should decay into a tightly collimated pair of leptons, called a lepton jet. A high mass ($>10 \text{ GeV}$) filter and a same sign filter is used on these lepton jets to create a control region that a much higher proportion of background (Drell-Yan) events, which look much like a dark photon event, are categorized into than real dark photon events. About 98.8% of signal events fall into the signal region as opposed to only about 29.6% of background events. We hope that behaviors in this control region can be extrapolated to make a data driven estimate of the QCD background.

Project ID: PHYS 02

10:25a.m. – 10:40a.m.

Title: The Resistivity nature of thin films under select environmental conditions

Presenter(s): Yash Yardi

Mentor(s): Dr. Anil U. Mane, Argonne National Laboratory

Abstract/Project Intention:

Under the supervision of Dr. Anil U. Mane, this investigation explores the environmental factors and the electrical resistance characteristics of microchannel plates. In particular, it examines the fundamental query: What impact do variables such as choice of materials, film thickness, temperature variations, and atmosphere have on the resistance properties displayed by these thin films? As researchers in the field of materials engineering strive to expand their horizons, the findings of this research contribute valuable insights into the ever-evolving domain of thin films. By offering a deeper comprehension of the electrical attributes of thin films across diverse environmental conditions and physical parameters, this study enriches the collective knowledge base. This investigation concluded the inverse relationship between temperature and resistance for thin films in a vacuum and air. In contrast, the relationship between voltage applied and resistance in MCPs followed Ohm's law (a linear trend) for all samples in the dataset. Between environmental settings including air and vacuums, the general trend discovered over this dataset was a slightly faster electron multiplication and less gas obstruction through a vacuum, maximizing performance, while in air, resistance tended to be higher due to the minor decrease in electron flow efficiency. In terms of MCP properties, this study confirms the impact of channel geometry on resistance, demonstrating how the aspect ratio (length by diameter) is involved with manipulating resistance.

Project ID: MEDH 45

10:25a.m. – 10:40a.m.

Title: DNDi OSN “hit to lead” Potential Therapies for Leishmaniasis

Presenter(s): Gabrielle Pride, Trinh Yong

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is an infectious, neglected tropical disease that needs further funding for research purposes. Leishmaniasis is a parasite associated with neglected populations who experience poor domestic sanitary conditions, weak immune systems, malnutrition, and lack of financial resources. In majority of cases, this disease is fatal if left untreated. Treatments and therapies have shown a lack of effectiveness over the disease as well as problems regarding drug resistance and cytotoxins. Even with treatment, this endemic disease can still cause detrimental harm to one's physical and mental health. Organizations like the Drugs for Neglected Disease Initiative (DNDi) have made programs like the Open Synthesis Network (OSN) to help find better, safer treatments for neglected diseases like leishmaniasis. OSN has already made progress in developing new compounds to test in a leishmaniasis assay. One of their projects includes the evaluation of a hit against leishmaniasis from a thorough compound screen. Through synthesizing and purifying different derivatives of the lead compound DNDI0003202833 and four other structures, nine compounds were successfully made and will be sent to DNDi for testing in a leishmaniasis assay. These tests will contribute to future work in the leishmaniasis field.

Project ID: CMPS 37

10:25a.m. – 10:40a.m.

Title: Physically Based Simulation for Real-World Scenes

Presenter(s): Michael Meng

Mentor(s): Zhi-Hao Lin, UIUC and Shenlong Wang,
University of Illinois Urbana Champaign

Abstract/Project Intention:

3D reconstruction for images has several applications including mixed reality, game development, and film production. Recently, several 3D reconstruction algorithms have been proposed such as Neural Radiance Fields (NERF) and 3d Gaussian Splatting, which can synthesize realistic images from novel viewpoints. However, these algorithms do not model the physical interactions of objects in scenes, which are crucial for an immersive experience in real-world applications. In the virtual content creation pipeline, the physical interactions are usually simulated on synthetic scenes and objects, and such pipelines cannot easily generalize real-world scenes. The goal of the project is to perform physically based simulations on real-world scenes. For instance, we intend to add fluid dynamics (e.g. flood), particle systems (e.g. snow), and object collisions in scenes. The key idea is to leverage 3D gaussian splatting for 3D reconstruction from real-world images, and perform physically based simulations with simulators such as Nvidia Warp and Taichi.

Session III – 10:45a.m. – 11:00a.m.

Project ID: BIO 02

10:45a.m. – 11:00a.m.

Title: Stabilizing regulatory T cell function in vitiligo using Treg-promoting genes FoxP3 and TIGIT

Presenter(s): David Dickson

Mentor(s): Dr. Caroline Le Poole, Rohan Shivde, Northwestern University, Feinberg School of Medicine

Abstract/Project Intention:

Melanocytes are highly differentiated cells that produce pigment melanin inside melanosomes. Vitiligo is an autoimmune disease characterized by the immune system attacking melanocytes. The result is symmetric white patches on the skin devoid of melanin. While there is no cure for vitiligo, researchers have found too few regulatory T cells (Tregs) in the skin of patients with vitiligo, and injecting Tregs into mice can help stop the progression of the disease. However, this requires consistent reinjection of Tregs into mice, or the vitiligo will return. In this project, we introduce FoxP3 and TIGIT genes into DNA constructs to see if these Treg-promoting genes have lasting effects in stabilizing Treg function. Initially, the construct we developed contained both the TIGIT and FoxP3 genes, which proved problematic as the construct was too large for effective introduction into T cells. We decided to create two constructs that only had either one of the stabilizing genes to compare and contrast their efficacy to maintain a regulatory phenotype of host T cells. Currently, we are ligating the plasmid and genes together so we have the construct needed to examine if there are lasting effects on transduced Treg stability and efficacy in vitro in functional assays.

Project ID: BIO 09

10:45a.m. – 11:00a.m.

Title: Genomic, transcriptomic, and epigenomic correlates of outcome among patients with high-risk neuroblastoma treated with anti-GD2 antibody

Presenter(s): Sahil Veeravalli

Mentor(s): Mark Applebaum, University of Chicago

Abstract/Project Intention:

Neuroblastoma is the most common extracranial solid tumor in childhood. Those with high-risk (HR) disease have a long-term survival rate of approximately 60%. Patients with high-risk neuroblastoma treated with the Anti-GD2 antibody have demonstrated significant improvements in outcome. Despite these improvements, approximately 30-35% patients continue to experience poor clinical outcomes. We aim to develop a biomarker of outcome which may identify patients who may benefit from novel approaches. RNA-Seq data from GMKF and TARGET databases (n = 29) was utilized to identify gene expression patterns associated with outcome from patients with high-risk neuroblastoma treated with Anti-GD2 antibody. Univariate cox regression models were used for each individual gene. Genes whose expression is identified as significantly associated with EFS (event-free survival) were evaluated using multivariable Cox modeling as well as Kaplan-Meier analysis. We identified 16,430 genes associated with outcome. However, after accounting for multiple testing, none of the genes were statistically significant. We identified eight genes whose high expression was significantly and independently associated with worse clinical outcome in patients with high-risk neuroblastoma treated with Anti-GD2. These genes have the potential to be used as biomarkers of outcome, however, a larger sample size is needed for them to be statistically significant.

Project ID: MEDH 04

10:45a.m. – 11:00a.m.

Title: Measuring Proliferation of Keratinocyte Skin Cells

Presenter(s): Anjali Ali, Sarah Kumar

Mentor(s): Dr. Bethany Perez White, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

Skin is a vital organ that protects us from harmful substances including chemicals and bacteria. The epidermis, the outermost layer of skin, is in equilibrium between proliferation and differentiation to maintain tissue regeneration and barrier function, respectively. This equilibrium is largely dictated by calcium levels. Our study aims to understand the proliferation of keratinocyte skin cells in response to different calcium levels using the DNA assay. First, we isolated primary epidermal keratinocytes from skin tissue and propagated them for experiments. We conducted three independent replicate experiments of the DNA assay and ran an analysis using the Victor X5 instrument to find differences between cells exposed to high calcium versus those exposed to low calcium. The results showed that cells exposed to low calcium proliferated significantly more than those with high calcium content. Specifically, increased keratinocyte proliferation at day 6 in low calcium was shown to be statistically significant (p -value = 0.025). This confirms that proliferation conditions are ideal when there is low calcium. Our next steps are to run additional DNA assay replicates to further strengthen our results. We will also perform a DNA assay using a range of calcium concentrations to better understand calcium effects on keratinocyte proliferation.

Project ID: MEDH 07

10:45a.m. – 11:00a.m.

Title: The Effects of Different Prosthetic Foot and Ankle Stiffness Combinations on Transfemoral Prosthesis Users

Presenter(s): Coutinho Rachel, Yoonseo Kim

Mentor(s): Steven A. Gard, Northwestern University

Abstract/Project Intention:

Prosthetic foot stiffness is typically prescribed based on a person's weight and activity level, which may not be optimal for a particular patient. This study investigates how different prosthetic foot stiffness levels affect foot-ankle roll-over shape. The aim is to enhance gait function and prosthetic design for transfemoral prosthesis users. The study mechanically characterized the keel and bumper components on the College Park Venture Foot, which revealed an increasing stiffness from soft to hard configuration. Kinematic and kinetic data were utilized to create the roll-over shape (ROS) radii of the different combinations. A novel method was developed to create a best-fit circle of the roll-over shape and can be applied in future studies when a portion of the data is linear as the constraints mitigate the linear portion's impact on the ROS radius calculation. Minimizing the standard deviation allows for a streamlined procedure while maintaining the outcome precision. All the different keel-bumper combinations in the roll-over shape experiment were proportional to their measured stiffness in the mechanical testing. As the optimal ROS parameters for ambulation and standing create a range of ROS radii, the clinician can alter the foot-ankle stiffness combination in the prescription to optimize the user's gait.

Project ID: BHVSO 15
10:45a.m. – 11:00a.m.

Title: Disparities in alcohol use behaviors and disorders by race, ethnicity, and sex

Presenter(s): Fopefoluwa Ojomalade

Mentor(s): Dr. Emma Childs, University of Illinois at Chicago
Department of Psychiatry

Abstract/Project Intention:

The USA is currently facing its largest illicit drug consumption crisis among younger generations. Additionally, high-intensity drinking is currently at historically high levels prompting diverse prevention efforts. Research has revealed disparities in substance use behaviors and disorders by sex and ethnicity, yet few studies have examined intersectionality of these factors. A better understanding of how biological (sex) and environmental/societal (race, ethnicity) factors interact to influence substance use is necessary to develop effective targeted interventions. In this study, we utilized publicly available data from the 2022 National Survey on Drug Use and Health (SAMHSA, 2023) to examine sex differences in alcohol use behaviors and disorders by race and ethnicity. We also examined demographic variation in perceived stigma as a potential mediator of differences in drinking and AUD. Analyses revealed significant differences in drinking and AUD across demographic groups ($p < 0.0001$). Women consistently reported less drinking and AUD than men with notable variations by race and ethnicity. Sex differences in perceived stigma differed significantly between demographic groups. Our findings demonstrate complex interactions between biological and environmental influences on drinking, AUD, and treatment. Efforts to reduce AUD stigma and to implement harm reduction treatment approaches may improve disparities due to sex, race, and ethnicity.

Project ID: BHVSO 13
10:45a.m. – 11:00a.m.

Title: Centering Those Engaged in Transactional Sex: A PrEP Initiative

Presenter: Natalia Morales

Mentor: Dr. Randi Beth Singer, University of Illinois at Chicago

Abstract/Project Intention:

Reducing HIV infection is a public health priority, with the Getting to Zero (GTZ) initiative in Illinois striving to stop new HIV infections by 2030, ending the epidemic in the state. Increasing HIV prevention, self-management, and harm reduction among at-risk populations is critical. HIV prevalence in individuals engaged in transactional sex or sex workers is 12 times greater than the general population, highlighting the need for targeted prevention efforts. Increasing optimal use of pre-exposure prophylaxis or PrEP within this population can help with the advancement of GTZ by 2030. However, stigma, criminalization, and financial instability can hinder sex worker's access to HIV preventions including PrEP. Evidence-based, community-centered, effective PrEP care in clinical settings must consider these social determinants facing this community. A group care model can empower this community by centering patient needs while alleviating healthcare demands.

Utilizing the EPIS framework we sought to gain insight into Federally Qualified Health Center (FQHC) care providers and staff members perspectives on an evidenced-based group PrEP care model, Centering PrEP, for sex workers.

Project ID: MEDH 05

10:45a.m. – 11:00a.m.

Title: B7-H3 Specific CAR T-Cell Three-Dimensional Killing Assay on Synovial Sarcoma Cell Lines

Presenter(s): Ayesha Bobat

Mentor(s): Dr. Seth Pollack, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

The Pollack Lab focuses on treating sarcoma tumors by performing in-vitro two-dimensional and three-dimensional killing assays with chimeric antigen receptor (CAR) T-cell therapy, a form of immunotherapy. Specifically, CAR T-cells are made by isolating T-cells from a patient's blood and genetically modifying them to specifically target the human B7-H3 gene on the surface of a tumor. B7-H3 is a tumor surface antigen that is broadly expressed in sarcoma tumors and responsible for tumor metastasis. The purpose of this experiment was to determine the efficacy of our CAR T-cells by first determining the density of the spheroids formed by each of our four synovial sarcoma cell lines, Fuji, SYO1, HSSY2, and Yamato. Depending on the type of spheroids formed, we can determine which synovial sarcoma cell lines most closely mimic a solid sarcoma tumor in a three-dimensional cell culture and seed them in either a two-dimensional or three-dimensional killing assay accordingly. To further establish CAR T-cell efficacy, we then measure the CAR T's ability to kill sarcoma tumor spheroids in three-dimensional in-vitro killing assays with different ratios of effector cells to target cells (E: T) and concentrations of tumor cells.

Project ID: RISE 05 (poster only)

Title: The Impact of 2-Propanol and Sodium Hypochlorite on Quantity of Extracted DNA from Human Fingerprints for the Advancement of Forensic Fingerprinting Technologies

Presenter: Maggie McIntyre, 9th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Dr. Karen Visick (PhD), Loyola University of Chicago,
Dr. Peter Larson (PhD), Loyola University Medical Center, Genomics Facility,
Mrs. Gabrielle Peterson, Glenbard South High School

Abstract/Project Intention:

Physical fingerprints are frequently used as evidence in forensic investigations. However, fingerprint evidence is often chemically tampered with. The purpose of this experiment was to determine the individual impact that two chemicals: sodium hypochlorite and isopropyl alcohol have on the DNA that can be successfully extracted from a fingerprint. The results collected from this research can inform the advancement of fingerprinting technologies. Fingerprints were taken on sterile pieces of filter paper and individually treated with five microliters of 5% concentration bleach and 99% concentration isopropyl alcohol. The DNA was extracted from each piece of filter paper and quantified in nanograms using qPCR. A negative control group with no DNA and a positive control group were utilized along with two positive control treatments. It was determined that sodium hypochlorite and 2-propanol decrease the amount of DNA found in fingerprint samples. t-tests revealed that sodium hypochlorite ($p < 0.0001$) and 2-propanol ($p < 0.0001$) contained significantly higher amounts of DNA than the negative control treatment, rejecting the null hypothesis. The data from this experiment may serve as a basis for future research in order to optimize forensic technologies.

Project ID: RISE 09

10:45a.m. – 11:00a.m.

Title: Novel Convolutional Neural Networks for Improved Accuracy in User-Accessible Brain Tumor Detection

Presenter: Kevin Tian, 9th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Mr. Sean Fu, Tesla,
Mr. Thomas Walton, Georgia Tech,
Dr. Haohan Wang (Ph.D.), Carnegie Mellon University

Abstract/Project Intention:

The purpose of this design investigation was to create three user-friendly artificial intelligence (AI) models, specifically convolutional neural networks (CNNs), each designed using different and novel techniques for brain tumor detection from Magnetic Resonance Imaging (MRI) scans. These models aimed to assist medical professionals in overcoming inefficiencies, reducing human error, and surpassing existing models in accuracy by addressing various gaps and limitations in their work. The design began by developing three CNNs, each employing different techniques which were then trained on a preprocessed dataset containing MRI scans of healthy and tumorous brains. The third model, utilizing the pretrained VGG19 architecture, performed the best and was then integrated into a user-friendly website allowing hospital workers to upload MRI images for tumor identification. A CNN that could discern between different tumor types and malignancy levels was desired but unable to be developed. In conclusion, a user interface was developed featuring the superior CNN model. This model, which had the highest accuracy (99%) and lowest loss (0.01), and an F-score of 98, was able to address some of the gaps in previous models, including low accuracy, the use of generic architectures, and the lack of a user interface. It took the model mere seconds to predict the outcome of a scan, providing a significantly faster alternative to manual tumor detection which could take hours or even days.

Project ID: RISE 10 (poster only)

Title: Permafrost Thaw in Relation to the Varied Photosynthetic Pathways and Abundance of *Chlorophytum comosum*, *Sedum angelina*, and *Senecio cineraria* to Limit Thermokarst Action

Presenter: Ashrith Valluri, 10th grade student,
Research Inquiry Skills & Experimentation

Mentors: Mrs. Allison Hennings, Illinois Mathematics and Science Academy,
Dr. Kristen Rahilly (PhD), COLDEX,
Dr. Julie Jastrow (Ph.D), Argonne,
Dr. Abira Sahu (Ph.D), Michigan State,
Ms. Amanda Raymond, Glenbard South High School

Abstract/Project Intention:

The purpose of this research was twofold: 1) to investigate if plants that used varied photosynthetic pathways (C3 or CAM) decrease permafrost thaw amount and subsequent CO₂ accumulation and 2) ascertain if plant abundance has any additive impact. Plants were selected from CAM and C3 groups due to their variations in methods of CO₂ fixation. This experiment addressed a gap regarding the analysis of photosynthetic pathways in relation to CO₂ change and permafrost thaw. The ultimate application of these findings is to combat climate change trends, devise solutions for small communities in permafrost regions through plant photosynthesis, and aid in the analysis of plant contribution to photosynthesis. Three groups were established with a control group that did not include plants, experimental group 1 (E1) with one plant per trial, and experimental group 2 (E2) with three plants per trial. For all groups, 20 trials were taken per species (n=20). Simulated permafrost layers were created and a CO₂ sensor was calibrated to simulate permafrost thaw and CO₂ concentration respectively. C3 plants were the most efficient in reducing permafrost thaw and CO₂. *C. comosum* (C3 plant) was most efficient due to being most suitable to the experimental environment while *S. angelina* was least efficient. Additionally, linear regression supported positive trends between rising CO₂ levels and thaw amounts. From statistical analyses, part of the null hypothesis was rejected regarding CO₂ change between the plant species due to strong variations between the groups ($p < 0.05$), however, could not be rejected regarding permafrost thaw ($p < 0.05$). The null hypothesis is rejected and the experimental hypothesis is supported.

Project ID: MEDH 17

10:45a.m. – 11:00a.m.

Title: Characterizing Neonatal Human Epidermal Keratinocytes-Derived Exosomes

Presenter: Devarsh Shah

Mentor(s): James Coy-Dibley (PhD Candidate),
Daniela M Menichella (PI), Northwestern University

Abstract/Project Intention:

Painful diabetic neuropathy (PDN) is a debilitating complication of diabetes with patients suffering from a painful, burning sensation in their extremities. Available treatments have limited effect in masking the pain without addressing the underlying mechanisms of the disease, which are currently poorly understood. Keratinocytes are in close proximity to cutaneous nerve terminals, enabling bidirectional communication between keratinocytes and cutaneous nerves. One mode of communication that is understudied in the skin is extracellular vesicles (EVs), namely exosomes, which are secreted nanoparticles of size range 30-150nm. To study keratinocyte-derived exosomes, we employed the immortalized neonatal human epidermal keratinocyte (NHEK) cell line and isolated NHEK-derived exosomes via size exclusion chromatography. We morphologically characterized the NHEK nanoparticles via dynamic light scattering and electron microscopy before molecularly confirming the exosomes with western blotting for known molecular markers. We confirmed the functional uptake of the isolated exosomes with DIR-labeling. These findings will be translated into primary cultures and in-vivo functional studies in the pursuit of uncovering novel treatments for PDN.

Project ID: CMPS 02

10:45a.m. – 11:00a.m.

Title: Cooperative cache optimization for HPC using binary tree overlay with Linux FUSE

Presenter(s): Samuel Brownell

Mentor(s): Kevin Harms, Argonne National Laboratory

Abstract/Project Intention:

High performance computing (HPC) applications often suffer performance degradation due to contention on storage servers when multiple compute nodes access small files. This paper proposes a cooperative cache layer to alleviate bottlenecks by funneling I/O requests through a specialized service on a single node, distributing results via a binary tree overlay network. Objectives include reducing load on storage servers, increasing cache hit ratio, and minimizing network traffic. The study outlines implementation, evaluation using benchmarks and real-world applications, and comparison with alternatives. Progress includes successful adaptation of Linux FUSE, development of CuFUSE translation program, and initial caching program development. Future work involves testing to refine efficiency and performance. Despite challenges, the study aims to optimize HPC storage systems, with implications for various applications, including loading Python modules in high performance environments.

Project ID: CMPS 41

10:45a.m. – 11:00a.m.

Title: Using NLP (Natural Language Processing) and models like TF-IDF (Term Frequency – Inverse Document Frequency), GloVe (Global Vectors for Word Representation), Open AI’s GPT, and Sentence-BERT (Bidirectional Encode Representations from Transformers) to sort through and organize the search queries to prevent question repeats in StackOverflow

Mod ver for ref page: Using NLP and models like TF-IDF, GloVe, Open AI’s GPT, and Sentence-BERT to sort through and organize the search queries to prevent question repeats in StackOverflow

Presenter(s): Yaalini Lakhani

Mentor(s): Dr. Phadmakar Patankar, Illinois Mathematics and Science Academy

Abstract/Project Intention:

This research presents an overview for search query management in StackOverflow, a popular platform for programming in which users can ask and answer questions about their code. With the use of Natural Language Processing (NLP) techniques, and models including TF-IDF (Term Frequency – Inverse Document Frequency), GloVe (Global Vectors for Word Representation), OpenAI’s GPT, and Sentence-BERT (Bidirectional Encoder Representations from Transformers), the research aims to effectively sort and organize search queries to prevent questions from being repeated in a different way. The TF-IDF method constructs a robust document-term matrix to quantify term importance, while GloVe enhances comprehension by converting words into vector representation. OpenAI’s GPT model generates contextually coherent responses, and Sentence-BERT allows for the comparison of semantic similarities to detect duplicate questions. Through integration of these methods, the research enhances search query management, ensuring efficient information retrieval and improved user experience on StackOverflow. The evaluation findings on real-world datasets highlight the effectiveness of the proposed method in reducing duplicate questions and optimizing query resolution processes. This research enhances search features in online technical forums, providing practical tips to boost user interaction and knowledge sharing in programming communities.

Project ID: CMPS 15

10:45a.m. – 11:00a.m.

Title: Self-Determination Theory (SDT) in Gamification

Presenter(s): Ryan Li

Mentor(s): Ms. Simone Downie, ISU

Abstract/Project Intention:

Self-determination theory (SDT) states that humans are motivated to pursue things that are intrinsically valuable to them, such as wellness or autonomy. Serious games implement different tactics such as identity, interactivity, agency or control, challenge, narrative, feedback, and immersion, to motivate the player to play the game and absorb its “serious” content, which is meant to improve the player’s expertise or knowledge of a certain topic. Indeed, in gamification and serious games, SDT is represented as a framework for player motivation based on autonomy, competence, and social relatedness/connection. The purpose of this study is to understand the role of SDT features in mainstream games, and how these features can be implemented into serious games to increase their popularity/success. Our analysis focuses on multiple popular titles which use SDT features such as player experience points and level progression, adaptive gameplay, and open-world movement. In our analysis, we compare the implementation of these features between mainstream games (>10 million player count based on registered accounts/active users), and serious games of similar genres. We aim to further understand SDT in the context of serious games through identifying what features incentivize participation in and optimize the effect of serious games.

Project ID: MEDH 26

10:45a.m. – 11:00a.m.

Title: Effect of Somatic Growth of Pulmonary Artery and Inferior Vena Cava on Fontan Conduit

Presenter(s): Aashi Dharia

Mentor(s): Dr. Narutoshi Hibino MD, PhD., University of Chicago, Hibino Lab

Abstract/Project Intention:

Single ventricular defects are a type of congenital heart disease that can be treated through the Fontan Procedure, where a conduit is implanted connecting the inferior vena cava (IVC) to the pulmonary artery (PA). Native vasculature grows over time, whereas the synthetic conduit does not. This study focused on the growth of the PA over time, resulting in conduit shape and hemodynamic changes. Three patients were analyzed at two timepoints spanning a range of one and four years, all of which had 18-20 mm Fontan conduits. Each timepoint's desired Fontan route was created into a 3D model through a process called segmentation using an MRI scan in Scan IP software. Abaqus CAE software was utilized to simulate exercise pressure conditions and investigate changes in structure. Results demonstrated that while the PA grew over time, Von Mises Stress changed and the conduit shifted. These findings explained the disproportionate movement of conduit walls as somatic PA growth occurred. Next steps include obtaining Computational Fluid Dynamics data on XFlow software for a more thorough analysis on hemodynamic state. In the future, this research can inform patient-specific conduit placement and size to achieve ideal hemodynamics, thus enhancing the Fontan Procedure to improve patient outcomes.

Project ID: MEDH 47

10:45a.m. – 11:00a.m.

Title: Inducing Physical Changes of Cancer Cells By Facilitating K⁺ Efflux of Big Potassium (BK) Channels; New Potential Target Genes In Cancer Metastasi Research

Presenter: Yanel Gonzalez

Mentors: Ekrem Emrah Er, Ph.D, University of Illinois at Chicago

Abstract/Project Intention:

Changes in the physical characteristics of cancer cells are a hallmark of tumorigenesis, and understanding how these changes affect tumor progression can provide novel therapeutic insights. Prior studies have discovered that increasing cancer cell stiffness reduces metastatic burden by activating cytotoxic T lymphocytes. MRTFA and MRTFB are two transcription factors that cause the stiffening of cancer cells, and preliminary data demonstrates that MRTFA expression causes the expression of potassium (K⁺) handling genes like the auxiliary unit of the Big K⁺ (BK) channels, suggesting that these channels are downstream genes of MRTFA/B. We hypothesize that activating BK channels will stiffen cancer cells and enhance the ability of cytotoxic lymphocytes to detect and eliminate metastatic colonies via mechanosurveillance. To investigate the impact of agonists NS-11021 and BMS-20432 on the potency of NK cells, we performed and analyzed time-lapse imaging of the interaction of NK cells isolated from mouse spleens and mouse mammary tumor cells that were plated and treated with varying concentrations of KCl, NS-11021, and BMS-20432. Using PrismGraphpad to analyze twenty cells per condition, we concluded that there are no significant statistical differences in the time it takes to kill across the different KCl and agonistic-mediated conditions. In the future, we plan to increase cell count to increase statistical confidence. Nonetheless, we will continue investigating downstream genes of MRTFA/B to discover new avenues to target to potentially facilitate cell stiffening, triggering mechanosurveillance and thus hindering cancer metastasis and outgrowth.

Project ID: ENGN 06

10:45a.m. – 11:00a.m.

Title: Reducing the Load of the Haptic Brain Stimulator

Presenter(s): Hunter Mathews

Mentor(s): Pedro Lopes, University of Chicago

Abstract/Project Intention:

We engineer a haptic device that renders touch and force-feedback across the user's entire body by stimulating the brain. Our technique builds upon transcranial magnetic stimulation (TMS), a neuroscience technology that non-invasively stimulates the brain using an electromagnetic coil. Medical-grade TMS coils are typically large, handheld devices, which makes integrating them into an actuated system challenging. Our technical contribution is to provide a novel robotic platform that precisely actuates the coil towards the target brain areas while ensuring user comfort and wearability. We explore methods to alleviate the load on the user, utilizing a supporting backpack or a hanging counterweight. By employing a lighter TMS coil, reducing the degrees of freedom of the actuator, using primarily laser-cut acrylic and FDM printed parts, and separating the electronics from the headset with Bowden cables, we have constructed a lighter and more comfortable device.

Project ID: PHYS 04

10:45a.m. – 11:00a.m.

Title: Predicting Results From Scintillating Bubble Chambers Through The Use Of Molecular Dynamic Simulations To Replicate Conditions Needed For Bubble Nucleation

Presenters: Komal Chivukula, Laya Gopalakrishnan, Tia Rice

Mentor: Prof. Eric Dahl, Northwestern University

Abstract/Project Intention:

Scintillating bubble chambers detect particle interactions between ionizing radiation and molecules in superheated liquids—liquids maintaining their state of matter despite being heated past their boiling point. These particle interactions can generate nuclear recoils, causing hot spikes experienced by small groups of the liquid's molecules, which lead to bubble nucleation in the chamber. Interactions with dark matter may also produce nuclear recoils; thus, identifying these bubble formations and understanding the conditions needed for bubbles to form is key to further understanding dark matter particle interactions. Using the HOOMD-Blue Python library, we created a molecular dynamics simulation that models particle interactions in such superheated liquids by creating hot spikes in the centers of simulated Lennard-Jones fluids in superheated liquid states. From the subsequent time the environments and visualizations of the particles' positions at different time intervals. We used this information to determine whether or not a given hot spike in a given superheated state resulted in a bubble. Several of these simulations did result in bubble formation, confirming that with the given tools, we can successfully model the bubble nucleation process.

Project ID: CHEM 13

10:45a.m. – 11:00a.m.

Title: Synthesis of Novel Medicinal Compounds for Leishmaniasis using DNDI's Hit Compound DNDI0003202883

Presenter(s): Tristen Castillo, Angel Lopez, Hagen Arriaga

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a parasitic disease that phlebotomine sandflies carry that typically affects impoverished tropical and subtropical regions, such as Africa, Latin America, the Middle East, and southern Asian countries. Currently, 98 nations have endemic leishmaniasis (Bilal Zulfiqar et al., 2017). These sandflies carry protozoan parasites which can induce fever, weight loss, swelling of the spleen and liver, and abnormal blood tests (World Health Organization, 2023). This research explores the process of synthesizing benzoxazole amide derivatives as leishmaniasis leads. The synthesized compounds are to be processed and developed to find viable derivatives from DNDI's hit compound DNDI0003202883 with potent in vitro and in vivo antileishmanial activity. We purified and worked up our compounds using thin-layer chromatography and column chromatography. The products were then subjected to IR and NMR testing. The aim was to create a Leishmaniasis remedy that is cost-effective, achieves high efficacy, and ensures safety for individuals with immunosuppressive conditions such as HIV, especially considering the drop in effectiveness of current treatments.

Project ID: PHYS 24

10:45a.m. – 11:00a.m.

Title: CROSS SECTIONS and FileParams FRAMEWORK RECONSTRUCTION

Presenter(s): Malcolm Wilson-Ahlstrom

Mentor(s): Dr. Peter Dong, Illinois Math and Science Academy

Abstract/Project Intention:

For our analysis of dark photons and the doubly-charged Higgs boson to get an accurate prediction of the number of events that can be expected, cross sections can be used in conjunction with luminosity that is set by each collaboration respectively and efficiency which is given by monte carlo. Using the given luminosity and efficiency it can be expected that the cross section scales linearly with how often a certain event or collision will occur. Another challenge that came up was for the framework of the analysis. There was a problem with the software being unable to know what kind of file was being read by the analyzer. In the framework data files are split up by year, but while the analyzer is running the software must know what data it's running on so it can change how it's using the data based on the information within a given file. To do this the structure of the file was modified so that the information about the file was accessible to the analyzer. In summary, the information regarding cross sections for different collisions and the restructure of the FileParams file system have filled in missing information and fixed past issues with the framework to move forward the analysis.

Project ID: CMPS 10

10:45a.m. – 11:00a.m.

Title: Understanding Entanglement for Quantum States

Presenter(s): Ellen Guan; Aashima Sisodia

Mentor(s): Dr. Zain Saleem, Argonne National Laboratory

Abstract/Project Intention:

Entanglement is a fundamental concept in quantum mechanics that describes when two particles are intrinsically correlated and that one of the particles cannot be described without the others. The phenomenon of entanglement is not well understood by physicists. However, we may be able to better understand its behaviors by quantifying entanglement through entanglement measures. Entanglement measures aim to quantify the degree of entanglement, which are particularly useful when considering mixed states. In our study, we studied two entanglement measures in particular: entanglement entropy, which measures the number of Bell pairs to either create or can be extracted from the given state, and geometric measure of entanglement, which calculates the minimum distance from a given state to the set of separable states. Using the Python library QuTiP, we have implemented these two methods and analyzed the results of inputting different types of quantum states.

Project ID: MEDH 43

10:45a.m. – 11:00a.m.

Title: Design of Novel Ribociclib Derivatives Using Computational Analysis as Potential Therapeutics for Breast Cancer

Presenters: Abigail Botello, Karla Sanchez

Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Approximately 10% of breast cancers are hormone-receptor-positive. Despite the array of available drugs for metastatic breast cancer, ribociclib stands out as one of the most potent options, particularly effective against HER2- breast cancer. However, its efficacy is countered by notable side effects including liver issues, neutropenia, skin reactions, and cardiac/respiratory problems. This research project aimed to computationally design molecules derived from ribociclib's molecular structure to potentially alleviate these adverse effects. 315 candidate molecules were designed and approximately 30 exhibited superior binding to human plasma compared to the original compound, with eight of the thirty having at least two superior toxicity factors.

Project ID: CMPS 38

10:45a.m. – 11:00a.m.

Title: Using Monte Carlo Simulations of Retinoblastoma Progression to Model Mutation Rates and Genetic Variability

Presenter(s): Vidyoot Senthilvenkatesh

Mentor(s): Dr. Christina Fliege and Joshua Allen,
University of Illinois Urbana Champaign

Abstract/Project Intention:

Human retinoblastoma is a pediatric cancer initiated by RB gene mutations in the developing retina. Originating in the retina, RB evolves in four separate stages. However, most patients do not have a distinct transition through these separate stages and these stages are not always preceded by a detectable preface state, making the cancer difficult to model. In this project, we present a novel method to model retinoblastoma progression, employing Monte Carlo simulations, a class of computational algorithms that rely on repeated random sampling to obtain numerical results, reflecting the randomness of real-life genetic mutations. This technique allows us to randomly generate mutations on the RB1 gene taking into account the genetic variability and hereditary factors known to influence retinoblastoma. Monte Carlo allows us to analyze the mutation rates and evolution of this cancer, also offering insights into the probability distributions of mutation occurrences, the mutations that are most likely to contribute to disease progression, and their impact on retinoblastoma progression.

Session III – 11:05a.m. – 11:20a.m.

Project ID: CHEM 03

11:05a.m. – 11:20a.m.

Title: Walter Sanford and the Materials Used in his Pieces

Presenter: Dael Garzon Torres

Mentor: Christopher Palenik, MicroTrace

Abstract/Project Intention:

The Chicago Black Renaissance marked a significant cultural, social, and artistic movement among African-Americans in the South Side of Chicago following the Great Migration in the early 20th century. This period witnessed a flourishing of racial pride expressed through various forms of creativity such as literature, music, and art. Walter Sanford, a prominent artist of this movement, contributed significantly to the Chicago Black Renaissance through his works in social realism, abstract expressionism, and cubist figure paintings. Sanford's legacy extends beyond his plethora of art pieces to include numerous awards, gallery features, and the establishment of the first black-owned gallery in Detroit. To gain a deeper understanding of Sanford's work and the broader artistic themes of the Chicago Black Renaissance, this project aimed to analyze his paintings and the materials and media that influenced their creation. This analysis can help us understand how Sanford's art changed and also tell us about the socio-cultural state of his environment at the time.

Project ID: BIO 10

11:05a.m. – 11:20a.m.

Title: β -Actin as a Transcription Factor of Hox Genes in Mouse Embryonic Stem Cells

Presenter(s): Kohl Vonder Haar

Mentor(s): Dr. Alexander Ruthenberg, Ms. Jelena Šćepanović,
University of Chicago,

Abstract/Project Intention:

Hox genes are conserved across all eukaryotic life. Playing an integral role in limb development, Hox genes produce transcription factors that regulate gene expression within embryos, subsequently impacting morphogenesis and the location of the spine and limbs. Playing such a crucial role in developmental genetics, investigations into transcription factors within Hox genes have been a recent topic of interest in the literature. However, one transcription factor that has yet to be investigated thoroughly for its impact and role in Hox gene expression is β -actin. A protein most well-known for its abundance in the cytoskeleton, playing an integral role in cell motility and structure, β -actin has shown a capacity to act as a transcription factor. Localizing to the Hoxa and Hoxb genes when perturbed by retinoic acid, β -actin has demonstrated activity as a transcription factor in localizing transcription complexes to Hox genes. We aim to design a new MS2/MCP system that can fluorescently express the localization of β -actin to the nucleus. We will show how activation of the β -actin complex plays a factor in Hox transcription, alongside other factors that play a role in Hox transcription and expression.

Project ID: MEDH 08

11:05a.m. – 11:20a.m.

Title: Neonatal Mesenchymal Stem Cells Seeded Scaffold Support Tissue Regeneration

Presenters: Brooke Hilderbrant, Arnav Patel

Mentor: Dr. Arun Sharma, Northwestern University,
Stanley Manne Children's Research Institute

Abstract/Project Intention:

Bladder exstrophy and neuropathic bladder are conditions that lead to dysfunctional bladder function, which congenital malformations or conditions may cause. Current surgical treatment can lead to a variety of complications, sparking a need for recreating bladder tissue to repair bladder function. During the study utilizing neonatal mesenchymal stem cells (nMSCs)-seeded elastomeric Poly(1,8-octanediol-co-citrate) (POC) scaffolds, rats underwent an approximate 50% bladder cystectomy, then augmented with the nMSC-seeded elastomeric scaffolds. These scaffolds were compared to previously studied adult mesenchymal stem cells (aMSCs)-seeded scaffolds, which showed to improve muscle repair and immune response in the bladder. Following 4 weeks post augmentation, total bladder capacity was recovered for animals treated with POC-nMSC-seeded bladder scaffolds. This also included non-complications such as kidney stone formation or hydronephrosis. There was a significant regeneration of bladder muscle tissue and percent vasculature of nMSC-seeded scaffolds compared to aMSC scaffolds. Peripheral nerve regeneration was significant in nMSC-seeded scaffolds and absent in aMSC-seeded scaffolds. Peripheral nerve regeneration in the bladder is crucial for proper function, involving sensory nerves signaling bladder fullness and motor nerves coordinating muscle contractions during voiding. nMSC-seeded scaffolds show promise as an alternative treatment to a dysfunctional bladder function.

Project ID: BVHSO 16
11:05a.m. – 11:20a.m.

Title: Influence of depressive symptomology on alcohol abuse liability in women

Presenter(s): Shanya Yang

Mentor(s): Dr. Emma Childs, University of Illinois at Chicago,
The HAPPY Lab

Abstract/Project Intention:

High comorbidity exists between AUD and mood disorders, especially in women, with unclear causes. Depressive symptoms may affect alcohol abuse liability and mood effects. Women, twice as likely to have depressive disorders, face higher AUD risk post-major depressive disorder diagnosis. Understanding alcohol abuse and depression link in women is vital. We assessed alcohol abuse liability in moderately to heavily drinking women with and without past-year depression symptoms (N=24). During alcohol challenge sessions (0, 80mg%), healthy women self-reported mood and subjective alcohol effects. Using repeated measures analysis (rmANOVA) compared responses between those with (N=12) and without (N=12) past-year symptoms, with symptom count as a covariate. No demographic differences were found. Women with past-year symptoms reported greater negative alcohol effects (sedation, confusion, dysphoria, $P_s < 0.05$). No differences in positive alcohol effects were seen in women with mild symptoms. Findings challenge expected alcohol-rewarding effects in women, indicating the need for further research on women's drug and alcohol interactions.

Project ID: BVHSO 07

11:05a.m. – 11:20a.m.

Title: Data Science to Identify Inequalities in CPS

Presenter(s): Alvena Bhutiani, William Guo, Dhaatri Maviti

Mentor(s): Angel Alvarez, Northwestern University,
Feinberg School of Medicine

Abstract/Project Intention:

This project aims to investigate and identify the disparities in resource allocation across Chicago's Public School System. Leveraging an array of data science tools including Microsoft Excel functions, Python, and Jupyter Notebook, we have conducted comprehensive analyses. Our data derives from publicly accessible datasets obtained through the Freedom of Information Act (FOIA) from CPS and the Illinois State Board of Education, encompassing transfer records, student performance metrics, budget records, and selective enrollment test scores. Additionally, we incorporate FOIA records from the Illinois District Attorney's office to scrutinize the processing of these records. We also utilize web scraping of websites to gather further data. Through our analyses, stark inequities emerge among schools and neighborhoods within the Chicago area. By presenting these findings and associated trends at board meetings, we aim to advocate for and enact reforms that foster a more just and equitable educational landscape for all students.

Project ID: ERSP 03

11:05a.m. – 11:20a.m.

Title: Broadband Spectral Survey of CH₃OH Emission toward Hyper-Compact and Ultra-Compact HII Regions

Presenter(s): Robert Mandell

Mentor(s): Dr. Esteban Araya, Western Illinois University

Abstract/Project Intention:

The existence of organic molecules outside of the atmosphere can serve as an indication of life outside of Earth and contribute to our understanding of the formation of stars. We search for methanol in star forming ultra-compact and hyper-compact HII regions through the use of spectral analysis. Examining data collected from the Very Large Array in region G032.7441 we compiled free-free radiation and emission spectrum graphs. From free-free radiation we systematically removed any data interfered with by radio signals. Specifically analyzing the specific emission spectrums, existence of methanol can be determined by examining the radio velocity range and their respective flux densities. All sources with suspected methanol detections were collected and stacked to form a strong consensus on the existence of methanol.

Project ID: MEDH 02

11:05a.m. – 11:20a.m.

Title: Improving Clinical Accuracy and False Alarm Sensitivity of Tonic-Clonic Seizure Predictors

Presenter(s): Rhea, Shah

Mentor(s): Anthony Cuturrufo, UCLA

Abstract/Project Intention:

Machine learning applications in diagnosing and predicting seizure symptoms among high-risk patients are critical to prevent life-threatening injuries. Despite existing research achieving near- perfect accuracies in controlled environments, existing models often falter in clinical settings and wearable devices, resulting in high false alarm rates and lower prediction success for Tonic-Clonic seizures. The OpenSeizureDatabase has revolutionized training models by incorporating previously unavailable false-alarm data and prediction failures of seizure predictors. To address these challenges, I conducted a comprehensive data analysis, and using novel machine learning techniques, I have employed a Convolutional Neural Network (CNN) to achieve an 88% predictive accuracy. This new model aims to enhance both false alarm reduction and the detection of previously missed seizures. This research places emphasis on the practicality of deploying machine learning models in their intended use in clinical settings, while representing a significant advancement in improving the performance of seizure prediction models. Shifting focus of diagnostic machine learning models to accuracy in clinical environments is essential for enhancing high-risk patient safety and care.

Project ID: CMPS 03

11:05a.m. – 11:20a.m.

Title: The Effects of De-identified Tokens on the Performance of Clinical Large Language Models

Presenter(s): Ishan Buyyanapragada

Mentor(s): Paul Landes, Argonne National Laboratory

Abstract/Project Intention:

Clinical Large-Language Models (LLMs) are essential to the biomedical industry: they can analyze and interpret physician notes, anonymize patient health information, and supplement diagnoses in various medical practices. Nowadays, most widely used clinical large-language models are trained on medical text that masks protected health information---corpora unlike the data that the models are used on in the field. Despite this, little to no research has been conducted to determine whether the masked corpora affect the performance of clinical large language models.

In our study, we trained models on commonly used anonymized corpora (MIMIC-III and MIMIC-IV) with the masked tokens replaced with pseudo-tokens (i.e., artificially generated names, dates, and locations) and compared their performance to the same models trained on unaltered corpora. The model's performance was based on their evaluation scores (f1, precision, and recall) on de-identification, inference, question-answering, and summarization tasks. Our data shows that the large-language models trained on our pseudo-corpora significantly outperform the ones trained on the original corpus in de-identification and inference-based tasks. The results of the study sustain that pseudo-generated data could provide a new framework for training corpora and creating stronger clinical large-language models.

Project ID: PHYS 12

11:05a.m. – 11:20a.m.

Title: Effect of Composition on Optical Properties of Bismuth Borate Glasses Doped with Europium Ions

Presenters: Amanda Barajas and Laasya Nagumalli

Mentors: Dr. P.K. Babu and Dr. Saisudha Mallur, Western Illinois University, Nanomaterials Research Lab

Abstract/Project Intention:

We studied the optical properties of Eu-doped bismuth borate glass samples. A series of bismuth borate glass samples were prepared with variations in mole percentages per compound. These molar ratios were as follows: $x\text{Bi}_2\text{O}_3 : (99-x)\text{B}_2\text{O}_3 : 1\text{Eu}_2\text{O}_3$ where $x = 30, 40, 50, 60$ mol %. These mixtures were then melted, quenched, annealed, and polished to create four transparent glass samples. The density by Archimedes' method and the refractive index by Brewster's Angle method were measured. The fluorescence spectra of rare earth ions and the optical absorption spectra were also recorded. Our results indicated a positive correlation between variation in density and refractive index with bismuth oxide concentration. The position of the intense Eu fluorescence peak reached a maximum around 40 mol %, indicating variation in Eu-O covalency. The area ratio indicates that the intensity of the intense peak decreases with bismuth oxide concentration. Optical band gap decreases with an increase in Bi_2O_3 concentration due to structural changes.

Project ID: ENGN 02

11:05a.m. – 11:20a.m.

Title: An Optimal Control Framework for Influencing Human Driving Behavior in Mixed- Autonomy Traffic

Presenter(s): Anirudh Chari

Mentor(s): Rui Chen, Dr. Changliu Liu
Carnegie Mellon University Robotics Institute;
Dr. Jaskaran Grover, Amazon Robotics

Abstract/Project Intention:

As autonomous vehicles (AVs) become increasingly prevalent, their interaction with human drivers presents a critical challenge. Current AVs lack social awareness, causing behavior that is often awkward or unsafe. To combat this, social AVs, which are proactive rather than reactive in their behavior, have been explored in recent years. With knowledge of robot-human interaction dynamics, a social AV can influence a human driver to exhibit desired behaviors by strategically altering its own behaviors. In this paper, we present a novel framework for achieving human influence. The foundation of our framework lies in an innovative use of control barrier functions to formulate the desired objectives of influence as constraints in an optimal control problem. The computed controls gradually push the system state toward satisfaction of the objectives, e.g. slowing the human down to some desired speed. We demonstrate the proposed framework's feasibility in a variety of scenarios related to car-following and lane changes, including multi-robot and multi-human configurations. In two case studies, we validate the framework's effectiveness when applied to the problems of traffic flow optimization and aggressive behavior mitigation. Given these results, the main contribution of our framework is its versatility in a wide spectrum of influence objectives and mixed-autonomy configurations.

Project ID: CMPS 19

11:05a.m. – 11:20a.m.

Title: Distributed Classification by Divide and Conquer Approach

Presenter(s): Max Chen

Mentor(s): Qiang Wu, Middle Tennessee State University

Abstract/Project Intention:

In this paper, we investigate the efficacy of the divide and conquer approach for implementing distributed logistic regression and distributed support vector machine (SVM) algorithms for classification of large-scale datasets. This approach is designed to handle datasets that exceed the capacity of a single processor, necessitating the partitioning of data into multiple subsets. Logistic regression or SVM is then applied to each subset, yielding individual local classifiers. Subsequently, a global classifier is derived by aggregating these local classifiers to make the final decision. We propose three strategies for the aggregation stage: voting based on predicted labels, averaging of real-valued predictions, and averaging of posterior probabilities. Our analysis reveals that for distributed logistic regression, probability averaging is the most robust approach and is therefore recommended. Conversely, in the context of distributed SVM, probability averaging requires additional modeling but has a minimal impact on the performance. Therefore, functional averaging is recommended instead.

Project ID: MEDH 27

11:05a.m. – 11:20a.m.

Title: Comparative Analysis of Heart Procurement Methods in Donors After Circulatory Death

Presenter(s): Sukanya Ghosh

Mentor(s): Dr. William Fiske Parker

Abstract/Project Intention:

Since 2019, there has been a notable rise in yearly heart transplantation rates following circulatory death (DCD) in the United States. The primary procurement methods are direct procurement and perfusion (DPP) and normothermic regional perfusion (NRP). DPP relies on ex situ machine perfusion with cold crystalloid cardioplegia followed by normothermic blood reperfusion. NRP involves in situ reperfusion using an open cardiopulmonary bypass circuit while clamping the innominate artery to prevent brain perfusion. Despite ethical controversies surrounding NRP, its procurement rates have significantly increased. However, organ procurement organizations do not consistently report specified methods, complicating survival rate analysis. Through empirical methods differentiating agonal time variables, we observed transplant cases categorized by procurement method using data from the Scientific Registry of Transplant Recipients between January 1, 2019, and December 31, 2021. Among 318 DCD heart transplants, 216 (68%) were procured via DPP and 102 (32%) via NRP. These findings could inform future research analyzing post-transplant survival rates.

Project ID: MEDH 38

11:05a.m. – 11:20a.m.

Title: Examining the Associations of Breast Cancer Outcomes and Air Pollution in Chicago

Presenter: Elaine Rao

Mentor: Beverly Chukwudozie, University of Illinois Chicago, Cancer Center

Abstract/Project Intention:

Breast cancer is a significant public health concern, with varying incidence and mortality rates among different demographic groups. Recent studies suggest a potential association between air pollution and breast cancer rates, prompting our investigation within specific Chicago areas from 2015 to 2021. Analyzing data from Metopio, across 77 community areas, we focused on PM2.5 as the primary air pollution variable. We considered environmental factors, socioeconomic status, and demographics. Descriptive stats revealed annual PM2.5 fluctuations, with decreased mean values over time. Correlation analyses showed negative correlations between incidence rates and environmental factors, poverty, but positive correlations with mortality rates. Linear regression revealed a positive association between PM2.5 and both incidence and mortality rates, with adjustments for other variables. Adding environmental factors improved models, yet race/ethnicity variables had the most significant impact. Our findings enhance understanding of air pollution and breast cancer rates in Chicago communities, advocating for public health strategies targeting socioeconomic and racial disparities to improve outcomes. Further studies can delve into the mechanisms underlying these relationships.

Project ID: ENGN 07

11:05a.m. – 11:20a.m.

Title: Deploying Sensorless V2V Communication for Enhanced Driver Awareness: A C-V2X and GNSS-Based System Utilizing OBD Ports for Broad Vehicle Integration

Presenter(s): Alea Ritchie

Mentor(s): Matthew Walter, Toyota Technological Institute at Chicago

Abstract/Project Intention:

This paper presents a Vehicle-to-Vehicle (V2V) communication system designed to enhance road safety by leveraging Cellular Vehicle-to-Everything technology and the Global Navigation Satellite System. Unlike Advanced Driver Assistance Systems (ADAS), which rely on external sensors and direct vehicle control for collision avoidance, this module focuses on boosting driver awareness through real-time auditory alerts. Utilizing the vehicle's onboard diagnostic port for data access, the system employs machine learning algorithms to analyze vehicular communication data. It identifies potential hazards based on historical collision data and movements preceding collisions, resulting in auditory warnings conveyed directly through the car's sound system. Although ADAS may achieve a higher reduction in collision rates by intervening in vehicle control, the proposed V2V module aims to significantly reduce accidents by alerting drivers to imminent dangers, thereby enhancing safety with broad accessibility and ease of retrofitting into existing vehicles. The system's design emphasizes ease of integration and scalability, supported by a detailed theoretical framework, positioning it as a promising advancement in vehicular safety technology.

Project ID: PHYS 05

11:05a.m. – 11:20a.m.

Title: Harnessing Magnetic Fields for Precise Ferrofluid Droplet Motion

Presenter: Chad Park

Mentor: Michelle Driscoll, Shih-Yuan Chen, Northwestern University

Abstract/Project Intention:

Ferrofluids, composed of magnetic nanoparticles suspended in a carrier liquid, offer unique fluidic properties and can be manipulated by external magnetic fields. My research project focuses on employing varying magnetic fields to control ferrofluids and investigates manipulating them to explore their potential for innovative navigation systems.

The experimental setup uses high-speed cameras to image a ferrofluid drop on a hydrophobic substrate to observe its dynamics in real time. We arranged three copper coil arrays to produce magnetic fields with adjustable parameters such as intensity and direction. We conducted systematic experimentation and analysis to measure the influence of magnetic field configurations on ferrofluid behavior. By modulating these fields, we precisely controlled the movement of ferrofluid drops within a maze. We also explored different maze layouts and obstacles to simulate diverse navigation challenges.

My results demonstrate the effectiveness of utilizing magnetic fields to manipulate ferrofluid motion. By harnessing the responsive nature of ferrofluids to magnetic fields, this research underscores the potential for developing adjustable navigation systems. These findings hold implications for applications in robotics, microfluidics, and biomedical engineering, where precise motion control is paramount for achieving desired functionalities.

Project ID: CHEM 15

11:05a.m. – 11:20a.m.

Title: Developing Novel Therapeutics for Leishmaniasis: Design and Synthesis Strategies

Presenter(s): Josefh Hernandez, Atharva Kapale

Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a tropical disease caused by infection, primarily spread by sandflies. Current treatments are unreliable, toxic, and expensive, making them unfeasible for many. A new treatment is being researched, using 5-chloro-1,3-benzoxazol-2-amine, a promising lead amine researched by the Drugs for Neglected Diseases Initiative's Open Synthesis Network. The synthesized analogs underwent Proton Nuclear Magnetic Resonance and Infrared Spectroscopy tests to determine if the intended molecule was made. The synthesized molecules will be sent to our collaborator for biological testing. To make the intended molecules, the 5-chloro-1,3- benzoxazol-2-amine derivatives were synthesized with one of three carboxylic acids (fluorophenylacetic acid, dimethylphenylacetic acid, chlorobenzoic acid) each one done separately. The fluorophenylacetic acid analog was synthesized with the amine in two separate experiments. The first experiment seemed to yield the amine, while the second experiment showed more promising results in yielding more of the desired product.

Project ID: PHYS 23

11:05a.m. – 11:20a.m.

Title: Generation of Multi-Channel Doubly Charged Higgs Boson Validation Plots

Presenter: Vikram Rao

Mentor: Dr. Peter Dong, Illinois Mathematics and Science Academy

Abstract/Project Intention:

Many extensions of the Standard Model predict the doubly charged Higgs boson (H^{++}), a beyond the Standard Model particle. To search for the H^{++} , we compare data with Monte Carlo background estimates through a validation plot to examine if there is a statistically significant difference. To generate this plot, we first created a framework to process and work with data files from CMS servers. Then, to compare the data and Monte Carlo, we created an analysis framework that produces separate validation plots – graphing opposite sign invariant mass – for each decay channel and mass target. The plots are published to a webpage for simple visualization. Separating plots by decay channel and mass target allows us to analyze the data's relationship with the individual background channels – $T\bar{T}$, multiboson, ZZ , and Drell-Yan. The validation plots are used to confirm that we understand our signal and background properly.

Project ID: CMPS 09

11:05a.m. – 11:20a.m.

Title: Testing the Type 2 Diabetes Risk Prediction Efficacy of a Synthetically Trained Machine Learning Model

Presenter(s): Sadkrith Malladi

Mentor(s): Dr. Ravi Madduri, Dr. Alexis Rodriguez,
Argonne National Laboratory

Abstract/Project Intention:

Several machine learning models trained on electronic health records (EHR) data have been able to predict risk for Type 2 Diabetes accurately, but the efficacy in risk prediction for models trained on synthetic genotype data remains to be tested extensively. Using data gathered from Genome-Wide Association Studies (GWAS) analyses, we identified several genes correlated with Type 2 Diabetes, each with hundreds of single nucleotide polymorphisms (SNPs). We are currently generating synthetic genotype data based on the GWAS summary statistic results and using it to train a supervised machine learning model. We will compare the accuracy of the risk prediction generated by our synthetically trained model with PrimeT2D, a model trained on EHR data. Synthetically trained models have more accessible data and can thus assist or even replace existing models that predict the risk for Type 2 Diabetes in patients if consistently found to be more accurate.

Project ID: MEDH 44

11:05a.m. – 11:20a.m.

Title: Synthesis of Novel Compounds for Leishmaniasis

Presenter(s): Olivia Aguilar, Nelly Piñón, Noel Skariah

Mentor(s): Dr. John Thurmond, Illinois, Mathematics and Science Academy

Abstract/Project Intention:

Leishmaniasis is a neglected tropical disease (NTD) affecting over 90 countries today. Visceral Leishmaniasis, is the most serious form of Leishmaniasis. Current treatment is shown to be toxic such as Liposomal amphotericin and no vaccine or medicine prevents or reduces infection. The project is partnered with Drugs for Neglected Diseases Initiative (DNDi). The purpose of this project was to use the hit compound DNDI0003202883 and alter it by making little modifications around the aromatic ring and studying the structure-activity relationship (SAR) of the compound. To do this, the carboxylic acid group was altered in a synthetic reaction and ran through a TLC test to check the number of potential products there was in a reaction. If the compound had more than one potential product, it was put through column chromatography to purify it. Then the purified compound is run through an infrared (IR) spectroscopy to confirm that the product is different from the amine. Then, the final compounds were sent to our collaborators for biological testing. This testing has brought many opportunities to find a treatment for Leishmaniasis that will increase the availability of nontoxic treatments to the general public.

Project ID: CMPS 39

11:05a.m. – 11:20a.m.

Title: Effectiveness of AprilTags: Tracking Objects through Mixed Reality Environments

Presenter(s): Kavin Venkat, David Weng

Mentor(s): Elahé Soltanaghai and Navid Tajkhorshid,
University of Illinois Urbana Champaign

Abstract/Project Intention:

Mixed reality (XR) can be simply described as a fusion between augmented (AR) and virtual reality (VR), allowing interactions to occur between a virtual world and physical elements. With powerful applications in the educational, medical, and entertainment industries, our exploration of this vast technology primarily focuses on utilizing a virtual setting to track the location of objects in the physical world. One of the more popular options in the market today is Apriltags, known for being able to both translate AR/XR elements into reality while also boasting quality imaging capabilities. However, with a limited working range, our research aimed to find ways to help boost the distance that Apriltags are effective in while maintaining their core benefits. Ultimately, our research indicated that borrowing technology from FLASH tags was essential in helping to increase the distance of Apriltags but this drastically reduced the quality of images produced. In building up our skill levels to tackle such a project, we worked on numerous demos, laying the foundation for concepts such as object manipulation and projecting objects onto a virtual environment that were essential in our study regarding Apriltags.

Business Internship

Session I – 8:15a.m. – 8:30a.m.

Project ID: Biz INTRN 01

8:15a.m. – 8:30a.m.

Title: Quantum Computing at Google Quantum AI

Presentor(s): Nishna Aerabati, Aashima Singh Sisiodia

Business Mentor(s): Doug Strain

Abstract/Project Intention:

With Mr. Strain at Google Quantum AI, we focused on both mathematical and computational aspects of quantum computing. We utilized key concepts in group theory such as groups, subgroups, and the commutative property in groups to understand Shor's algorithm, which has the theoretical possibility of breaking RSA encryption. This algorithm represents a solution to the Hidden Subgroup Problem (HSP), which involves identifying a subgroup H "hidden" within a function f that remains constant across the cosets of H . We will be surveying known results for the HSP for multiple classes of groups. In addition, we explored quantum machine learning. Quantum Machine Learning (QML) algorithms use principles of quantum mechanics for tasks in machine learning. QML algorithms alternate between quantum circuit execution and classical optimization of gate parameters to utilize both the exponentially large space of quantum states and the power of classical machine learning. QML algorithms can operate on quantum data and can process information in superposition and entanglement states, potentially offering speedups for certain computations and better machine learning classification on quantum data. This makes QML valuable for problems like optimization, pattern recognition, and data analysis.

Project ID: Biz INTRN 12

8:15a.m. – 8:30a.m.

Title: Designing IMSA’s AI Future: The IMSA AI Center

Presentor(s): Neev Patel, Rachel Tsang

Business Mentor(s): Britta McKenna, Illinois Mathematics and Science Academy,
Director of Special Initiatives

Abstract/Project Intention:

The IMSA AI Center, incubated at IN2, and currently located in A148, is one of the IMSA Vision 2033 themes. The team is creating an AI Center that serves to educate and inspire the IMSA community about the potential of Artificial intelligence. The internship developed and hosted 10 “AI Bytes” community learning sessions. The team also created a rubric and evaluated the objectives and needs of the AI Center, which helped select a prototype location. The team considered stakeholder inputs of AI Center locations, and helped identify the recommended prototyping space in A148 and A145 and their furnishings. These rooms were opened after spring break of 2024 as IMSA’s AI Center, with an office for the AI Lab Manager and interns. A145 is available as an IMSA AI Training Center. The team also participated in the Flint.ai pilot program that tested and considered Flint’s potential usage in a classroom setting, engaged with the AI Book Read, and explored corporate partnerships to increase the accessibility of AI development resources. Looking ahead, this internship is creating a vision for the space, tools, and learning opportunities for next year’s AI Center and interns

Project ID: Biz INTRN 13

8:15a.m. – 8:30a.m.

Title: Computational Finance analysis at Illinois State Treasurer's Office

Presenter(s): Pranav Pabbisetty

Business Mentor(s): Mr. Alan Duncan

Abstract/Project Intention:

The Illinois State Treasurer's Office, an institution tasked with the management and investment of state finances. The focus of the program resulted in creating a Long-Term Financial Analyzer: this program transforms investment strategy by equipping users not only with five-year stock price forecasts but also critical technical indicators – thereby improving their decision-making knowledge. By harnessing cutting-edge algorithms and incorporating up-to-the-minute financial data, the project prioritized two key objectives: refining accuracy for seasoned investors as well as newcomers; enhancing user accessibility for all levels of expertise. Extensive market research, predictive modeling, and user interface design bridged the gap between finance and technology in this initiative. The introduction of the Long-Term Financial Analyzer into the Treasurer's Office's suite of tools represents a step forward in utilizing technology to support financial analysis and investment strategies, reflecting a practical application of combining market knowledge with tech-based solutions.

Session I – 8:35a.m. – 8:50a.m.

Project ID: Biz INTRN 05
8:35a.m. – 8:50a.m.

Title: Impact of Artificial Intelligence (AI) on Business Operations

Presenter(s): Einsey Socrates

Business Mentor(s): Steve Goldblatt

Abstract/Project intention:

In my IMSA Internship/Independent Study, "Impact of Artificial Intelligence (AI) on Business Operations," mentored by Steve Goldblatt, I delve into the transformative role of AI technologies across industries. This study explores AI applications, focusing on automation, workforce dynamics, decision-making processes, customer experience, ethics, and future trends. My goals include mastering AI concepts, refining research skills, and enhancing communication abilities. Through extensive research, case studies, and surveys sent to companies, I aim to understand the nuanced implications of AI integration in business operations. My outcomes comprise a research paper, executive summary, and presentation, synthesizing key insights for scholarly and practical audiences. By scrutinizing AI's impact on businesses, I aspire to contribute valuable insights and recommendations for navigating the evolving AI landscape. Crucially, I highlight the ethical considerations and strategies imperatives essential for leveraging AI effectively in business operations.

Project ID: Biz INTRN 08

8:35a.m. – 8:50a.m.

Title: Legislative Research at the Office of the State Representative Maura Hirschauer

Presentor(s): Sabriya Attia

Business Mentor(s): Kat Maggio

Abstract/Project Intention:

State Representative Maura Hirschauer, serving the constituents of State House District 49, is committed to enhancing education, bolstering local organizations, and advocating for sensible gun control measures within her community. Our office diligently assists constituents in connecting with federal agencies, collaborates with local organizations, participates in community events, and spearheads legislative initiatives aimed at ameliorating the state. As an intern, my primary focus revolves around constituent services, encompassing tasks such as responding to constituent inquiries, liaising with businesses, and facilitating community engagement. Moreover, I've been entrusted with conducting legislative research, specifically exploring avenues to support student teachers. This research revolves around proposing legislation that would enable student teachers to receive compensation for assuming substitute teaching roles, thereby addressing the substitute teacher shortage while simultaneously aiding student teachers, who often lack stipends and struggle to balance work and coursework during their teaching placements.

Project ID: Biz INTRN 27

8:35a.m. – 8:50a.m.

Title: Utilizing Discord for the Establishment of Online Youth Advisory Councils: A Mixed Methods Study Advancing Digital Strategies for Youth Health Preventions

Presentor(s): Anna Yang

Business Mentor(s): Dr. Kathryn Macapagal, Julianna Lorenzo, Eva Minahan, Institute for Sexual and Gender Minority Health and Wellbeing, Northwestern University.

Abstract/Project intention:

Addressing sexual and gender minority (SGM) adolescents' healthcare barriers is critical for developing inclusive interventions. Digital platforms like Discord offer an effective avenue for discreetly reaching and engaging SGM teens. In developing a national text-message-based health intervention, we utilized Discord to host a virtual Youth Advisory Council (YAC), engaging 21 participants across the U.S. through polls, open-ended questions, and content creation. Their feedback led to significant developments in the intervention's content and design, making it more inclusive and reflective of SGM teens' experiences and improving the technical aspects of its delivery. An acceptability survey revealed that 93.3% of participants valued their involvement and found the process convenient, highlighting Discord's efficacy in engaging SGM adolescents in advisory roles. With a 93.8% retention rate for subsequent sessions, our findings underscore Discord's potential to facilitate meaningful participation among SGM youth. Recommendations for future digitally hosted YACs include using diverse engagement methods, incorporating interactive elements, and maintaining open communication about the impact of participants' feedback to enhance engagement and build trust.

Session I – 8:55a.m. – 9:10a.m.

Project ID: Biz INTRN 10
8:55a.m. – 9:10a.m.

Title: Nuclear Energy Policy with Office of Illinois House Representative
Maura Hirschauer's Office

Presenter: Jacob Nendza

Business Mentor: Kat Maggio

Abstract/Project Intention:

As an intern in the office of Illinois House Representative Maura Hirschauer, my primary responsibilities centered on constituent contact, social media management, and research into nuclear energy policy for the State of Illinois. Over the course of six months, this internship afforded me invaluable opportunities. These included establishing connections with constituents, local businesses, and government agencies, as well as gaining experience in database and social media management. During my six months with the Representative's office, the office experienced growth in operational capacity and productivity due to the addition of extra staffing. Additionally, my research and report on nuclear power legislation provided Representative Hirschauer's office with a deeper understanding of this crucial policy area as Illinois transitions towards complete green energy.

Project ID: Biz INTRN 21

8:55a.m. – 9:10a.m.

Title: Mechanic Intern

Presenter: Noah Walker

Business Mentor(s): OJ Lopez

Abstract/Project intention:

Learn Automotive Mechanic Skills Fluid Motor Union (FMU) is a luxury automotive service and maintenance shop based in Naperville IL. They focus on maintaining, repairing, and upgrading high-end vehicles for their loyal customers around the area. The project's initial idea was to get hands-on experience with different cars to expand my knowledge on the topic. Over these last 6 months, I have done projects, such as replacing a transmission, fabricating a new exhaust system, pulling an engine, rebuilding an engine, and many more. I was even able to bring my own vehicle to work on. I have learned more about automotive mechanics than I could have ever imagined and this internship has grown my love for cars exponentially.

Project ID: Biz INTRN 25

8:55a.m. – 9:10a.m.

Title: Product Development in Airline Heavy Maintenance Planning

Presenter(s): Netra Rameshbabu

Business Mentor(s): Elliot Margul, Aerostrat

Abstract/Project Intention:

Aerostrat's heavy maintenance planning solution, Aerros, assists airlines and MROs with heavy maintenance planning to maximize efficiency, forecast budgets, and aid in various decision-making for optimal yield and vendor support. Airlines must manage C-checks by tracking vendor updates, maintenance statuses, and deadlines, ensuring operational readiness and optimal fleet management. This is where Aerros tracks vendor updates, maintenance statuses, and optimal yields to assist customers. Over the course of six months, Aerostrat provided intensive training on MRO planning, airline etiquette, Aerros' offerings, past clients, pricing information, data metrics, and opportunities to join customer meetings and sessions with United Airlines. After narrowing down research topics from faulty metrics, pricing strategies, and telemetry data for possible interface improvements, I focused on notifications and a simple metric display within the Aerros interface for customer summaries and customizable widgets to improve workflow efficiency. While focusing on product development, we conducted a research survey and organized stages from research to UI/UX implementation, refining product offerings for all scenarios through Figma wireframes sent to engineers. Customers will be able to use toggle buttons to customize dashboards and notifications to receive summarized updates, including change logs, progress digests, KPIs, unscheduled requirements, and real-time schedule changes.

Session II – 9:20a.m. – 9:35a.m.

Project ID: Biz INTRN 14

9:20a.m. – 9:35a.m.

Title: Financial Products with The Illinois State Treasurer’s Office

Presenter: Evelyn Cunneen

Mentor: Maggie Owen, Financial Programs Manager

Abstract/Project intention:

The Illinois State Treasurer’s Office protects Illinois residents by making smart investment choices while managing the state’s portfolio of approximately \$25 billion dollars. The office is dedicated to encouraging savings plans for college or trade school, increasing financial education among all ages, and removing barriers to a secure retirement. As a Financial Products intern, I worked closely with the 529 College Savings and Financial Education teams, providing support on many different projects. Throughout the year, I reported returned mail and provided statistics on retention rates for the First Steps program. The new initiative provides Illinois children with seed funding for BrightStart’s college saving accounts. I also created teacher and student registration guides for the Illinois Personal Finance Challenge, which were sent to teachers across the state. Over the course of a few weeks, I reviewed the sitemap for the financial literacy section of the Treasurer’s Office website and drafted a new sitemap with modern layouts and updated content. Lastly, I scripted a video concept and presented it to Illinois Treasurer Michael Frerichs and other members of the office. Overall, in my time here I have thoroughly enjoyed working with the team and assisting in these projects.

Project ID: Biz INTRN 15
9:20a.m. – 9:35a.m.

Title: Strengthening Cybersecurity and Linux Integration

Presentor(s): Aneesh Bargaje

Business Mentor(s): Alan Duncan

Abstract/Project intention:

During my Internship at the Illinois State Treasury Office, I got in contact with the Cybersecurity and Infrastructure Security Agency (CISA) to conduct a vulnerability scan that they offer. This scan revealed potential vulnerabilities within the office's infrastructure and proposed solutions to mitigate risks effectively. By addressing these vulnerabilities, we fortified the organization's resilience against cyber threats. Simultaneously, I researched the integration of Linux systems into the existing framework of the State Treasury Office. This research encompassed evaluating compatibility requirements, security protocols, and performance optimization strategies. By optimizing the integration of Linux systems, we aimed to streamline operations and enhance efficiency while maintaining robust cybersecurity measures throughout the transition. The most impactful outcome was improving cybersecurity and researching the integration of Linux systems, ensuring better efficiency and security at the State Treasury Office.

Project ID: Biz INTRN 17

9:20a.m. – 9:35a.m.

Title: Forecasting Stock Profitability Using Language Models

Presenter: Sufiya Hussaini

Business Mentor: Andrew Kominik, William Blair

Abstract/Project intention:

The success of an investment management firm hinges greatly on its capacity to forecast stock returns, a factor crucial for garnering investor confidence and satisfying customer expectations. One approach to achieving this is through the development of linear regression models using programming languages like Python, leveraging datasets such as those provided by Fred. This methodology exemplifies a proactive strategy aimed at predicting future stock outcomes, thereby enhancing the firm's decision-making process. By harnessing publicly available data sources like FRED, investment firms can construct sophisticated models, including linear regression models, to not only forecast the overall performance of the equity market but also to analyze and predict the performance of specific market segments. This strategic utilization of data-driven methodologies equips investment management companies with valuable insights, empowering them to navigate the dynamic landscape of financial markets with greater precision and confidence.

Session II – 9:40a.m. – 9:55a.m.

Project ID: Biz INTRN 07

9:40a.m. – 9:55a.m.

Title: Legislation for After School Program to Improve Literacy Rates in Elementary Education

Presenter(s): Ellen Hsuan

Business Mentor(s): Kat Maggio, Maura Hirschauer

Abstract/Project intention:

State Representative Maura Hirschauer’s District Office provides resources for constituents in the Suburban Cook, DuPage, and Kane Counties and champions legislation in the Illinois General Assembly. Over the course of six months, I worked with fellow interns to gain knowledge about government processes, communication, and issues within the District 49 community. Our responsibilities included social media management, assistance with the planning of local events, and correspondence with constituents through stance emails. At the same time, I conducted research for an unofficial legislative bill concerning early childhood education. In recent years, reports have shown that an increasing percentage of Illinois students in grades K-8 are behind grade level in literacy as shown by data obtained from standardized testing scores. Students from low-income households in particular suffer from this disparity. My business project focuses on the implementation of a free after-school mentoring program to improve literacy rates in elementary school students.

Project ID: Biz INTRN 11

9:40a.m. – 9:55a.m.

Title: Representative Internship for Rep. Hirschauer

Presenter(s): Evan Trone

Business Mentor(s): Kat Maggio, Rep. Hirschauer, Mariah Perez

Abstract/Project intention:

The Illinois Kratom Consumer Protection Act aims to establish safety standards for Kratom products, safeguard consumers from adulterated goods, and regulate sales to minors. It seeks to balance public safety with individuals' rights to access Kratom for legitimate purposes like pain management and anxiety relief. The Act defines such terms as "Certified Kratom Product" and "Processor" to clarify its scope. Safety standards, as determined by the Department of Public Health in consultation with stakeholders, will guide processors in preparing and distributing Kratom products. Adulterated products will be prohibited, and guidelines for testing and certification established to ensure compliance. Administrative penalties for violations are stipulated, with collected fines directed to the Food and Drug Safety Fund. Age restrictions prohibit sales to those under 21, aligning with existing regulations. Retailers acting in good faith upon representations of Kratom product manufacturers or distributors may be exempt from liability. The Act allows 180 days for implementation to facilitate compliance. It includes a severability clause to preserve its efficacy in the event of legal challenges. Enacted to address health and safety concerns, this legislation reflects Illinois's commitment to responsible Kratom regulation.

Project ID: Biz INTRN 18

9:40a.m. – 9:55a.m.

Title: Various Testing Methods to Diagnose Pediatric Hearing Loss

Presenter: Gabriella Boscarino

Mentors: Richard Novy and Paige Gallagher

Abstract/Project intention:

Throughout the 2023-2024 school year, I have had the opportunity to intern at a school for children with hearing loss and understand more about the methodology and function of various hearing tests. In a school setting, I worked with children ages 2 to 7 and consequently administered only specific tests relevant to their age group. Additionally, I also learned about the different devices that are used to aid hearing and the criteria to be considered for each. The methodology of the tests as well as working with the software was also something that I learned to do. Another aspect is patient care and troubleshooting which is exceedingly important while working in the pediatric field, as children can sometimes be unpredictable and uncooperative. Overall, this experience served as a fantastic first look into what the field of pediatric audiology entails and some of the nuances that are not discussed in formal settings.

Session II – 10:00a.m. – 10:15a.m.

Project ID: Biz INTRN 02

10:00a.m. – 10:15a.m.

Title: APS Data Technologies Internship

Presentor(s): Anmol Singh, Blessita Charly, Aruuke Ulanbek, Andre Mendez, Raphael Talusan, Angel Lopez, Srihari Gurugubelli

Business Mentor(s): Kelsey Cozens, Harish Ananthapadmanabhan

Abstract/Project intention:

APS Data Technologies is a software development company that develops software tools to serve Aurora area businesses. The multiple projects involved market research, mobile application development, artificial intelligence model development, backend development, and web development. One team developed a mobile application engaging with Aurora's murals through mixed reality. The application was designed with a user-friendly interface, making it easy for businesses to adopt the software tools. Another team worked on developing the front end of a smart parking application for which two additional teams developed AI models that could track license plates and vehicles in a parking lot using a camera, thereby improving security. The model was designed to be flexible and could be customized to meet the specific needs of individual businesses. The backend was also a critical part of this whole process. The intention behind these projects was to transform Aurora into a smart city.

Project ID: Biz INTRN 04

10:00a.m. – 10:15a.m.

Title: Scientific Technology Advertising at the Polsky Center for Innovation and Entrepreneurship

Presenter(s): Sydney Hunter

Business Mentor(s): Dr. Michael Hinton

Abstract/Project Intention:

The Polsky Center for Entrepreneurship and Innovation at the University of Chicago works to advance all University of Chicago entrepreneurship and research commercialization innovation activities through the creation of new ventures and partnerships. The focus of the business project is to assist inventors and innovators in finding partnerships and funding their innovations and technologies. This is accomplished by parsing and rewording submitted scientific patent applications for technologies developed by individuals affiliated with the University of Chicago into briefs to be put on the Polsky Center website and advertised to University of Chicago affiliates. This substantially increases the number of patents that the Polsky Center can efficiently process and advertise, thus allowing more scientists to receive support and partnership in their work.

Project ID: Biz INTRN 22

10:00a.m. – 10:15a.m.

Title: Stem Cell Research in the Lens of Orthopedics

Presenter(s): Sar'aiyah Murphy

Business Mentor(s): Noah Paras and Christopher Chalko

Abstract/Project Intention:

Dive Into the understanding of Stem Cells and how they are used in Orthopedics Stem Cells are used in a variety of ways within the medical field with the commonality used for body repairs. In Orthopedics Stem Cells are used to improve overall function, reduce inflammation and pain, and aid in tissue regeneration. The focus of the business project for Stem Cell research in the lens of orthopedics is to dive deep into the use and moral use of stem cells within orthopedics. The business project has changed to include both the orthopedic and moral use of Stems Cells. Athletico Physical therapy is a rehabilitation center that is focused on providing proper care and attention to every individual that walks through the door of every facility. I intern at the location 15-20 away from the academy on Eola road. Athletico Physical Therapy allotted many opportunities to work with patients who had Stem cell injections, the therapy they experienced was similar but different from those who did not have an injection. The main purpose of this project is to gather a full understanding of Stems Cells within Orthopedics as research about the topic is limited. To continue and help others learn about Stem Cells and provide a detailed report on the Orthopedic use of Stem Cells.

Session III – 10:25a.m. – 10:40a.m.

Project ID: Biz INTRN 06

10:25a.m. – 10:40a.m.

Title: Pet Welfare in Chicago

Presentor(s): Alyssa Abendroth

Business Mentor(s): Lauren Osborne, PAWS Chicago Intake Director

Abstract/Project Intention:

PAWS Chicago, the city's largest animal rescue, is committed to tackling urban pet homelessness and abuse. Throughout the internship, work has been done with various programs, such as adoption, crisis-care, Parvo+ puppy care, CACC (Chicago Animal Care and Control) diversion, pet food pantries, feral cat TNR (Trap, Neuter, Release), domestic and international transports, fundraising, and more, to aid in PAWS' mission to create a no-kill city.

Project ID: Biz INTRN 09

10:25a.m. – 10:40a.m.

Title: Behind the Legislative Process

Presentor(s): Avyay Duggirala

Business Mentor(s): Kat Maggio | Rep Hirschauer Office

Abstract/Project Intention:

Representative Maura Hirschauer hails from the 53rd Congressional district of Illinois, representing West Chicago and Bartlett. I worked with the Representative's office to research and propose legislation that modifies Illinois's Baby Bonds System. In the status quo, Illinois offers a \$50 dollar seed fund for the opening of a 529 account for any child born after 2022. My proposed legislation, HB4720, would double that seed fund to \$100 dollars for children born on medicaid to bolster the initiative of opening a 529 account for lower income families. Throughout my time in the internship, I was able to conduct my own research on the efficacy of such a baby bonds system and create the physical piece of legislation that is being debated by the 103rd General Assembly. Aside from my primary baby bonds project, I assisted Representative Hirschauer and her team handle a variety of constituent cases, and helped manage the various Social Media accounts under the name of the Representative. Fundamentally, I collaborated with Representative Hirschauer to research and create HB4720, legislation that changes the baby bonds system, while concurrently assisting her office in the management of both constituent cases and social media accounts.

Project ID: Biz INTRN 24
10:25a.m. – 10:40a.m.

Title: Business Operations Intern

Presentor(s): Shridhar Mehendale

Business Mentor(s): Marcia Edel

Abstract/Project Intention:

KiwiWrite Math Software LLC is a web application designed for students who have dysgraphia, a condition that makes it difficult to physically write, that allows students to edit their math worksheets in PDF or image format online. As an intern, I handled a variety of tasks that varied over time according to business needs, ranging from software testing to creating marketing content. Specifically, I expanded the in-app math function library to include Calculus topics as well as thoroughly verified the functionality of two new features that were released — app integration with Google Classroom and expanding worksheets by adding white space. Furthermore, I created regular Instagram, LinkedIn, and Facebook posts that helped promote the current product and notify users of software updates. Additionally, I performed search engine optimization for the current website using HTML and the Wix Editor. Throughout this internship I gained an insight on the daily operations of a startup company and learned valuable workplace skills.

Session III – 10:45a.m. – 11:00a.m.

Project ID: Biz INTRN 16
10:45a.m. – 11:00a.m.

Title: Construction Design with PM Construction

Presenter(s): Ryan Mojzis

Business Mentor(s): Philip Lang

Abstract/Project intention:

PM Construction is a general contracting company that performs a wide range of construction contracts, but specializes in commercial construction. The focus of the business project was to use various Computer Aided Design (CAD) softwares to design construction plans and generate estimates for job costs and scope of work. Over the course of seven months, the company provided opportunities to visit potential job sites and interact with clients to determine the depth of work, design construction plans for job sites, and use those plans to generate estimates to bid on jobs.

Project ID: Biz INTRN 20
10:45a.m. – 11:00a.m.

Title: Equity in STEMM Innovation and AI (EQ-SI) Grant Writing and Program and Web Development

Presenter(s): Victoria Nalepka, Saad Sheikh, Asad Sheikh, and Abhinav Anne

Business Mentor(s): Ms. Dima Elissa

Abstract/Project Intention:

Draft and grant proposal for a diversity-driven summer program, supplemented by a clear website draft and well-defined curriculum Equity in STEMM Innovation and AI (EQ-SI) is a diversity-driven organization aimed to increase female and racial minority presence in the medical field. EQ-SI was created by Ms. Dima Elissa, who is also the CEO of VisMed3D, a biotechnology consulting company. Our business project catalyzed many of EQ-SI's projects including the expansion of the curriculum and development of STEMM Prep+, a summer program designed to increase diversity and inclusion among motivated STEM students, developed EQ-SI's website while supplementing it with the development of a Fitness Quiz for startup developers, and ultimately writing two grants, one for the aforementioned STEMM Prep+ program and the other for a collaborative program the Aparecio Foundation for college women interested in medicine. Over the course of six months, Ms. Dima provided us with work opportunities to design and organize the EQ-SI website, develop a curriculum focused on addressing socioeconomic and racial barriers. Ms. Dima additionally arranged consultations with real business professionals, who offered feedback on our progress. VisMed3D benefited from our work, as it was capable of launching EQ-SI's website for future consumer use and developed its consumer outreach through the development of the aforementioned programs.

Session III – 11:05a.m. – 11:20a.m.

Project ID: Biz INTRN 03

11:05a.m. – 11:20a.m.

Title: Affordable Housing Policy with the City of Aurora Mayor’s Office of Economic Development

Presentor(s): Pranet Swain

Business Mentor(s): David Dibo

Abstract/Project Intention:

This report provides a comprehensive analysis of the intricate dynamics between landlords and tenants in Aurora, Illinois, against the backdrop of a diverse housing market fraught with challenges and opportunities. The study focuses on understanding the mutual experiences and practices within this context, aiming to highlight the impacts on housing disparities and equity. Significant findings illuminate the financial advantages and challenges associated with renting to Housing Choice Voucher (HCV) holders, revealing a complex landscape of strategic tenant selection that influences housing accessibility and affordability. Landlords' experiences shed light on the delicate balance required to navigate the housing market's profitability while ensuring quality living conditions, emphasizing the importance of targeted tenant retention strategies. These insights form the basis for a set of recommendations aimed at policy adjustments and interventions. Proposed measures include incentivizing landlord participation in voucher programs, establishing fair tenant recruitment and retention guidelines, fostering partnerships for supportive services, and enhancing communication from housing authorities. These recommendations are designed to improve housing equity and accessibility, addressing the identified challenges to benefit both landlords and tenants in Aurora's evolving housing landscape.

Project ID: Biz INTRN 19

11:05a.m. – 11:20a.m.

Title: Rebranding and Rebuilding with SciTech

Presenter(s): Xander Albertson, Donovan Morrow, Byrd Gilissen

Business Mentor(s): Amanda Mistretta

Abstract/Project intention:

SciTech is a former children's museum turned mobile learning center, focusing on STEM based educational activities. During the course of our internship we focused on marketing, program designing, and communication with other local businesses. We started by helping SciTech rebrand themselves and change into a more mobile company, and creating a solid frame by managing their social media. This included building and designing a website as well. As the internship progressed we delved into two projects. One is restarting their StarLab by looking over the program and updating the curriculum for a modern audience. The other was creating a STEM Alliance, which works and communicates with related organizations nearby to create STEM programming for children. Our work helped bring back SciTech's former reach and audience, as well as create opportunities for the organization's future growth.

Project ID: Biz INTRN 23

11:05a.m. – 11:20a.m.

Title: Intern at Torch Architecture

Presenter(s): Jaxon Womack

Business Mentor(s): Rob Costello, Principal of TORCH Architecture

Abstract/Project intention:

TORCH Architecture is an Architecture firm from Naperville, Illinois. TORCH has completed a wide range of projects, but a majority of the projects that I have aided them with were their commercial projects, specifically car dealerships. There is an extensive revision process for every building permit at the end of a project, so I worked with colleagues to write response letters to city reviewers to ensure the revision process happens as smoothly as possible. As I progressed in knowledge, a formal project was transferred to me. The goal of the project was to design a Habitat for Humanity, also known as HFH (a nonprofit organization that provides low-income housing to those in need), home that produced a minimum monthly operating cost. This included design decisions with the intent to preserve the use of air conditioning, heat, gas, and electricity. Additionally, the goal of this home was environmental awareness, where carbon emissions were minimized by design. Designing this home happened alongside HFH guidelines so that this project may be considered for HFH in DuPage County. My mentor, Rob Costello, is a board member for DuPage HFH, so he has been working tirelessly with the organization to ensure this project's success.

Presentation Schedule Reference List | IMSAloquium 2024

<u>Student First</u>	<u>Student Last</u>	<u>Session - Time - Room</u>	<u>Project ID</u>
Alyssa	Abendroth	III - 10:25a.m. - IN2 Alpha Design Studio	BIZ INTRN 06
Nishna	Aerabati	II - 9:20a.m. - MATH STUDY	CMPS 32
Nishna	Aerabati	I - 8:15a.m. - IN2 Learning Lab	BIZ INTRN 01
Olivia	Aguilar	I - 11:05a.m. - B133	MEDH 44
Fiyinfoluwa	Akinyemi	II - 9:40a.m. - B108	ENGN 03
Mesoma	Akpuokwe	II - 10:00a.m. - B115	MEDH 41
Xander	Albertson	III - 11:05a.m. - IN2 Commons	BIZ INTRN 19
Anjali	Ali	III - 10:45a.m. - A117	MEDH 04
Iris	Amit	II - 9:40a.m. - B133	MEDH 42
Fredy	An	II - 10:00a.m. - B110	PHYS 25
Ibrahim	Arif	II - 9:20a.m. - A131	RISE 01
Hagen	Arriaga	I - 8:55a.m. - B133	CHEM 07
Hagen	Arriaga	III - 10:45a.m. - B115	CHEM 13 (SMR)
Sabriya	Attia	I - 8:35a.m. - IN2 Commons	BIZ INTRN 08
Sreevardhan	Atyam	I - 8:15a.m. - B110	PHYS 16
Ibrahim	Bah	III - 10:25a.m. - A129	PHYS 03 (SMR)
Manasa	Balasubramanian	II - 10:00a.m. - A117	MEDH 49
Keegan	Balow	I - 8:15a.m. - B125	ENGN 08
Amanda	Barajas	III - 11:05a.m. - A149	PHYS 12 (SMR)
Aneesh	Bargaje	II - 9:20a.m. - IN2 Alpha Design Studio	BIZ INTRN 15
Aria	Barve	I - 8:55a.m. - A149	CMPS 26
Bikrant	Bhattacharyya	II - 10:00a.m. - B110	PHYS 25
Alvena	Bhutiani	III - 11:05a.m. - A123	BHVS0 07
David	Biruduganti	III - 10:25a.m. - A147	CMPS 01
Samuel	Biruduganti	II - 9:20a.m. - B125	ENGN 01
Emerson	Blair	I - 8:35a.m. - A133	MEDH 23
Jaden	Blankenship	II - 10:00a.m. - A155	MEDH 34
Ayesha	Bobat	III - 10:45a.m. - A129	MEDH 05
Gabriella	Boscarino	II - 9:40a.m. - IN2 Commons	BIZ INTRN 18

Abigail	Botello	III - 10:45a.m. - B133	MEDH 43
Arjun	Brahmandam	II - 9:40a.m. - A113	CHEM 05
Divya	Brahmbhatt	I - 8:55a.m. - A133	MEDH 24
Samuel	Brownell	III - 10:45a.m. - A147	CMPS 02
Nandini	Budithi	I - 8:15a.m. - A119	ENVR 01
Ishan	Buyyanapragada	III - 11:05a.m. - A147	CMPS 03
Patrick	Cahill	II - 9:20a.m. - B108	ENGN 10
Zhuoer	Cai	II - 10:00a.m. - MATH STUDY	CMPS 36
Chinara	Caldwell	I - 8:35a.m. - B133	CHEM 08
Semi	Campos Gonzalez	I - 8:15a.m. - B133	CHEM 14 (SMR)
Daniel	Cano	I - 8:55a.m. - B133	CHEM 07
Michael	Capriotti	II - 9:40a.m. - A121	BHVS0 06
Tristen	Castillo	III - 10:45a.m. - B115	CHEM 13 (SMR)
Laura	Cervantes	I - 8:35a.m. - B125	ENGN 09
Sindhu	Chalasanani	III - 10:25a.m. - A117	MEDH 06
Anirudh	Chari	III - 11:05a.m. - A150	ENGN 02
Blessita	Charly	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02
Shatakshi	Chatterjee	I - 8:35a.m. - A117	BIO 12
Carissa	Chen	II - 9:40a.m. - MATH STUDY	CMPS 34
Ivan	Chen	I - 8:35a.m. - B110	PHYS 17
Max	Chen	I - 8:35a.m. - B116	PHYS 31
Max	Chen	III - 11:05a.m. - A151	CMPS 19 (SMR)
Richard	Chen	I - 8:55a.m. - B108	PHYS 07
Arjun	Cherukuri	III - 10:25a.m. - A155	MEDH 35
Ria	Cherukuri	I - 8:55a.m. - A117	BIO 13
Sreehaas	Chinnala	III - 10:25a.m. - A113	BIO 15
Jediael	Chintha	III - 10:25a.m. - A152	MEDH 46
Shivani	Chirumamilla	I - 8:55a.m. - A119	ENVR 05
Komal	Chivukula	III - 10:45a.m. - B110	PHYS 04
Ryan	Cho	II - 10:00a.m. - A149	MEDH 25
Ian	Chung	I - 8:35a.m. - A119	ENVR 02
Charles	Conner	I - 8:55a.m. - A121	BHVS0 01

Rachel	Coutinho	III - 10:45a.m. - A119	MEDH 07
Evelyn	Cunneen	II - 9:20a.m. - IN2 Commons	BIZ INTRN 14
Aahana	Das	I - 8:15a.m. - A135	MEDH 19
Aarushi	Das	II - 10:00a.m. - A151	CMPS 27
Manya	Davis	I - 8:15a.m. - A151	CMPS 04
Aadi	Desai	I - 8:35a.m. - MATH STUDY	CMPS 30
Aashi	Dharia	III - 10:45a.m. - A152	MEDH 26
David	Dickson	III - 10:45a.m. - A113	BIO 02
Navya	Dixit	I - 8:15a.m. - A129	PHYS 01
Aleksandra	Duda	II - 9:40a.m. - A119	ENVR 04
Avyay	Duggirala	I - 8:35a.m. - A121	BHVSO 03 (SMR)
Avyay	Duggirala	III - 10:25a.m. - IN2 Commons	BIZ INTRN 09
Shrikar	Dulam	I - 8:55a.m. - B116	PHYS 27
Keyan	Dunmore	I - 8:35a.m. - A123	BHVSO 08
Cameron	Eddington	I - 8:55a.m. - B116	PHYS 27
Tae Geon	Eom	I - 8:15a.m. - B108	ERSP 02
Jose	Florenzano	I - 8:35a.m. - A129	PHYS 08 (SMR)
Jaykrish	Ganesan	I - 8:15a.m. - B108	ERSP 02
Dael	Garzon Torres	I - 8:15a.m. - B133	CHEM 14 (SMR)
Dael	Garzon Torres	III - 11:05a.m. - A113	CHEM 03
Katherine	Ge	I - 8:55a.m. - A115	ENVR 06
Johanna	Germo	II - 10:00a.m. - A117	MEDH 49
Sukanya	Ghosh	III - 11:05a.m. - A152	MEDH 27
Byrd	Gilissen	III - 11:05a.m. - IN2 Commons	BIZ INTRN 19
Ava	Gonzalez	I - 8:15a.m. - A155	MEDH 28
Yanel	Gonzalez	III - 10:45a.m. - A155	MEDH 47
Laya	Gopalakrishnan	III - 10:45a.m. - B110	PHYS 04
Michael	Granger	II - 9:20a.m. - A150	CMPS 18
Ellen	Guan	III - 10:45a.m. - B125	CMPS 10
Riya	Gumidyala	I - 8:35a.m. - A115	BIO 04
William	Guo	III - 11:05a.m. - A123	BHVSO 07
Srihari	Gurugubelli	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02

Eduardo	Gutierrez	I - 8:15a.m. - A149	CMPS 21
Albert	Han	I - 8:55a.m. - B110	PHYS 18
Aditya	Hansoty	II - 10:00a.m. - B133	CHEM 09
Shrishant	Hattarki	I - 8:15a.m. - A147	CMPS 06
Alyssa	Hernandez	I - 8:35a.m. - B133	CHEM 08
Alyssa	Hernandez	III - 10:25a.m. - B115	CHEM 16 (SMR)
Ashley	Hernandez	I - 8:55a.m. - A123	BHVS0 09
Josefh	Hernandez	I - 8:55a.m. - A115	ENVR 06
Josefh	Hernandez	III - 11:05a.m. - B115	CHEM 15 (SMR)
Brooke	Hilderbrant	III - 11:05a.m. - A119	MEDH 08
Madhav	Hota	II - 10:00a.m. - A150	MEDH 36
Ellen	Hsuan	II - 9:40a.m. - IN2 Alpha Design Studio	BIZ INTRN 07
Sydney	Hunter	II - 10:00a.m. - IN2 Learning Lab	BIZ INTRN 04
Sufiya	Hussaini	II - 9:20a.m. - IN2 Learning Lab	BIZ INTRN 17
Kaylee	Hwang	I - 8:35a.m. - A135	MEDH 20
Kannan	Ilamparithi	II - 9:20a.m. - A135	MEDH 09
EmmaLi	Isham	I - 8:35a.m. - A155	MEDH 29
Cara	Jacob	I - 8:15a.m. - A131	MEDH 10
Catherine	Jenks	II - 9:20a.m. - B110	PHYS 19
Jazmyn	Johnson	III - 10:25a.m. - B115	CHEM 16 (SMR)
Blaise	Jones	I - 8:55a.m. - A113	CHEM 02 (SMR)
Vedanti	Joshi	II - 9:20a.m. - A117	BIO 16
Diya	Kamath	II - 10:00a.m. - A121	MEDH 37
Maya	Kannan	II - 9:20a.m. - B116	PHYS 28
Atharva	Kapale	II - 9:40a.m. - A129	ERSP 01
Atharva	Kapale	III - 11:05a.m. - B115	CHEM 15 (SMR)
Sohum	Kashyap	I - 8:35a.m. - A147	CMPS 07
Anwita	Kasturi	II - 9:20a.m. - B116	PHYS 28
Andrew	Katson	II - 9:20a.m. - A152	MATH 01
Ebba	Kaulas	III - 10:25a.m. - B108	ENGN 12
Aidan	Kim	I - 8:15a.m. - A149	CMPS 21
Jongwoo	Kim	I - 8:35a.m. - A131	MEDH 11

Josephine	Kim	I - 8:15a.m. - A131	MEDH 10
Yoonseo	Kim	III - 10:45a.m. - A119	MEDH 07
Anisha	Kolambe	I - 8:55a.m. - A131	MEDH 12
Krish	Konda	I - 8:15a.m. - B108	ERSP 02
Pranavi	Korapati	II - 9:40a.m. - A117	BIO 14
Justina	Kostiv	I - 8:55a.m. - A155	MEDH 30
Dominik	Kozbiel	II - 10:00a.m. - B110	PHYS 25
Marcus	Kubon	II - 9:40a.m. - B116	PHYS 20
Aditya	Kumar	I - 8:15a.m. - B115	MEDH 50 (SMR)
Aditya	Kumar	III - 10:25a.m. - A149	PHYS 10
Sarah	Kumar	III - 10:45a.m. - A117	MEDH 04
Yaalini	Lakhani	III - 10:45a.m. - A150	CMPS 41
Nathan	Laud	I - 8:55a.m. - A147	CMPS 08
Joshua	Lee	II - 9:20a.m. - A119	ENVR 03 (SMR)
Dashiell	Leigh	II - 9:40a.m. - A152	MEDH 40 (SMR)
Ryan	Li	II - 9:20a.m. - A150	CMPS 18
Ryan	Li	III - 10:45a.m. - A151	CMPS 15 (SMR)
Brayden	Lindstrom	II - 9:20a.m. - B115	CHEM 10
Zuyu	Liu	II - 9:40a.m. - B125	ENGN 11
Angel	Lopez	III - 10:45a.m. - B115	CHEM 13 (SMR)
Angel	Lopez	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02
Charles	Ludwig	I - 8:15a.m. - B108	ERSP 02
Aldo	Magana	II - 10:00a.m. - A129	HIST 01
Sadkrith	Malladi	III - 11:05a.m. - B125	CMPS 09
Manhitha	Mamillapalli	II - 10:00a.m. - A135	MEDH 13
Robert	Mandell	I - 8:15a.m. - B116	PHYS 29
Robert	Mandell	III - 11:05a.m. - A129	ERSP 03 (SMR)
Sebastian	Mark	II - 10:00a.m. - B125	PHYS 26
Hunter	Mathews	III - 10:45a.m. - B108	ENGN 06
Luke	Mauk	II - 9:20a.m. - A121	BHVS0 05
Dhaatri	Maviti	III - 11:05a.m. - A123	BHVS0 07
Raven	McKelvin	III - 10:25a.m. - B115	CHEM 16 (SMR)

Shridhar	Mehendale	III - 10:25a.m. - IN2 Learning Lab	BIZ INTRN 24
Andre	Mendez	I - 8:35a.m. - A129	PHYS 08 (SMR)
Andre	Mendez	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02
Michael	Meng	III - 10:25a.m. - MATH STUDY	CMPS 37
Myra	Mensah	II - 9:40a.m. - A119	ENVR 04
Aubrey	Miller	I - 8:15a.m. - A113	CHEM 01
Ryan	Mojzis	III - 10:45a.m. - IN2 Learning Lab	BIZ INTRN 16
Mikaella	Moraga	III - 10:25a.m. - A135	MEDH 14
Natalia	Morales	III - 10:45a.m. - A123	BHVS0 13
Donovan	Morrow	III - 11:05a.m. - IN2 Commons	BIZ INTRN 19
Joshua	Mu	I - 8:15a.m. - A117	BIO 05
Sriya	Mudumba	II - 9:40a.m. - B133	MEDH 42
Sar'ayah	Murphy	II - 10:00a.m. - IN2 Alpha Design Studio	BIZ INTRN 22
Himani	Musku	I - 8:15a.m. - A150	CMPS 16 (SMR)
Himani	Musku	III - 10:25a.m. - A150	CMPS 17
Laasya	Nagumalli	II - 9:20a.m. - A123	BHVS0 10
Laasya	Nagumalli	III - 11:05a.m. - A149	PHYS 12 (SMR)
Ashwin	Nair	I - 8:15a.m. - A155	MEDH 28
Victoria	Nalepka	III - 10:45a.m. - IN2 Commons	BIZ INTRN 20
Diego	Nava	II - 9:40a.m. - A151	CMPS 23
Jacob	Nendza	I - 8:55a.m. - IN2 Alpha Design Studio	BIZ INTRN 10
Yicole	Ng	II - 9:40a.m. - A123	BHVS0 11
Ellen	Nguyen	III - 10:25a.m. - A121	BHVS0 14
Eliana	Nungaray	II - 9:40a.m. - A119	ENVR 04
Claire	O'Brien-Dull	II - 9:40a.m. - B110	PHYS 21
Fopefoluwa	Ojomalade	III - 10:45a.m. - A121	BHVS0 15
Kosi	Okeke	II - 10:00a.m. - B115	MEDH 41
Chiamaka	Okoli	I - 8:55a.m. - A123	BHVS0 09
Gwendolyn	Olney	II - 9:40a.m. - A119	ENVR 04
Gavin	O'Malley	III - 10:25a.m. - B116	PHYS 22
Pranav	Pabbisetty	I - 8:15a.m. - IN2 Alpha Design Studio	BIZ INTRN 13
Jayram	Palamadai	I - 8:15a.m. - B116	PHYS 29

Georgi	Panchev	I - 8:55a.m. - MATH STUDY	CMPS 42
Maitreyi	Pandey	II - 10:00a.m. - A113	BIO 01
Joseph	Paras	I - 8:55a.m. - A135	MEDH 21
Chad	Park	III - 11:05a.m. - B110	PHYS 05
JaeJun	Park	III - 10:25a.m. - A119	MEDH 03
Mia	Park	II - 9:40a.m. - B115	CHEM 11
Advayth	Pashupati	I - 8:55a.m. - MATH STUDY	CMPS 42
Aarav	Patel	II - 9:40a.m. - A131	RISE 07
Aarna	Patel	III - 10:25a.m. - A117	MEDH 06
Arnav	Patel	III - 11:05a.m. - A119	MEDH 08
Neev	Patel	I - 8:15a.m. - IN2 Commons	BIZ INTRN 12
Rushina	Patel	II - 9:20a.m. - A113	CHEM 04
Neev	Patel	II - 10:00a.m. - A152	MEDH 16 (SMR)
Nelly	Pinon	I - 11:05a.m. - B133	MEDH 44
Kyler	Ponx	II - 10:00a.m. - B116	PHYS 30
Carter	Poskozim	I - 8:55a.m. - B125	ENGN 05
Aditya	Prashanth	I - 8:55a.m. - A151	CMPS 11
Gabrielle	Pride	III - 10:25a.m. - B133	MEDH 45
Rachel	Qi	II - 9:40a.m. - A115	BIO 06
Netra	Rameshbabu	I - 8:55a.m. - IN2 Commons	BIZ INTRN 25
Elaine	Rao	III - 11:05a.m. - A155	MEDH 38
Vikram	Rao	III - 11:05a.m. - B116	PHYS 23
Kavya	Reddy	II - 10:00a.m. - A119	MEDH 01
Ethan	Remedios	II - 9:20a.m. - A151	CMPS 20
Tia	Rice	III - 10:45a.m. - B110	PHYS 04
Stella	Ristic	I - 8:35a.m. - B108	PHYS 06
Alea	Ritchie	III - 11:05a.m. - B108	ENGN 07
Brent	Rodrigo	II - 10:00a.m. - A117	MEDH 49
Brandon	Rogers	III - 10:25a.m. - B110	PHYS 32
Shashi	Salavath	II - 9:20a.m. - A149	CMPS 28
Deepanjali	Samal	II - 9:40a.m. - A135	BIO 07
Karla	Sanchez	II - 9:20a.m. - A129	IND ST 01

Karla	Sanchez	III - 10:45a.m. - B133	MEDH 43
Anirudh	Saravanan	III - 10:25a.m. - A131	RISE 08
Tate	Schneider	I - 8:35a.m. - A113	CHEM 06
Torin	Schroeder	II - 9:20a.m. - B115	CHEM 10
Raymond	Schumacher	II - 9:20a.m. - A133	PHYS 13 (SMR)
Max	Schwartz	I - 8:55a.m. - B125	ENGN 05
Vidyoot	Senthilvenkatesh	I - 8:15a.m. - A152	CMPS 43 (SMR)
Vidyoot	Senthilvenkatesh	III - 10:45a.m. - MATH STUDY	CMPS 38
Aaditya	Shah	II - 9:40a.m. - A149	CMPS 31
Devarsh	Shah	III - 10:45a.m. - A135	MEDH 17
Haley	Shah	II - 9:20a.m. - A155	MEDH 31
Rhea	Shah	I - 8:15a.m. - A150	CMPS 16 (SMR)
Rhea	Shah	III - 11:05a.m. - A135	MEDH 02
Nethra	Shanbhag	II - 9:40a.m. - A147	CMPS 13
Asad	Sheikh	III - 10:45a.m. - IN2 Commons	BIZ INTRN 20
Haoran	Shi	I - 8:15a.m. - A115	BIO 03
Anmol	Singh	II - 9:40a.m. - A150	CMPS 33
Anmol	Singh	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02
Aashima	Singh Sisodia	I - 8:15a.m. - IN2 Learning Lab	BIZ INTRN 01
Raghav	Sinha	II - 10:00a.m. - A147	CMPS 24
Aashima	Sisodia	III - 10:45a.m. - B125	CMPS 10
Noel	Skariah	I - 11:05a.m. - B133	MEDH 44
Daunye	Slatton	III - 10:45a.m. - A149	PHYS 14
Einsteinia	Socrates	I - 8:35a.m. - IN2 Learning Lab	BIZ INTRN 05
Joshua	Solone	II - 9:20a.m. - B108	ENGN 10
Alexander	Sorescu	I - 8:15a.m. - MATH STUDY	CMPS 29
Nataliya	Stewart	I - 8:35a.m. - B133	CHEM 08
Lucinda	Stocco	III - 10:25a.m. - A115	BIO 08
Jeremiah	Suarez	I - 8:35a.m. - A152	CMPS 35 (SMR)
Jeremiah	Suarez	II - 10:00a.m. - B116	PHYS 30
Danica	Sun	II - 9:40a.m. - A121	BHVS0 06
Pruschothum	Sureshkumar	II - 9:20a.m. - B133	CHEM 17 (SMR)

Pranet	Swain	III - 11:05a.m. - IN2 Learning Lab	BIZ INTRN 03
Raphael	Talusan	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02
Rithik	Thekiniath	II - 9:40a.m. - A155	MEDH 32
Kevin	Tian	III - 10:45a.m. - A131	RISE 09
Vignesh	Tiruvannamalai	I - 8:15a.m. - A131	MEDH 10
Ayan	Trivedi	II - 10:00a.m. - B133	CHEM 09
Evan	Trone	II - 9:40a.m. - IN2 Learning Lab	BIZ INTRN 11
Rachel	Tsang	I - 8:15a.m. - IN2 Commons	BIZ INTRN 12
Aruuke	Ulanbek	II - 10:00a.m. - IN2 Commons	BIZ INTRN 02
Kavya	Uppal	I - 8:35a.m. - A150	CMPS 14
Kavya	Uppal	III - 10:25a.m. - A151	CMPS 22 (SMR)
Megan	Vanhoof	II - 9:20a.m. - B108	ENGN 10
Shruthi	Vasudevan	II - 9:20a.m. - A147	CMPS 12
Prabhav	Veeramachaneni	II - 10:00a.m. - B133	CHEM 09
Sahil	Veeravalli	I - 8:15a.m. - A121	BHVSO 02 (SMR)
Sahil	Veeravalli	III - 10:45a.m. - A115	BIO 09
Kavin	Venkat	III - 11:05a.m. - MATH STUDY	CMPS 39
Kohl	Vonder Haar	III - 11:05a.m. - A115	BIO 10
Ankit	Walishetti	I - 8:15a.m. - A149	CMPS 21
Noah	Walker	I - 8:55a.m. - IN2 Learning Lab	BIZ INTRN 21
Stephen	Walsh	I - 8:15a.m. - A123	BHVSO 17
Colin	Ward	I - 8:15a.m. - A149	CMPS 21
David	Weng	III - 11:05a.m. - MATH STUDY	CMPS 39
Malcolm	Wilson-Ahlstrom	III - 10:45a.m. - B116	PHYS 24
Mila	Wolkowitz	I - 8:55a.m. - B115	CHEM 12
Jaxon	Womack	III - 11:05a.m. - IN2 Alpha Design Studio	BIZ INTRN 23
Andrew	Wong	I - 8:55a.m. - A150	MEDH 18
Dylan	Xianto	II - 9:20a.m. - B115	CHEM 10
Cindy	Xu	II - 10:00a.m. - A115	MEDH 33
Anna	Yang	I - 8:35a.m. - IN2 Alpha Design Studio	BIZ INTRN 27
Shanya	Yang	I - 8:15a.m. - B133	CHEM 14 (SMR)
Shanya	Yang	III - 11:05a.m. - A121	BHVSO 16

Jeffery	Yao	I - 8:55a.m. - A152	CMPS 40
Yash	Yardi	III - 10:25a.m. - B125	PHYS 02
Trinh	Yong	III - 10:25a.m. - B133	MEDH 45
Vincent	You	I - 8:35a.m. - B116	PHYS 31
Nashra	Younus	II - 10:00a.m. - B108	ENGN 04
Jeanmyung	Yu	II - 9:40a.m. - A133	MEDH 39
William	Yu	I - 8:15a.m. - A133	BIO 17
Melinda	Yuan	I - 8:35a.m. - A149	CMPS 25
Annabelle	Zhang	II - 10:00a.m. - A117	MEDH 49
Carolyn	Zhang	III - 10:25a.m. - A123	BHVS0 12
Lily	Zhang	II - 9:20a.m. - A115	BIO 11

Mentor List | Student Inquiry and Research

Argonne National Lab

Chandrachur Bhattacharya
Debolina Dasgupta
Zelimir Djurcic
Chris Fry
Kevin Harms
Shana Havenridge
Joochan Kim
Ravi Madduri
Anil Mane
Tarak Nandi
Aleena Rafique
Zain Saleem
Lauren Valentino

Augustana College

Katherine Brown

Benedictine University

Ellen Ziliak

Carnegie Mellon University

Rui Chen
Changliu Liu

Digital Maelstrom

Ellen Taylor-Lubrano

Illinois Institute of Technology

Maurice Dawson
Yan Yan

Illinois State University

Christopher Mulligan

Ann & Robert H. Lurie Children's Hospital

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Jessica Amacher
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Peter Dong
Eric Hawker
David Hernandez
Laura Kopff
Ashwin Mohan
Sara O'Leary-Driscoll
Phadmakar Patankar
Nicole Ross
Eric Smith
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Sheila Wille

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Pingali Viswanath

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Niechen Chen
Melissa Lenczewski
Wesley Swingley
Zhili Xiao

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Randall Berry
Eric C Dahl
Michelle Driscoll
Carola Frydaman
Jean-Francois Gallard
Kimberly Gray
Mirta Hartmann
Kevin Kleczka
Igor Kadota
Daniel Lecoanet
Ian Savage
Kristen Viola
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Cover designed by Harish Chandar, IMSA student, April 17, 2024.

