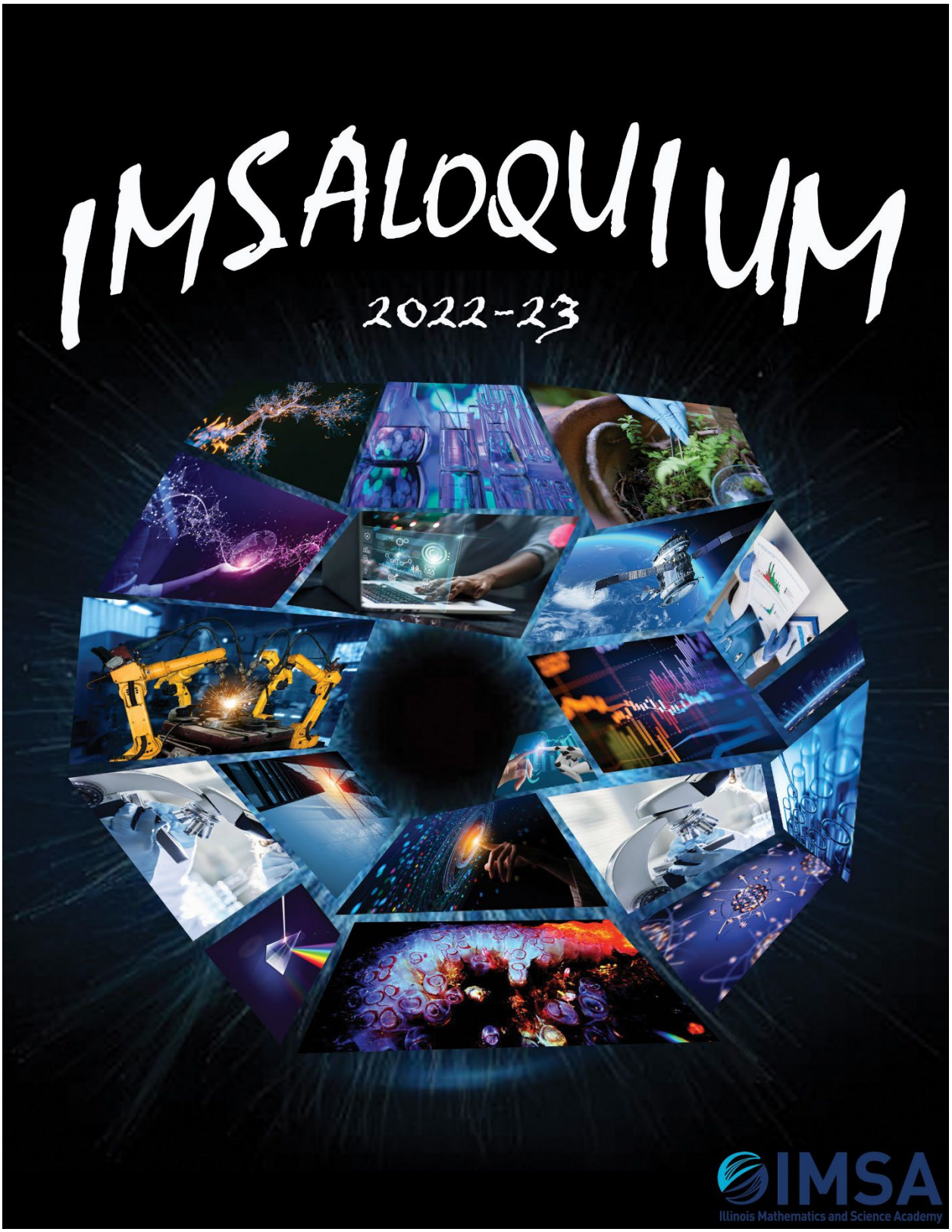

IMSA Illinois Mathematics and Science Academy | Student Inquiry and Research

April 19, 2023

Dear IMSA Students, Faculty, Staff and Friends,

Welcome to IMSAloquium 2023. This is IMSA's 36th year of leading in educational innovation, and the 35th 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 form 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 about 180 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 third 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 morning and find it to be a rewarding and educational experience!

Sincerely,

IMSA SIR Program Team
Sowmya Anjur, Ph.D.
Mark Carlson, Ph.D.
Cathy Cunz
Peter Dong, Ph.D.
Andrew Reif
Brian Trainor, Ph.D.

IMSA Principal's Office
Comfort Akwaji-Anderson, Ph.D., Principal
Anita Connors White, Ph.D., Dean of Academics and Equity
Paul Gaszak, Dean of Student Support and Equity

IMSA Internship Manager
Sue Fricano

IMSA President
Evan M. Glazer, Ph.D.

Table of Contents

IMSAloquium |April 19, 2023 | Schedule | Zoom*

Introduction 8:30a.m

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

8:50a.m. - 9:05a.m.
9:05a.m. - 9:20a.m.
9:20a.m. - 9:35a.m.
9:35a.m. - 9:50a.m.

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

10:05a.m. - 10:20a.m.
10:20a.m. - 10:35a.m.
10:35a.m. - 10:50a.m.
10:50a.m. - 11:05a.m.

Session III Virtual Project Presentations ***(20 min. + 5 min. Q & A)***

11:25a.m. - 11:50a.m.
11:55a.m. - 12:20p.m.

Live Keynote

1:00p.m. – 1:25p.m. Auditorium

Live Poster Session

1:40p.m. – 3:10p.m. Main Gym - Student Inquiry & Research
1:40p.m. – 3:10p.m. IN2 Commons - Business Internship

***NOTE:**
All presentations scheduled within these sessions will have a Zoom meeting ID. These Zoom meetings will have one staff member and one student from the presentation group assigned as a co-host.

IMSAloquium 2023 Keynote

Angel Alvarez

Director, Stem Cell Core, Northwestern University
angel.alvarez.phd@gmail.com

Credentials

PhD, Biomedical Sciences, University of Central Florida
Certificate in Life Science Entrepreneurship, University of Alabama at Birmingham
BS, Biological Sciences, University of Illinois at Chicago

Research Interests

Dr. Angel Alvarez is the Director of the Stem Cell Core and a Research Assistant Professor in the Department of Neurology at Northwestern University. He has extensive experience in stem cell biology, imaging, gene delivery, and biotechnology. As the Director of the Northwestern Stem Cell Core, he establishes disease models to accelerate therapeutic development using organoid technology and patient-derived induced pluripotent stem cells. Many of the most rewarding aspects of his current position are derived from the Core's exciting collaborations in reproductive biology, neuroscience, and pathology. Beyond his lab research, Dr. Alvarez has a passion for employing his analytical skills to address inequity in education.

Accomplishments

During his doctoral research, Dr. Alvarez investigated the development of stem cell technologies and the biology of cancer. He demonstrated the critical role of nanog in facilitating induced pluripotency and established patient-derived cell lines to characterize gene expression, cell pathway activation, and protein markers in brain tumors. During his post doctorial research, he developed tumor stem cell lines to study oncogenic signaling and factors that mediate tumor growth, invasion, and radiation resistance; notably through Wnt signaling and exosome secretion. Dr. Alvarez has earned several competitive awards, including separate pre- and post-doctoral T32 fellowships, in addition to funding from universities, private foundations, and the NIH. His research has led to the development of exciting intellectual property in both stem cell technology and cancer, yielding 11 issued US patents as well as multiple pending and international patents. He has served as a mentor to numerous emerging scholars, including several IMSA SIR students, and is most proud of being a father to his amazing daughter.

Abstract Titles by Category | Project ID Reference List

Categories	Codes	Entries
Behavioral and Social Sciences	BHVSO	8
Biology	BIO	12
Chemistry	CHEM	6
Computer Science	CMPS	16
Engineering	ENGN	7
Environmental Science	ENVR	5
Earth and Space Sciences	ERSP	3
History	HIST	1
Mathematics	MATH	5
Medical and Health Sciences	MEDH	39
Physical Science	PHYS	24
Business Internship	BIZ INTRN	20
Independent Study	IND STDY	3

Behavioral and Social Sciences | BHVSO

Using Social Network Analysis to Build Human-Autonomy Teams Rashmi Alawani	BHVSO 01
The Impact a Executive's Relation to Their Firm Has on the Implications of Their Exogenous Death Michael Capriotti and Danica Sun	BHVSO 02
Fertility Considerations in Early Pubertal Trans Youths' Decision-Making about Pubertal Suppression Treatment Luke Mauk	BHVSO 03
Data Science to Identify Inequalities in CPS Aaliyah Ali and Michelle Li	BHVSO 04
More Trains Equals More Gains: Evaluating the Impact of Access to Public Transit on Poverty and Economic Productivity in Chicago Samuel Go	BHVSO 05
Optimizing Commercial Video Advertising Cues Revanth Poondru	BHVSO 06
Gender Breakdown of STEM Achievement at IMSA: Analysis of Student Grades from 2012-2016 Shanan Riley	BHVSO 07

Availability of suboxone films and naloxone nasal spray in pharmacies in Cook County, IL Megan Sia	BHVSO 08

Biology | BIO

Bioremediation of Polystyrene by Superworms Rylie Bozarth, Divya Choudhary and Kelly Cruz	BIO 01
A Comparative Study of Bioplastics Srihari Gurugubelli	*BIO 02*
Conceptual Life-History Models for the Desert Tortoise (Gopherus agassizii) Elizabeth Carlson	BIO 03
Amyloid-ß Oligomer Formations Over Time Maitreyi Pandey	*BIO 04*
Testing the overexpression of a PNCTR through PNCs and the effect of the knockdown expression of proteins on PNC prevalence Cara Jacob	BIO 06
Modeling the Epidermal Barrier in Atopic Dermatitis with 3D Human Skin Organoids Gracelyn Daum and Sophia Syed	BIO 07
Investigating the Role of TET2 Enzymes in the Proliferation, Differentiation, and Survival of Hematopoietic Stem Cells David Dickson	BIO 08
Conformational dynamics of Mycobacterium tuberculosis M13 metalloprotease Zmp1 and how it interacts with potential substrates Vidyoot Senthilvenkatesh	BIO 10
5-hydroxymethylcytosine Deposition Mediates Polycomb Repressive Complex 2 Function in MYCN-amplified Neuroblastoma Sahil Veeravalli	BIO 11
Wastewater-Based Epidemiology Ella Mixer	BIO 12

Business Internship | BIZ INTRN

Web App Development in Finance & Trading Melanie Cuenca	BIZ INTRN 01
Data Pipeline Improvements with 4170 Trading Benedict Simmons	BIZ INTRN 02
Junior Software Developer, APS Data Technologies Bhavyaa Chauhan, Braeden Cullen, Shria Halkoda, Rebecca Liu	BIZ INTRN 03
Interning With Local Government Yoanna Georgieva and Sajal Shukla	BIZ INTRN 04
Urban Economic Policy with the Mayor's Office of Economic Development Pranet Swain	BIZ INTRN 05
Ethical Hacking and Password Safety Conor Craddock	BIZ INTRN 06
Financial Products Research Avyay Duggirala	BIZ INTRN 07
Malware Detection for the ABLE Program Aditi Kumar	BIZ INTRN 08
IMSA Digital Commons and pathways to publication Raven McKelvin	BIZ INTRN 09
Intern at the Center of Innovation and Inquiry Einsteinia Socrates	BIZ INTRN 10
Noise Effects on Quantum Computing Nishna Aerabati	BIZ INTRN 11
POSH Girls Mentorship Program w/ MYTT Nooriyah Doriwala	BIZ INTRN 12
The Raspberry Pi-Powered Photobooth Daunovan McCullough	BIZ INTRN 13
Dust Defender with Neelyx Labs Charles Ludwig, Ethan Remedios and Joshua Solone	BIZ INTRN 14
Software Development with Network Perception Dorothy Peters	BIZ INTRN 15

Construction Design with PM Construction Ryan Mojzis	BIZ INTRN 16
Website Development with SafeStart Medical Evelyn Cuneen and Emily Karbowniczek	BIZ INTRN 17
Art and Morale in Therapy Faelyn Rakow	BIZ INTRN 18
Civil Engineering: Water main replacement in the City of Naperville Steven Espinoza	BIZ INTRN 19
UIC Urban Health Club Ayati Lala	BIZ INTRN 20

Chemistry | CHEM

The Binding Energies and Interactions of a Gastric Carcinoma Segment with the Polymer Segment (2E,4R,5S)-2,3,4,5-tetrahydroxy-6-(palmitoyloxy)hex-2-enoic acid Using Molecular Modeling Ashwin Nair and Kavya Reddy	CHEM 01
Applying Computer- Aided Drug Discovery Techniques For the Improvement of Proton Pump Inhibitors Used For the Treatment of Eosinophilic Esophagitis (EoE) Komal Chivukula	CHEM 02
The Effect of Janus-Kinase Inhibitors on the Neutralization of Eczema Nathaniel Huang	CHEM 03
Finding an Alternative to Metformin Dominik Kozbiel	CHEM 04
Potential Treatments for Mycetoma Using Synthesized Ferinamol Derivatives Ireland Morgan and Damilola Tabiti	CHEM 05
Design and Synthesis of Potential Treatments for Leishmaniasis Mojadesola Suleiman	CHEM 06

Computer Science | CMPS

Engineering | ENGN

Removal of Aluminum Foil from Lithium-ion Battery Cathode in the Recycling Process Zuyu Liu	ENGN 01
Determining The Optimal Phase Angle of Stirling Engine in Various Temperatures Edgar Carlos, Kevin Lemus and Ilan Lunken	ENGN 02
Capacitive Deionization and Biorefinery Design, Simulation, and Techno-Economic Analysis Anthony Kholosenko and Jesse Park	ENGN 03
Concrete: Renewable Alternative Julius Wardlow	ENGN 04
Designing a Variable Compliance Leg for Soft-Ground Locomotion Jai Sutaria	ENGN 05
Autonomous Vehicles: Obstacle Detection Nikita Rudrapati	ENGN 06
Pitching Biomechanics studied through A Developing Motion Capture Software Luis Hernandez Aguirre	ENGN 07

Environmental Science | ENVR

Conceptual Life History and Habitat Suitability Models for the Greater Sage-Grouse (Centrocercus urophasianus) Manasa Balasubramanian and Annabelle Zhang	ENVR 01
Effectiveness of Machine Learning Applications in Environmental Nitya Jakka	ENVR 02
Saprotrophic Fungi in Restored Agricultural Plots Christian Cline and Sofia Zasiebida	ENVR 03
Experimental Analysis of the Shinnery Oak Shrub Using High Resolution Unmanned Aerial Vehicle Imagery Lily Song	ENVR 04
Promoting Environmental Justice by Using a Community-Based Approach to Design a Midwest Comprehensive Visualization Dashboard Alexandra Orantia	ENVR 05

Earth and Space Sciences | ERSP

Estimating the Number of Earth-Sized Habitable Planets in the Milky Way Galaxy Fredy An, Umika Arora, Mia Benitez, Laya Gopalakrishnan, Saul Juarez, Sridevi Krothapalli, Emerald Lendi and Tia Rice	ERSP 01
The Relationship Between Overlapping Resonances and Stability in Planetary Systems Jayant Kumar	ERSP 02
Optimum Temperature for Phosphomonoesterase Soil Enzyme Activity Assay Joshua Lee	ERSP 03

History | HIST

Medicine and Indigenous Mexican Culture After the Conquest Aldo Magana	HIST 01

Independent Study | IND ST

The Impacts of Taekwondo on Children with Neurodevelopmental Disorders Shreya Chakraborty	IND ST 01
Independent Study - Minority Aviation High School Experience Janelle Le Roy	IND ST 02
Cornelia: Mother of the Gracchi and Imperial Roman Exemplum Ella Barnett	IND ST 03

Mathematics | MATH

Approximating the Row-Wise Weighted Total Least Squares Regression Solution Cole Plepel	*MATH 01*
The Isomorphy Classes of the Special Orthogonal Group of Low Dimension in Characteristic 2 Shiqi Cheng	*MATH 02*
The Converse Sharkovskii Theorem and Characterization of Maximal Orbits Jeff Duan and Renaldo Venegas	*MATH 03*
Hypothesis Testing Involving Candidate Topological Spaces To Learn How Topological Noise Arises Through Different Probability Distributions Akshat Gupta	*MATH 04*
Defined Benefits vs Defined Contribution Plan Defined Benefits Plan; Defined Contribution Plan; Annuitization; Retirement Wealth Rafael Rotger	*MATH 05*

Medical and Health Sciences | MEDH

Effect of Artificial Sweeteners on Blood Glucose levels Sreekeerthi Panchagnula	MEDH 01
Using Natural Condiments to to Manage Diabetes Mellitus Vignesh Tiruvannamalai	MEDH 02
Alternative Treatments for Necrotizing Enterocolitis using Computer-Aided Drug Design Sindhu Chalasani	MEDH 03
Antimicrobial analysis of guava leaves on E. coli Jazmyne Germo	MEDH 04
Design of Potential New Medications Based on the Atypical Antipsychotic Aripiprazole Using Computer-Aided Drug Design Johanna Germo	MEDH 05
The Synthesis of Cycloserine and market price analysis Maya Holland	MEDH 06
Design and Synthesis of Analogs of Dasatinib as Potential Treatments for Chronic Myeloid Leukemia and Acute Lymphatic Leukemia Diya Kamath and Ellen Nguyen	MEDH 07

Utilization of Computer-Aided Drug Design for the Treatment of Bipolar Disorder Karla Sanchez	MEDH 08
Synthesis of 2-aminothiazole Derivatives as Potential Treatments of Mycetoma Sumedha Surubhotla	MEDH 09
Assessing the Performance of Automated Human Phenotype Ontology (HPO) Term Extraction for Deep Phenotyping of Patients Receiving Whole Genome/Whole Exome Sequencing in a Clinical Diagnostic Laboratory Sachleen Tuteja	MEDH 10
The Relationship between Allergen-Specific to Total Immunoglobulin E Ratio and Oral Food Challenge Outcome in Patients Sensitized to Cashew and Pistachio Aubrey Hall	MEDH 11
The Effect of Cutaneous Electrical Stimulation on Hypertonia in Chronic Hemiparetic Stroke Shreya Chakraborty and Yina Wang	MEDH 12
Impairments in bilateral reaching and grasping after stroke JaeJun Park	MEDH 13
Blood Plasma-derived Exosomes as Potential Biomarkers for Painful Diabetic Neuropathy Arjun Cherukuri	MEDH 14
Evaluating the degrees of Cerebellar Ataxia on the Genetically Modified PCP2-MW through motor performances and various vivisection techniques Shivani Chirumamilla	MEDH 15
The dichotomy of NSD1 as an autophagic regulator in HNSCC Marguerite DiMarco	MEDH 16
The potential benefits of caffeine for diabetics Riman Doodin and Catherine Shi	MEDH 17
Key Elemental Differences causing Cisplatin Induced Hearing Loss Pranit Guntupalli	MEDH 18
Analyzing the Effects of pre-mRNA Strand on Nucleolar Structure Kimani Kamineni	MEDH 19
Using the Poco-synthetic Polymer Graft for Urinary Bladder Regeneration Vikram Karra and Nachiket Rajinkanth	MEDH 20
Impact of the Skin Epithelial Knockout of Malate Dehydrogenase 2 on Basal Keratinocyte Proliferation Anisha Kolambe	MEDH 21

Sickle Cell Awareness Sufiya Hussaini, Kosi Okeke and Muna Onwuameze	MEDH 38
JAG1-Mediated Signaling Promotes Lymph Node Metastasis in Breast Cancer Jerrick Li and Bhavya Begesna	MEDH 39

Physical Science | PHYS

Automatic Datacard Generation and Significance Estimation with Punzi Criterion for Higgs Analyses Gautham Anne	PHYS 01
Analysis of Efficiency of Dark Photon Decay to Lepton Jets Sreevardhan Atyam and Malcolm Wilson-Ahlstrom	PHYS 02
Monte Carlo Analysis of Dark Photon Production Dean Barrow	PHYS 03
A Comparison of Various Dark Photon Production Mechanisms George Bayliss	PHYS 04
Parametrizing Doubly Charged Higgs Invariant Mass Histograms Surya Bhamidi	PHYS 05
Calculating and Displaying Limits of the Doubly Charged Higgs Boson at Different Branching Ratios Ivan Chen and Marcu Kubon	PHYS 06
Automatic Histogram Generation for Multi-Channel Analyses Dean Cianciolo	PHYS 07
An Investigation of Lepton Jet Kinematics, Fakes, and Production from Dark Photons Jesus Fileto	PHYS 08
Relationship between dark photon delta R and gamma Albert Han and Vikram Rao	PHYS 09
Integration of CMSSW software into the Analysis Framework Kevin Huang	PHYS 10
Optimizing Trigger Selection for Detection of Doubly Charged Higgs Bosons at the LHC Rohan Jain	PHYS 11
H++ Decay Channel Efficiencies Catherine Jenks	PHYS 12

Session I - 8:50a.m. - 9:05a.m.

Project ID: PHYS 02
8:50a.m. - 9:05a.m.

Title: Analysis of Efficiency of Dark Photon Decay to Lepton Jets
Presenter(s): Sree Atyam and Malcolm Wilson-Ahlstrom
Mentor(s): Peter 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 matter. 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. The area of interest in these jets comes in the form of analysis of the varying-flavor pairs in the jets. If the given pair in a lepton jet has two particles of different flavor, this observation can offer evidence for possible connections to show relative probabilities of correct-flavor and wrong-flavor decays, which can be used to test theoretical models of particle interactions. Ratios of wrong-flavor to total pairs, and correct pairs are also important relevant measures. These results can be used to search for new particles or phenomena beyond the Standard Model of particle physics. Another important thing to note, is the facet of measurement itself: we are measuring in data, in contrast to Monte Carlo, as Monte Carlo is not reliable when looking at only very rare cases, and data-driven estimates can be preferable. In summary, we discuss the discovery process of rates of fake lepton jets, by using indicators in the form of different-flavor pairs. These pairs cannot occur in any known Standard Model or beyond process so they are good indicators of these fake jets, therefore giving the inference that they were formed by luck, the rate of which is what we are interested in.

Project Category Code: MEDH 03
8:50a.m. - 9:05a.m.

Title: Alternative Treatments for Necrotizing Enterocolitis using Computer-Aided Drug Design
Presenter(s): Sindhu Chalasani
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Necrotizing enterocolitis (NEC) is a disease that affects the intestines, primarily in prematurely-born newborns. NEC is the death of intestinal tissue following inflammation and infection. It is likely caused by the immaturity of the intestines and the growth of dangerous bacteria. The current treatments for NEC include both natural treatments and antibiotic treatments. One natural treatment people frequently use is stopping feedings and using intravenous fluids instead for nutrition. For antibiotic treatment, some commonly-used drugs are gentamicin, metronidazole, and ampicillin. Despite the benefits of these drugs in minimizing the effects of NEC, they also have side effects. For example, gentamicin is ototoxic, meaning it can cause serious hearing issues. Using computer-aided drug design, over 200 new molecules were designed based on the gentamicin drug molecule, many of which are able to bind better than the original gentamicin molecule.

Project Category Code: BIO 02
8:50a.m. - 9:05a.m.

Title: A Comparative Study of Bioplastics
Presenter(s): Srihari Gurugubelli
Mentor(s): Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
Abstract/Project Intention:
As a promising and fairly new field, bioplastics are a topic of high interest in the scientific community. Mainly due to their significant environmental benefits compared to traditional plastics, many studies have found good reason to research them. The aim of this project was to compare bioplastics of various compositions to each other through an assortment of physical tests. This project also placed an emphasis on the environmentally friendly nature of the materials with which the bioplastics were produced, highlighting their real-world potential to create dramatic change. By producing bioplastics with varying constituents through a simple heating procedure and then comparing their physical properties such as tensile strength, the project provided insight into what specific components are the most important in a bioplastic's makeup, notably including the potency of seaweed as a natural biopolymer. Seaweed was used as a component of multiple bioplastics, and the physical impacts of its presence in differing amounts were analyzed. In the real world, bioplastics hold incredible potential to revolutionize the plastic industry, and so determining optimal makeup is key. This project was conducted because of the experimenter's desire to work with biological constructs with real world, large-scale relevance in the current day.

Project Category Code: ENGN 02
8:50a.m. - 9:05a.m.

Title: Determining The Optimal Phase Angle of Stirling Engine in Various Temperatures
Presenter(s): Edgar Carlos, Kevin Lemus, Ilan Lunken
Mentor(s): Dr. Mark Carlson, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Internal combustion engines are ubiquitous, but other types can be more effective in certain circumstances. Stirling engines can be a low-cost, non-polluting alternative. Our study focused on finding the optimal phase angle of a gamma-type Stirling engine to improve its efficiency and make it more competitive. Our tests consisted of setting the phase angle of the engine, placing it on either a hot plate or in an ice bath, and measuring the RPM with a strobe light. Our cold bath tests revealed a maximum speed of 123 degrees, while our hot tests had a maximum of 56 degrees $\mp$ 10 degrees for each. The hot temperature had a 15% increase in speed when compared to 90 degrees (the theoretical optimal phase angle) while the cold temperature had a 20% increase. Because the new angle would provide a significant increase in the efficiency of Stirling engines, we are currently developing a mechanism that will allow the user to easily alternate between the optimal hot and cold phase angle without the need for precise measurements. Our ultimate goal is for this finding to allow stirling engines to become a more plausible alternative to traditional combustion engines.

Project Category Code: PHYS 11
8:50a.m. - 9:05a.m.

Title: Optimizing Trigger Selection for Detection of Doubly Charged Higgs Bosons at the LHC
Presenter(s): Rohan Jain
Mentor(s): Dr. Peter J. Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In this project, we aim to programmatically find the most efficient triggers for selecting H++ events for application in the Compact Muon Solenoid experiment. Highly efficient triggers are defined as those with high signal efficiency and low background efficiency to give as much signal and as little background as possible. The types of events analyzed were H++, Drell-Yan, and QCD. The initial process started with finding the most efficient triggers on the three sets of events independently, then pairwise comparing the differences, and then finally creating a new figure of merit which was the harmonic mean of all the differences.

Project Category Code: PHYS 20
8:50a.m. - 9:05a.m.

Title: Monte Carlo Simulations of Factors Influencing Seasonal Variation of Multiple Muon Events
Presenter(s): Ellen Guan
Mentor(s): Dr. Maury Goodman, Argonne National Laboratory
Abstract/Project Intention:
In a 2015 study, particle physicists reported the first observed seasonal variation of multiple muon events in the MINOS Far and Near Detectors, where multiple muon events created by cosmic rays were observed to be more numerous in the winter than in the summer. This goes against researchers' initial hypothesis, because it has long been measured that single muon rates are higher in the summer. Using Python, I simulated three potential factors that could affect this: muon decay, altitude, and the fate of the leading pion from the first interaction. My data gives support to the conclusion that the seasonal variation is due to the geometry of the underground particle detectors and related to the higher altitude of the atmosphere in the summer.

Project Category Code: MEDH 10
8:50a.m. - 9:05a.m.

Title: Assessing the Performance of Automated Human Phenotype Ontology (HPO) Term Extraction for Deep Phenotyping of Patients Receiving Whole Genome/Whole Exome Sequencing in a Clinical Diagnostic Laboratory
Presenter(s): Sachleen Tuteja
Mentor(s): Dr. Kai Lee Yap, Ann & Robert H. Lurie Children's Outpatient Center
Abstract/Project Intention:
A comprehensive list of Human Phenotype Ontology (HPO) terms capturing a patient's phenotypic features is essential for the creation of a prioritized gene list for whole exome and whole genome sequencing (WES/WGS) analysis. However, the conversion of a patient's clinical notes into HPO terms is inefficient, requiring human intervention, and introduces subjectivity. In this study, we evaluated the performance of various Natural Language Processing (NLP) and gene-ranking algorithms that partially automate the identification of HPO terms from rich narrative notes and accomplish deep phenotyping. manually curated a set of 50 patients who underwent WES with resultant disease-causing variants. These clinical notes were processed in the EHR-Phenolyzer pipeline, which utilizes HPO terms extracted by MetaMap to generate a ranked gene list on the Phenolyzer algorithm. The accuracy of the extracted HPO terms were compared to provider submitted terms. A cross comparison was also made with ClinPhen-Phen2Gene workflow. The EHR-Phenolyzer pipeline ranked genes with disease-causing variants at positions <250th in 38% of the WES cases (19/50), as compared to 30% of cases (15/50) using MetaMap-Phen2Gene. ClinPhen-Phen2Gene workflow demonstrated comparable performance. Adoption of NLP-assisted deep phenotyping and gene-ranking is critical to minimize the variable effects of human recall bias.

Project Category Code: BHVSO 01
8:50a.m. - 9:05a.m.

Title: Using Social Network Analysis to Build Human-Autonomy Teams
Presenter(s): Rashmi Alawani
Mentor(s): Noshir Contractor, Vsevolod Suschevskiy, Northwestern Univ.
Abstract/Project Intention:
With the rise of Artificial Intelligence (AI), research must be conducted on how compatible human-autonomy teams truly are. This relationship can be measured qualitatively through a social network analysis of interactions between groups of up to nine humans and one robot, named Vero, working collaboratively to complete practical and creative tasks under a time constraint. Network ties are drawn based on the order of speaking as recorded by transcript data; thus tie strength increases with repeated interaction. ERGM coefficient for race homophily—the preference for associating with individuals of the same racial background—will define how much weight race holds in team success by representing the change in the likelihood of a tie for a unit change in a predictor. By exploring different types of homophily: race, education, gender, and socioeconomic status, the ERGM coefficients and their respective SNA model types reveal what teammate qualities, both in humans and AI models, can best predict positive team dynamics and/or team success.

Project Category Code: BIZ INTRN 09
8:50a.m. - 9:05a.m.

Title: IMSA Digital Commons and pathways to publication
Presentor(s): Raven McKelvin
Business Mentor(s): Jean Bigger
Abstract/Project intention:
In this internship, student Raven McKelvin has been working on identifying and strengthening existing support for students on a research to publication pathway through portfolio building, workshops and presentations. While also working with Jean Bigger on advancing information about digital commons.

Project Category Code: BIZ INTRN 14
8:50a.m. - 9:05a.m.

Title: Dust Defender with Neelyx Labs
Presentor(s): Ethan Remedios, Joshua Solone, Charles Ludwig
Business Mentor(s): Shyam Saladi
Abstract/Project intention:
Neelyx Labs is a highly innovative research and development company that seeks alternative methods to COVID testing. Our team of highly skilled and experienced scientists, engineers, and researchers is dedicated to creating cutting-edge solutions that can address some of the most pressing problems facing society today. Over the past several months, we have had the opportunity to collaborate with Neelyx Labs on a highly complex and multifaceted project to screen for COVID-19 in closed environments using dust collection cards. Our team was responsible for designing and engineering the cards, as well as analyzing the data generated by the system to identify and track patterns in the spread of the virus. Throughout this project, we learned how to implement a research plan, from ideation to execution. Our team also honed our technical and analytical skills and gained experience leveraging cutting-edge technologies and methodologies, such as data analytics and RT-PCR techniques. The deliverables of our project include a fully developed system of dust collection cards that have undergone extensive testing and validation, as well as a sophisticated data analysis framework that can accurately detect the presence of COVID-19 and provide valuable insights into the spread of the virus on campus.

Project Category Code: BIO 01
8:50a.m. - 9:05a.m.

Title: Bioremediation of Polystyrene by Superworms
Presenter(s): Rylie-Nicole Bozarth, Divya Choudhary, Kelly Cruz
Mentor(s): Jessica Amacher, Illinois Mathematics and Science Academy
Abstract/Project intention:
One of the greatest dangers to the environment is industrial waste, in particular, polystyrene (PS). Zophobas morio, commonly referred to as superworms, have the ability to break down polystyrene plastics. In this study, we investigate the suitability of Z. morio as a bioremediation organism. Three sets of 100 superworms were separated into three terrariums containing a normal diet (oats, apples, and potatoes), an extruded polystyrene (XPS) diet, and an expanded polystyrene (EPS) diet. Growth rates of the larvae were measured over a period of five weeks. After four weeks, the larvae were tested in choice chambers to determine their preference for the three diet options or a control. Results showed that superworms could survive on either PS diet but displayed indicators of stress raised on the PS diets, especially on the XP diet. Our choice chamber experiments indicated that Z. morio preferentially chose the diet that they were raised upon. These results confirm that Z. morio can indeed be raised on a PS diet, and that it may be possible to condition these organisms to continue breaking down PS in their environment when raised in that environment through their larval stage.

Project Category Code: ERSP 01
8:50a.m. - 9:05a.m.

Title: Estimating the Number of Earth-Sized Habitable Planets in the Milky Way Galaxy

Presenter(s): Fredy An, Umika Arora, Mia Benitez, Laya Gopalakrishnan, Saul Juarez, Sridevi, Krothapalli, Emerald Lendi, Tia Rice
Mentor(s): Dr. Eric Hawker, Illinois Mathematics and Science Academy

Abstract/Project Intention:
NASA's Kepler Space Telescope was designed to determine the frequency of Earth-sized planets within our galaxy. Using planetary transits accessed from Kepler lightcurve data, one can use a transit detection algorithm to find simulated transits to determine how accurate the algorithm will be against non-simulated data. We used the data from these light curves and applied parameters of temperature, orbital radius, density, and other parameters to determine the habitable zone. We were able to determine the habitable zone by using the environmental qualities needed for liquid water to exist. Then, we used our equations to extend the small portion of the data we selected to other datasets. We found Earth-sized habitable exoplanets seen by Kepler to estimate the number of Earth-sized habitable planets in the Milky Way Galaxy.

Project Category Code: CHEM 01
8:50a.m. - 9:05a.m.

Title: The Binding Energies and Interactions of a Gastric Carcinoma Segment with the Polymer Segment (2E,4R,5S)-2,3,4,5-tetrahydroxy-6-(palmitoyloxy)hex-2-enoic acid Using Molecular Modeling

Presenter(s): Meera Mutharasan, Kavya Reddy, Ashwin Nair
Mentor(s): Dr. Joe Golab, Illinois Mathematics and Science Academy
Abstract/Project intention:
We modeled the binding of a segment of gastric carcinoma to the polymer segment (2E,4R,5S)-2,3,4,5-tetrahydroxy-6-(palmitoyloxy)hex-2-enoic acid using SPARTAN Student v9. Our aim is to provide more data to the drug industry on how gastric carcinoma binds to molecular strands and, by analogy, real proteins. When producing drugs for different diseases, scientists can save time and resources using modeling software because computational results help prioritize leads to follow-up in the laboratory. To begin our calculations, we found a specific model of the substrate polymer and cancer we wished to study. Once we built these molecular models, we applied the SPARTAN Molecular Mechanics Force Field (MMFF) to predict binding energy between the two models. To model the binding interaction between the cancer and polymer strands, we divided the strand of cancer protein into five binding sites. Then we placed the polymer in 20 different positions along the cancer strand and measured the binding energy of the interaction between the molecules. Once we had those energy values, we used two formulas to help us compare the energies and to make predictions of how the cancer strand binds to the polymer segment.

Project Category Code: BIZ INTRN 10
8:50a.m. - 9:05a.m.

Title: Intern at the Center of Innovation and Inquiry
Presentor(s): Einsey Socrates
Business Mentor(s): Steve Goldblatt, Illinois Mathematics and Science Academy
Abstract/Project intention:
The mission of the Center of Innovation and Inquiry is to uplift students by launching ground-breaking projects into the global arena and providing experiences that are applicable, collaborative, and culturally sensitive on a global scale. During my year-long internship at the Center of Innovation and Inquiry under the guidance of Steve Goldblatt, I had the opportunity to work on several exciting projects. One of my main responsibilities was to create an interactive website for kids that explained the business model in an engaging and informative way. Additionally, I worked on designing a website to display business articles, and helped create the Power Pitch Intro Video. Another highlight of my internship was designing the IN2bbulletin board. Through these experiences, I gained valuable skills in web design, video editing, and project management. Overall, my time at the Center of Innovation and Inquiry was a valuable learning

Project Category Code: BIZ INTRN 01
8:50a.m. - 9:05a.m.

Title: Web App Development in Finance & Trading
Presenter(s): Melanie Cuenca
Business Mentor(s): Kyle Campbell and Jon Aston, 4170 Trading
Abstract/Project intention:

4170 Trading, a proprietary trading firm based in Chicago, primarily transacts in fixed-income cash, futures, and options markets with both actively managed and algorithmic trading strategies. The business project dwells on three major topics which were web development, data analysis, and financial modeling. Using these topics we created a web application modeling crucial financial information as requested by the traders in the company. The project began by gathering information on which data was needed and gathering intel on the specific functions the traders found to be most essential. From this research, the main backend functions of gathering, displaying, and analyzing data were created. These functions were tested and then placed in the application. On the front-end, the main focus was the organization as the company prioritized user-friendliness, accessibility, and aesthetics. Overall, creating an efficient and effective web application that will help the firm maintain a competitive edge across the globe.

Project Category Code: CMPS 11
8:50a.m. - 9:05a.m.

Title: A High-throughput Machine Learning Model for Predicting Neuronal Identity and Identifying Mutation-caused Neuropathological Defects
Presenter(s): Elaina Xiao
Mentor(s): Jubao Duan and Siwei Zhang, NorthShore Univ. HealthSystem
Abstract/Project Intention:
Congenital mental disorders, such as schizophrenia and major depressive disorder, affect approximately 20% of the US population. Research in clinical psychiatry, brain development, and medical genetics has established causal links between the nature of genetic backgrounds to the firing pattern of different types of neurons in the brain, which, in turn, leads to the psychopathological symptoms documented in clinical settings. Whilst significant efforts have been devoted to analyzing and comparing the neuronal firing patterns under different genetic contexts, such efforts are frequently complicated by low measurement throughput, neuron heterogeneity, repetitive manual and error-prone analysis, as well as categorization bias derived from different researchers. Here, we introduce a machine learning-based, fully-automated high-content imaging pipeline designed for batch-analyzing large quantities of multi-photon confocal microscope data of health and schizophrenia patient-derived neurons. Written in Python with the published and proven scientific packages CaImAn and scikit-learn, our pipeline has demonstrated abilities to perform automatic image segregation, cell identification, signal quantification, and separation of neural and non-neural (astrocytes) cells through pattern recognition, integration of training data sets, and clustering. Finally, frequency analysis revealed discrepancies in neuron firing rates from healthy and schizophrenia-risk mutant individuals. We propose our pipeline especially advantageously for mixed-culture systems.

Project Category Code: MEDH 22
8:50a.m. - 9:05a.m.

Title: Transdermal Application of Mutant HSP70i
Presenter(s): Ayati Lala
Mentor(s): Dr. Le Poole, Northwestern University
Abstract/Project Intention:
Heat shock proteins (HSPs) are a group of proteins involved in protecting cells from damage. HSP70 is a type of HSP that is found in high levels in various types of cells, playing an important role in the regulation of protein folding, stabilization, and the prevention of protein aggregation. Recent research has suggested that the expression of is reduced in vitiligo patients, which may contribute to the destruction of melanocytes, the cells that produce pigment in the skin. In TCR transgenic mouse models of vitiligo, it has been shown that the introduction of HSP70iQ435A can prevent and treat the disease. This has led to an interest in exploring the potential use of HSP70iQ435A as a potential treatment for vitiligo in humans. This project introduces HSP70iQ435A in both DNA and protein formats using electroporation, a titanium micro roller, and a gene gun, for the introduction of DNA as a range of options for drug delivery. The proposed method of detecting the tagged HSP70iQ435A is through immunohistology using various HSP70 primary antibodies and secondary antibodies. This provides insight into the distribution of the drug in the skin and its potential effectiveness as a treatment for vitiligo and melanoma.

Project Category Code: MATH 03
8:50a.m. - 9:05a.m.

Title: The Converse Sharkovskii Theorem and Characterization of Maximal Orbits
Presenter(s): Jeff Duan, Renaldo Venegas
Mentor(s): Keith Burns, Northwestern University
Abstract/Project Intention:
The Sharkovsky ordering of the natural numbers is $3 \succ 5 \succ 7 \succ \ldots \succ 2\cdot3 \succ 2\cdot5 \succ 2\cdot7 \succ \ldots\ldots \succ 22\cdot3 \succ 22\cdot5 \succ 22\cdot7 \succ \ldots \succ 23 \succ 22 \succ 2 \succ 1$. Sharkovsky proved that if m comes before n in this ordering and a continuous map f: $\mathbf{R} \rightarrow \mathbf{R}$ has a periodic point with least period m, then it also has a point of least period n. A periodic point for such a map f is called *Sharkovsky maximal* if no other periodic point of f has a least period that comes earlier in the Sharkovsky ordering than that of p. In the light of Sharkovsky's Theorem, it is interesting to characterize the Sharkovsky maximal orbits. This has already been done by a number of authors. We do it again. In contrast with previous treatments our arguments are simple. We inherit this approach from Professor Keith Burns from Northwestern University and Professor Boris Hasselblatt from Tufts University.

Session I - 9:05a.m. - 9:20a.m.

Project ID: PHYS 03
9:05a.m. – 9:20a.m.

Title: Monte Carlo Analysis of Dark Photon Production
Presenter: Dean Barrow
Mentor: Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
At present, dark matter theories predict the presence of dark photons. Detection of dark photons could provide insights into the nature of dark matter and its interactions with ordinary matter. Monte Carlo simulations are generated to understand Dark Photon production. Thus, we report the results of various files created. Monte Carlo generation was automated to derive branching ratios for dark photon mass. Additionally, the study examined the Delta R distribution relative to different mass points (ranging from 0.1 to 4.0 GeV). Results indicated no significant deviation between the mean and standard deviation of the different delta distributions, suggesting no dependence on mass for kinematics, but an impact on branching ratios.

Project ID: CHEM 02
9:05a.m. – 9:20a.m.

Title: Applying Computer- Aided Drug Discovery Techniques For the Improvement of Proton Pump Inhibitors Used For the Treatment of Eosinophilic Esophagitis (EoE)

Presenter: Komal Chivukula
Mentor: John Thurmond, Illinois Mathematics and Science Academy

Abstract/Project Intention:
Eosinophilic Esophagitis (EoE) is an autoimmune condition that causes inflammation of the digestive tract due to a high buildup of eosinophils, a white blood cell that both mediates and controls responses to allergies and asthma. When trigger allergens are exposed to EoE patients, the immune system gets activated, leading to the buildup of eosinophils contributing to tissue damage and inflammation of the digestive tract. The most common class of medicines used to treat EoE are proton pump inhibitors (PPIs). This study tested Omeprazole, one of the first developed PPIs. This study also used the Aryl Hydrocarbon Receptor (AHR) as Omeprazole's biological target protein. The AHR, once activated, mediates responses to both internal and external stimuli and aids in gene expression. Computer aided drug discovery programs were used to pinpoint the parts in omeprazole's molecular structure that were not effectively binding to the AHR. Hundreds of novel structures were designed. Several of these novel structures have been recorded to have a significantly better binding affinity with the AHR than that of Omeprazole. These results have important implications that the use of computer aided drug design in the drug discovery process can aid in the development of treatments for Eosinophilic Esophagitis (EoE).

Project ID: MEDH 01
9:05a.m. – 9:20a.m.

Title: Effect of Artificial Sweeteners on Blood Glucose levels
Presenter(s): Panchagnula, Sreekeerthi
Mentor(s): Dr. Sowmya Anjur, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Around the world, diabetes has become a disease that is increasing in the population. Although not fatal, it can impact a person's life especially in their diet. One of the things that diabetics will face is the foregoing of sugary foods. As a substitute, many food companies decided to create artificial sweeteners such as Splenda and Equal. However, it is unknown whether these artificial sweeteners are causing more harm to patients already suffering from diabetes. The objective of this study was to demonstrate how four popular artificial sweeteners (Splenda, Equal, Sweet n' Low, Truvia) react with human blood. We conducted different experiments to identify the best sweetener recommended for diabetic patients based on their effects on blood glucose levels. Our results showed that Splenda, Equal and Sweet n' Low had an adverse effect on blood glucose while Truvia has shown to be the best among all the artificial sweeteners with respect to its low effect on blood glucose. Based on our experiments, we conclude that Truvia is the safest artificial sweetener to use for diabetics as a result of its negligible effect on increasing blood glucose.

Project ID: ENGN 03
9:05a.m. – 9:20a.m.

Title: Capacitive Deionization and Biorefinery Design, Simulation, and Techno-Economic Analysis
Presenter(s): Anthony Kholoshenko, Jesse Park
Mentor(s): Dr. Lauren Valentino, Argonne National Laboratory
Abstract/Project Intention:
The transition to a sustainable bioeconomy is critical for achieving decarbonization, reducing dependence on non-renewable resources, and decreasing greenhouse gas emissions. This project aims to achieve the following: i) evaluate the environmental and economic impacts of bioprocesses using BioSTEAM, a python platform and ii) investigate capacitive deionization as an alternative strategy for industrial separations. BioSTEAM is a free, open-source platform that encompasses the design, simulation, techno-economic analysis (TEA), and life-cycle assessment (LCA) of biorefineries. By applying various parameters and combining process modeling and engineering design with economic evaluation, BioSTEAM helped guide research and development by identifying the most influential factors on cost and sustainability. Regarding capacitive deionization, varying concentrations of aqueous sodium chloride, an inorganic salt, were passed through an electrochemical cell to investigate the effects of concentration on performance metrics. The applied voltage was also varied to quantify the effects on adsorption capacity. The internal stack components were also reassembled and adjusted to attain greater yields. Overall, the BioSTEAM modeling supports the production of [biofuel/product] from [feedstock] through system analysis, and the capacitive deionization experiments provides a basis for the development of an electrochemical separation technology for the separation and recovery of inorganic ions from aqueous solution.

Project ID: PHYS 12
9:05a.m. – 9:20a.m.

Title: H++ Decay Channel Efficiencies
Presenter(s): Catherine Jenks, Claire O'Brien-Dull
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
We present a study of the expected efficiencies of different three- and four-lepton decay channels of the H++ particle at the CMS experiment at the Large Hadron Collider (LHC). The H++ particle is a Higgs-like scalar particle that arises in certain extensions of the Standard Model. We investigate the decay of the H++ particle in the context of the left-right symmetric model (LRSM) and analyze the expected yields of different three- and four-lepton channels using simulated events via a Monte Carlo simulation run in PYTHIA. Our results will provide guidance for future searches for the H++ at the CMS experiment and contribute to the ongoing efforts to expand our knowledge of the Standard Model.

Project ID: MATH 01
9:05a.m. – 9:20a.m.

Title: Approximating the Row-Wise Weighted Total Least Squares Regression Solution
Presenter(s): Cole Plepel
Mentor(s): Dr. Evan Glazer, Illinois Mathematics and Science Academy;
Dr. Aritra Dutta, University of Southern Denmark
Abstract/Project Intention:
Motivated by applications as a kernel of nonlinear regression algorithms, the row-wise weighted total least squares regression problem is examined to find a consistent and accurate estimator. Specifically, the proposed estimator has a time complexity linear in the number of observations and a space complexity constant in the same value, as the number of observations can be quite large in many modern applications, often many orders of magnitude larger than the number of input and output features. Further, to accommodate large data sets, an algorithm functions by updating an intermediate representation from each observation, allowing for parallelization of the necessary computation. Several related algorithms are proposed, based on approximating the noncentral second moment of the underlying data by a weighted mean, requiring only linear time in the number of observations. Experimental findings show the proposed algorithm to be competitive with existing methods intended to solve other variants of the Total Least Squares problem. Directions for continued iteration and further investigation are proposed.

Project ID: MEDH 11
9:05a.m. – 9:20a.m.

Title: The Relationship between Allergen-Specific to Total Immunoglobulin E Ratio and Oral Food Challenge Outcome in Patients Sensitized to Cashew and Pistachio

Presenter(s): Aubrey Hall
Mentor(s): Dr. Sakina Bajowala, Kaneland Allergy and Asthma Center

Abstract/Project Intention:
Oral food challenges (OFC) are the gold-standard method to confirm the diagnosis of food allergies but entail a risk of inducing allergic reactions. To more accurately identify which patients are likely to successfully complete an OFC, researchers have calculated optimal allergen-specific/total IgE ratios for various food types. If this sIgE/tIgE ratio is less than the cutoff value, the patient is highly likely to pass an OFC. When using the recommended sIgE/tIgE ratio cutoff for pistachios and cashews, allergists have noted a higher-than-expected number of failed OFCs. To investigate whether a different sIgE/tIgE ratio might better predict the outcome of cashew or pistachio OFC, we conducted a retrospective chart review of patients who underwent cashew or pistachio OFC in a private allergy clinic from 2020 through 2022. Our analysis of 38 OFCs revealed that the median sIgE/tIgE ratios for failed and successful pistachio OFC were similar (0.28% vs. 0.29%), and the ratios for failed and successful cashew OFC were 0.28% vs. 0.14%. However, with a p-value of 0.055, the difference in ratio between the failed and successful cashew OFC groups was not statistically significant.

Project ID: BHVSO 04
9:05a.m. – 9:20a.m.

Title: Data Science to Identify Inequalities in CPS
Presenter(s): Aaliyah Ali, Michelle Li
Mentor(s): Dr. Angel Alvarez, Feinberg School of Medicine, Northwestern Univ.
Abstract/Project Intention:
This project aims to understand and address the unequal distribution of resources within the Chicago Public School System. We have conducted various analyses using data science techniques such as Microsoft Excel functions, SQL, and Tableau. Our data sources are publicly available datasets under the Freedom of Information Act (FOIA) from CPS and the Illinois State Board of Education, including transfer records, truancy records, and selective enrollment test scores. Data also includes FOIA records from the Illinois District Attorney's office, which allow us to see how these records are being processed. These analyses reveal patterns of inequality between different schools and neighborhoods within Chicago. By presenting this data and the trends it outlines at board meetings, we are able to propose and implement changes that will lead to a more equitable education system for all students.

Project ID: BIZ INTRN 11
9:05a.m. – 9:20a.m.

Title: Noise Effects on Quantum Computing
Presentor(s): Nishna Aerabati
Business Mentor(s): Doug Strain, Google Quantum Cirq Development
Abstract/Project intention:
Over the past year, this study delved into the libraries of Cirq and in understanding many different concepts within Quantum Computing. We explored quantum circuits using the open-source frameworks of Cirq for projects. Different techniques and mechanisms were studied including depolarizing noise models, amplitude damping, and dephasing. Effects of noise were looked at on many different algorithms and implement with cirq. The development of noise within a quantum computer and the limitations of the current hardware was explored. This included understanding and implementing basic Quantum Error Correction, Quantum Key Distribution, and Cross Entropy Benchmarking. Additionally, understanding the measurement and effects of entanglement on noise and the hardware of a quantum computer was also explored. Within the topic of entanglement, projects included identifying estimating state space and identifying noise profiles on the BB84 algorithm using the FSIM gate. The goal of this independent study was to develop and understand basic skills used for real world quantum computing and the limitations of noiseand how that impacts long term algorithms, as well as NISQ devices.

Project ID: BIZ INTRN 15
9:05a.m. – 9:20a.m.

Title: Software Development with Network Perception
Presentor(s): Dorrie Peters
Business Mentor(s): Atul Boharra, Network Perception
Abstract/Project intention:
Network Perception is a cybersecurity company that organizes and tests the strength of firewall systems. They work with a variety of different operating systems for different clients, and the purpose of this business project was to begin working on the software for a new operating system, Juniper or JunOS. Over the last six months, I wrote python regular expression tests to verify the strength of a firewall specific to JunOS. These tests included topics like password specifications, authentication checks, naming conventions, and web restrictions. After further integration of the Juniper Operating System, these python tests will be used when displaying the stability of a firewall to future clients. This project is useful to the company because it is necessary that they can accommodate any operating system a client may use. Having the testing software for JunOS opens up a realm of possible new business opportunities.

Project ID: MEDH 18
9:05a.m. – 9:20a.m.

Title: Key Elemental Differences causing Cisplatin Induced Hearing Loss
Presenter(s): Pranit Guntupalli
Mentor(s): Claus-Peter Richter, Department of Otolaryngology,
Feinberg School of Medicine, Northwestern University
Abstract/Project Information:
Cisplatin is a platinum-based chemotherapy drug used to treat various types of cancers, including sarcomas, some carcinomas (i.e. small cell lung cancer, and ovarian cancer), lymphomas and germ cell tumors (DrugBank, 2021). Cisplatin can cause hearing loss in the cochlea, which is a result of some of the cancer therapies that happen in hospitals. Three experimental groups were looked at, Cisplatin alone, Cisplatin in conjunction with Honokiol, and Honokiol by itself. Honokiol is used due to the possibility that the drug can provide effects to limit cisplatin induced hearing loss by inhibiting the production of ROS. Samples of the three test groups were taken and scanned at Argonne National Laboratory using an 8-BM photon beam. With the help of the software iMaris, it's been revealed that the concentration of elements located within the inner can in fact lead to differences in levels of radiation in cancer therapy. A closer look at Cisplatin with Honokiol revealed significant differences in Platinum levels when compared to Cisplatin alone and reports of significantly less hearing loss is recorded with these patients. Cisplatin levels of Platinum reveal ototoxicity and with a complement of Honokiol can bind to platinum and significantly reduce the ototoxicity present.

Project ID: ERSP 02
9:05a.m. – 9:20a.m.

Title: The Relationship Between Overlapping Resonances and Stability in Planetary Systems
Presenter(s): Jayant Kumar
Mentor(s): Professor Yoram Lithwick, Northwestern University
Abstract/Project Intention:
Studies have been conducted to determine the role of overlapping resonance's chaos and stability within two to three planetary systems. Most studies prove that overlapping resonances are the cause of chaotic orbits and thus the stability of systems, however, it is not understood how resonances contribute to the stability of multi-planet systems. Our project investigates the roles of overlapping first-order and second-order resonances with chaos within our own solar system and other Kepler systems. Our investigation uses simulations, using an n-body integrator package called REBOUND, to understand the resonances found among the planets. Through simulating hundreds of thousands of systems with slight variations in orbital periods and eccentricities, we can understand the relationship between the resonances and stability shown in the system. The results of our surveys will determine what factors play into the magnitude of the roles that resonances have on the stability of multi-planet systems.

Project ID: MEDH 09
9:05a.m. – 9:20a.m.

Title: Synthesis of 2-aminothiazole Derivatives as Potential Treatments of Mycetoma
Presenter(s): Sumedha Surubhotla
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Fungal mycetoma is a neglected tropical disease that destroys skin, subcutaneous, and bone tissues in limbs, causing deformity, physical disability, and in severe cases death. The disease spreads after contamination of wounds, typically on the feet or legs of a patient. There are over 70 identified fungal species that can cause fungal mycetoma after infecting humans. Although progress is being made by the countries of origin it is difficult to control the disease due to its prevalence in more rural localities as well as a lack of education regarding identification and treatment. The disease is most prevalent in arid, tropical regions of Venezuela, Chad, Ethiopia, India, Mauritania, Mexico, Senegal, Somalia, Sudan, Thailand, and Yemen. Despite its effects, fungal mycetoma is still poorly understood and no treatments have been found for the disease. To combat this disease, an open-source project has been created to find drug lead compounds that impact the disease. In our research, we synthesized different 2-aminothiazole analogs that can be sent to our collaborators for further testing to determine their biological efficacy against fungal mycetoma.

Project ID: IND ST 01
9:05a.m. – 9:20a.m.

Title: The Impacts of Taekwondo on Children with Neurodevelopmental Disorders
Presenter(s): Shreya Chakraborty,
Mentor(s): Steve Goldblatt, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The impacts of general exercise and sports on mental health is emerging as a significant research front, with more than 34 studies from over 10 countries concluding positive behavioral health outcomes as a result of team sports and about 74% of sports-related studies demonstrating an improvement in psychological health in participants who engaged in athletic activities (Zuckerman et al., 2020). Cumulative evidence suggests that martial arts education has steadily improved fine and gross motor skills in children and teens with Developmental Coordination Disorder, and contributed to better balance in those on the Autism Spectrum. The purpose of this project was to determine if taekwondo, a popular traditional form of Korean martial arts, is also effective in alleviating psychosocial symptoms of Autism Spectrum Disorder and to find general trends of such impacts on neurodiverse children practicing taekwondo across the United States. To this end, a thorough literature review was conducted on the growing body of research surrounding the therapeutic elements of martial arts for athletes with developmental disabilities, followed by a general survey study, collecting qualitative data and input from taekwondo masters and instructors from over 23 US states. A significant majority of taekwondo centers who are inclusive of students with ASD have reported a higher retention of focus, decrease in anxiety, and increased self-confidence and sociability in their students as a result of taekwondo training. The results from this study can not only suggest that taekwondo can be an effective form of recreational therapy for children with ASD, but further advocate for more inclusive martial arts special-education programs across the country.

Project ID: BIZ INTRN 02
9:05a.m. – 9:20a.m.

Title: Data Pipeline Improvements with 4170 Trading
Presentor(s): Ben Simmons
Business Mentor(s): Kyle Campbell, 4170 Trading
Abstract/Project intention:
4170 Trading is a financial trading firm. For my internship, I worked on several projects that helped their efficiency and reliability. For the first semester, I worked on a data pipeline improvement, in which I created an automated program for automatically updating and downloading a set of products to trade. After that, I created an announcement system using the Discord API and HTTP POST requests, then I added on a program and website to automatically check whether a set of servers had crashed and alerts the Discord announcement system if one had. All of these projects used Python, and the more recent ones used Flask and Docker, testing out a new CI/CD and website deployment system that they had been working on. These projects benefited the company by making their systems more reliable, more feature-rich, and require less manual work to keep running.

Project ID: CMPS 12
9:05a.m. – 9:20a.m.

Title: Computational Models in Mega Constellation Satellite Communications
Presenter(s): Aadi Desai, Shaan Doshi
Mentor(s): Dr. Randall Berry, McCormick School of Engineering, Northwestern
Abstract/Project Intention:
Mega-Constellations are interconnected webs of thousands of satellites that deliver high-speed wireless communication to ground station clients. Major corporations, such as SpaceX and Amazon, utilize mega-constellations stationed at various altitudes in Low Earth Orbit (LEO). In recent years, the number of LEO satellites in orbit has greatly increased, resulting in conflicting bandwidth usage. Any such overlaps between various mega-constellations, known as interferences, are handled using the primitive "1/n" rule, where each interfering satellite receives an equal "1/nth" section of the shared bandwidth. However, the simplicity of this rule allows parties to intentionally create more interferences while accepting the same setbacks as independent systems operating in their own space. Through the creation of a Python Monte Carlo simulation, tradeoffs between interferences, successful transmissions, and signal coverage are investigated to generate new interference regulations and optimize satellite communications. The 2D simulation evaluates fixed satellites in time, analyzing the complex relationships and tradeoffs generated by different numbers of satellites and clients, transmission angles, satellite heights, and the number of companies. Both computational and parametric optimizations were implemented into the simulation, and 1D mathematical models based on ideal circumstances were investigated.

Project ID: MEDH 28
9:05a.m. – 9:20a.m.

Title: Producing a GFP Positive HEK239 Cell Line Via Transduction for In-Vitro Experiments
Presenter(s): Nandana Varma
Mentor(s): Dr. Seth Pollack, Feinberg School of Medicine, Northwestern Univ.
Abstract/Project Intention:
The Pollack Lab is primarily focused on immunology work with sarcomas, and we recognize the benefits of GFP positive cell lines to image metastases, quantify angiogenesis, and analyze various other hallmarks of cancer and tumor characteristics. Our lab is planning to host a variety of killing assays and in vitro experiments for a new mouse study in which a GFP positive cell-line would be useful. Through this project, I use the following molecular techniques: inoculation of bacteria, transformation, transfection, and transduction alongside live cell imaging. The purpose of my project is to isolate GFP plasmid DNA from Escherichia coli (E. Coli) competent bacterial cells for the transfection of Immortalized Human Embryonic Kidney cells (HEK 293T) to produce GFP virus and subsequently produce a GFP positive cell line via transduction.

Project ID: MATH 04
9:05a.m. – 9:20a.m.

Title: Hypothesis Testing Involving Candidate Topological Spaces To Learn How Topological Noise Arises Through Different Probability Distributions
Presenter(s): Akshat Gupta
Mentor(s): Ryan Robinett, University of Chicago
Abstract/Project Intention:
Topological data analysis (TDA) combines algebraic topology and other tools from pure mathematics to allow for a rigorous study of the 'shape' inherent to data. The foundational tool is persistent homology, an extension of homology to point cloud data. Persistent homology has been applied to various types of data in computer vision, manufacturing of porous materials, and cell differentiation trajectories.

Session I - 9:20a.m. - 9:35a.m.

Project ID: PHYS 04
9:20a.m. – 9:35a.m.

Title: A Comparison of Various Dark Photon Production Mechanisms
Presenter(s): George Bayliss
Mentor(s): Peter J. Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
A dark photon (ZD) is a theoretical boson in a new Abelian U(1) gauge symmetry which is predicted by various dark sector models. Dark photons originating from different models can all decay to collimated lepton jets via a process known as kinetic mixing. Production mechanisms for dark photons can vary widely but generally make use of a dark pseudoscalar. I present five different production mechanisms, or portals, generating dark photons from Higgs bosons, supersymmetric particles, and Z' bosons. I also compare the event signatures corresponding to each production mechanism and show that limits for each production mechanism can be parameterized from a single portal.

Project ID: MEDH 04
9:20a.m. – 9:35a.m.

Title: Antimicrobial analysis of guava leaves on E. coli
Presenter(s): Jazmyne Germo
Mentor(s): Dr. John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Natural products have been used throughout history to treat various illnesses and diseases. Approximately 80% of drugs on the market are derived from natural products, which include plants, herbs, and other organisms. Psidium guajava, known as guava, is a popular fruit found in the Philippines, a tropical country in Southeast Asia. Not only is Psidium guajava a staple in many Filipino dishes and desserts, but is also known to possess medicinal properties. Dry guava leaves and liquid extract were acquired from companies in Washington and Texas. Dried guava leaves were crushed to a fine powder and added to four different solvents: ethanol, methanol, water, and hexane. The guava leaf extract was set aside for testing. The solutions were studied by testing their antimicrobial properties against Escherichia coli using disk diffusion method. Results showed a larger zone of inhibition with ethanol, methanol, and liquid extract.

Project ID: MEDH 02
9:20a.m. – 9:35a.m.

Title: Using Natural Condiments to to Manage Diabetes Mellitus
Presenter(s): Vignesh Tiruvannamalai
Mentor(s): Sowmya Anjur, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Diabetes mellitus is a predominantly chronic disease that results from blood glucose levels that exceed healthy limits. Diabetes is on the rise in modern times, and an estimated 366.000,000 people are expected to have this disease by 2030. The primary way to treat diabetes and prevent complications is to have proper dietary habits and eat nutritious foods. Some condiments are even known to help reduce blood glucose concentrations. Therefore, these condiments (turmeric, psyllium, barnyard millet, cinnamon, fenugreek, and bitter melon) were added to simulated blood at scaled amounts of 50%, 75%, and 100% of their daily recommended maximum intakes. The blood glucose concentrations were then measured, and the data was analyzed to determine which of these foods (and at what concentrations) are the most and least effective at reducing blood glucose levels. It was hoped that such experimentation can inform future research and development into diabetes management practices.

Project ID: ENGN 04
9:20a.m. – 9:35a.m.

Title: Concrete: Renewable Alternative
Presenter(s): Julius Wardlow
Mentor(s): Frank Harwath, Dr Harwath
Abstract/Project Intention:
The Cement industry is responsible for at least 8% of the world's CO2 emissions. When limestone is fired in a kiln, CO2 is released into the atmosphere through a chemical reaction; this is in addition to all the pollution that is created when transporting cement building materials from site to site, and any other processes of the cement industry. Previous research done on this topic has already identified that a mix of Sub-soil aggregates and an organic polymer (Lignosulfonate), after drying, has significantly high compressive strength and resistance to water. In our research, we work to experimentally develop a sustainable alternative to cement. With the use of different-sized Sub-soil aggregates and an organic polymer, we can create a compressed brick that is somewhat analogous to the strength of concrete. Our experiment is primarily to identify what mix of Sub-Soil aggregates allows the compressed brick to have an optimal compressive strength. Establishing a renewable alternative to cement and concrete creates significant implications for the environment and our society. By reducing the carbon intensity of cement production, we can work to lower our overall Carbon footprint and reduce our dependence on fossil fuels that are typically used in the production of cement.

Project ID: PHYS 13
9:20a.m. – 9:35a.m.

Title: Utilizing CRAB for Limit Findings
Presenter(s): Caroline, Kowal
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In order to discover results faster, we have worked on simulating specific events through CRAB. CRAB submission to the grid allows multiple online computers to run several jobs simultaneously thus allowing for shorter turnback time. We utilize the outputs by finding limits on our data which assist with the analysis of particle events thus helping with our limit cuts on dark photons and the doubly charged Higgs. With the help of the CombineHarvester's CMS Higgs Combine Tools, we are able to run CRAB without much setup and running many scripts.

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

Title: Applying Privacy-Preserving Federated Learning to Biomedical Datasets
Presenter(s): Madhav Hota
Mentor(s): Dr. Ravi K. Madduri, Argonne National Laboratory
Abstract/Project Intention:
Machine learning and artificial intelligence have become increasingly used in the healthcare industry, but they have privacy concerns. Federated learning is presented as a potential solution to these concerns, but its vulnerability to inference attacks is noted. The Argonne Privacy-Preserving Federated Learning (APPFL) framework is introduced as a privacy-preserving technique for federated learning. The project aims to evaluate the effectiveness and accuracy of training machine learning models using APPFL on biomedical datasets and electronic health record data in a simulated environment. We successfully trained models on synthetic data using a simulated instance of APPFL on one machine. The models had high accuracy, and they showed better generalization for the test set than models trained without APPFL. This project contributes to the growing literature on the use of federated learning and privacy-preserving techniques in protecting sensitive data.

Project ID: PHYS 22
9:20a.m. – 9:35a.m.

Title: Observing Hoffmeister Effects Through Floating Monolayer Isotherms
Presenter: Sara Kashyap
Mentor: Dr.Pulak Dutta, Yanlin Li, Northwestern University
Abstract/Project Intention:
The Hoffmeister Series ranks ions found in salts based on their effects on protein solubility. The series ranks them from “salting in” to “salting out”, i.e. how strongly the ions cause proteins to either dissolve or precipitate. It has been believed previously that ions of the same valence will cause a similar effect, however, in fact each ion has a different effect on the solubility of different protein functional groups, even when they have the same charge. In this project, monovalent ions were studied through floating monolayer isotherms. By varying the pH, we could test the effect of both cations and anions on positively charged octadecylamine (‘ODA’), negatively charged heneicosanoic acid (‘C21 acid’) and octadecanamide (‘C18 amide’) with neutral headgroups. Testing ODA at high, low, and neutral pH with potassium salts allowed the observation of anion effects on protonated and deprotonated ODA. For C21 acid, high, low, and neutral pH with chlorine salts allowed the observation of cation effects on protonated and deprotonated C21 acid. C18 amide was tested with both types of salts to observe both cation and anion effects because C18 amide is neutral at all pH. The monolayer pressure-area isotherms confirmed specific ion effect. Each of the salts stabilized or destabilized the molecules differently, despite having the same charge. The degree to which the ions stabilized or did not stabilize the protein head groups followed the predictions of the Hoffmeister series.

Project ID: BHVSO 02
9:20a.m. – 9:35a.m.

Title: The Impact a Executive's Relation to Their Firm Has on the Implications of Their Exogenous Death
Presenter(s): Michael Capriotti, Danica Sun
Mentor(s): Carola Frydman, Kellogg School of Management, Northwestern Univ.
Abstract/Project Intention:
The equity price of a business determines its success, at least in the eyes of an investor. The higher the stock price, the more support the business receives from its investors; conversely, the lower the stock price, the less support the company gets from its investors. Guided by Dr. Carola Frydman at Northwestern University's Kellogg School of Management, this paper addresses the question of whether how an executive reached their position impacts the extent to which firms are affected by deaths of executives, what features characterize an ideal director, and who the most influential directors of the 1990s were. The acts of the executives have a direct impact on the business, but so can their untimely deaths. The impact of exogenous deaths of executives on the stock market are used to assess a company's worth. The characteristic of directors being analyzed is their relation to the firm, specifically if they are the founder, family to the founder, or are non-familial. This can help companies determine whether they should be or remain as a family firm rather than expand.

Project ID: BIZ INTRN 12
9:20a.m. – 9:35a.m.

Title: POSH Girls Mentorship Program w/ MYTT
Presentor(s): Nooriyah Doriwala
Business Mentor(s): Udania Smith, Mentoring Youth Through Technology
Abstract/Project intention:
Mentoring Youth Through Technology (MYTT) is a technology company that provides STEM education opportunities to underserved students in the Chicagoland area. The focus of the business project is to create a mentorship program for middle school aged girls that teach important social-emotional skills, build confidence and community, and provide career exposure that runs through MYTT. Over the last several months, I have been given the opportunity to aid in designing the curriculum and logistics of the mentorship program, including defining target audience, lesson plans, mentors, location, time commitment, marketing, and growth assessment tools. MYTT has benefited by gaining my new, and experienced perspective in the design of the program, as well as my perspective as an advocate for young girls and education. The most significant impact of this internship will be the pilot program that runs this year.

Project ID: BIZ INTRN 16
9:20a.m. – 9:35a.m.

Title: Construction Design with PM Construction
Presentor(s): Ryan Mojzis
Business Mentor(s): Phil Lang and Erim Tezcan, PM Construction
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 construction design with Computer Aided Design (CAD) software, though the types of projects changed due to the departure of Erim Tezcan from the company. 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. The most impactful of the work performed was the contributions to a collection of premade plans for regularly requested additions that the company can integrate quickly and easily into future design projects.

Project ID: MEDH 29
9:20a.m. – 9:35a.m.

Title: Alterations in Osteogenesis Imperfecta: Middle Ear Ossicles and Ligaments During Morphogenesis and Growth

Presenters: Faisal Patel, Irene Liu
Mentor: Claus-Peter Richter, Department of Otolaryngology, Feinberg School of Medicine, Northwestern University

Abstract/Project Information:
Osteogenesis Imperfecta (OI) is a rare collagen disease that affects patients with impaired bone growth, a greater risk of fractures, and other bodily impairments such as hearing loss. This paper observes differences in concentrations of biologically essential elements in the middle ear of oim mice, alendronate-treated oim mice, WT mice, and alendronate-treated WT mice using X-ray fluorescence microscopy (XFM). XFM allows the concentrations of elements within each part of the middle ear to be quantified. The elements measured include iron, calcium, zinc, phosphorus, and copper, and they were selected due to their role in bone growth. Using relative concentration values, the results showed that oim mice obtained larger concentrations in the bone, stapes, and incus compared to the WT mouse across all three comparisons. However, in the malleus, the results differ, the WT mouse showed greater values across all three comparisons. The difference of values between sections of the middle ear is due to the thickness of the samples scanned between the incus, bone, and stapes then with the malleus. Patients with osteogenesis imperfect have lower element concentrations across the elements examined with XFM and draw a correlation to the reason behind why symptoms related to OI occur.

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

Title: 5-hydroxymethylcytosine Deposition Mediates Polycomb Repressive Complex 2 Function in MYCN-amplified Neuroblastoma

Presenter: Sahil Veeravalli
Mentors: Mark Applebaum, Mohan Chennakesavulu, University of Chicago

Abstract/Project Information:

Neuroblastoma, the most common extracranial solid tumor in childhood, is hallmarked by epigenetic deregulation as a driver of oncogenesis. Polycomb Repressive Complex 2 (PRC2) methylates lysine 27 on histone 3 (H3K27me1-2-3), is generally associated with transcriptional silencing through deposition of H3K27me3 at promoter regions. In contrast to H3K27me3, 5-hydroxymethylcytosine (5-hmC) is an intermediate generated in the active demethylation of methylated cytosines (5-mC) and is associated with active transcription. Surprisingly, we found that 5-hmC is enriched at genes targeted by PRC2 in high-risk neuroblastoma tumors. Thus, we hypothesized a cooperative function between 5-hmC and PRC2 to mediate a de-differentiated state in MYCN-amplified neuroblastoma. We found that at the mononucleosome level, DNA associated with H3K27me3 was enriched for 5-hmC, suggesting a possible direct functional relationship between the two marks. Inhibition of EZH2 through treatment with tazemetostat significantly reduced levels of H3K27me3 and upregulated genes associated with differentiation and development, but did not significantly alter patterns of 5-hmC deposition. We found that there was significant overlap in genes upregulated following treatment with either decitabine (a hypomethylating agent) or tazemetostat. In conclusion, we identified an association between 5-hmC deposition and H3K27me3 enrichment at the mononucleosomal level in MYCN-amplified neuroblastoma cell lines.

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

Title: Designing a Variable Compliance Leg for Soft-Ground Locomotion
Presenter(s): Jai Sutaria
Mentor(s): Paul Umbanhowar, Northwestern University
Abstract/Project Intention:
Legged locomotion on soft-ground is essential to designing robots for tasks such as disaster relief and extraterrestrial exploration where the ground is typically yielding instead of rigid. In order to have successful legged locomotion on soft-ground, as much energy as possible needs to be conserved. This project aims to conserve this energy by minimizing the penetration depth of a robot foot hitting the ground. In order to do this, a mechanism is tested that utilizes force control by means of springs with data being collected for further analysis. Through utilizing an integrator simulation as a basis of comparing data, this project sets the groundwork for designing a robot leg. Eventually, this project aims to create a robot leg able to adapt to a variety of terrains with different ground stiffnesses.

Project ID: IND ST 02
9:20a.m. – 9:35a.m.

Title: Independent Study - Minority Aviation High School Experience
Presentor(s): Janelle Le Roy
Business Mentor(s): Steve Goldblatt, Illinois Mathematics and Science Academy
Abstract/Project intention:
The pursuit of aviation by minorities has gained significant attention as the aviation industry strives to foster diversity and inclusiveness. Historically, minorities have had lower representation in aviation, prompting current efforts from leading companies like NASA and United Airlines to rectify the situation. Therefore, my current project involves undertaking ground school courses and working towards obtaining my Private Pilot license with the aim of increasing awareness of available resources for minorities in the field. To support this project, I am conducting a qualitative and anecdotal study of aviation organizations in the Midwest that focus on minorities and their various initiatives aimed at promoting opportunities for minority high school students. This abstract will feature some aspects of ground school training, which I intend to use as an informative project to enlighten students at my high school, the Illinois Mathematics and Science Academy, who might be interested in pursuing this path, as well as an analysis of the aviation organizations and their programs.

Project ID: BIZ INTRN 03
9:20a.m. – 9:35a.m.

Title: Junior Software Developer, APS Data Technologies
Presentor(s): Braeden Cullen, Bhavyaa Chauhan, Shira Holkoda, Rebecca Liu
Business Mentor(s): Harish Ananthapadmanabhan, APS Data Technologies
Abstract/Project intention:
APS Data Technologies is a software development company focused on developing tools for businesses within the Aurora community to improve the profitability and efficiency of day-to-day tasks. The focus of the business project for APS Data Technologies changed over time and included market research, mobile application development, artificial intelligence model development, backend development, and web development. Over the course of this internship, we had the opportunity to interact directly with local business leaders to determine their needs. We would then tailor our products to fit the needs of these individuals, slowly honing our application over time. During this internship, the APS Data Technologies team had the opportunity to contribute to the development of software tools that helped businesses in the Aurora community to improve their overhead substantially. Our business project involved various tasks and evolved over time to cater to the needs of our clients better.

Project ID: CMPS 13
9:20a.m. – 9:35a.m.

Title: Spectral Algorithms for Semi-Supervised Community Detection
Presenter(s): Raghav Sinha
Mentor(s): Dr. Julia Gaudio, Department of Industrial Engineering and Management Sciences, Northwestern University
Abstract/Project Intention:
Community detection is the problem of identifying groups or clusters of nodes in a network that are more densely connected to each other than to the other clusters. This is an important problem in network analysis and has applications in a wide range of fields, including social networks, biology, and computer science. In 1983, the Stochastic Block Model (SBM) was introduced as a probabilistic model for generating clustered networks. Since then, the SBM has served as a testbed for community detection algorithms and has enhanced our understanding of the fundamental limits of community detection. In many community detection applications, such as tracking protein connections in biology, connecting similar hyperlinks on search engines, or keeping track of friendships on social networks, we may already have prior knowledge of community labels. Such scenarios are modeled by the Semi-Supervised SBM, a model which has received limited attention despite its practical importance. In this work, we investigate efficient algorithms for community detection in the Semi-Supervised SBM under two information models: the erasure model (the erasure model removes edges in a network with a certain probability, then uses the resulting subgraph to infer the community structure) and the flip model (flips edges in a network with a certain probability, rather than removing them). Specifically, we focus on spectral algorithms (a type of algorithm that operates on the spectral properties of a given data set or problem, using eigenvalues or eigenvectors) due to their efficiency. The spectral algorithms first compute the adjacency matrix representation of the given network and find its leading eigenvectors. Nodes are embedded into a low-dimensional space using the leading eigenvectors, then clustered based on proximity. We investigate the empirical performance of spectral algorithms in the erasure and flip models. The results validate the theoretical properties of the algorithms, demonstrating their even for moderately sized networks. Our results suggest that spectral algorithms correctly leverage prior knowledge of community memberships and are promising for use in practical applications.

Project ID: MEDH 31
9:20a.m. – 9:35a.m.

Title: The Association of Physical Activity with Cognitive Resilience in Students Attending a Mid-Size University in the United States
Presenter(s): Kohl Vonder Haar
Mentor(s): Dr. Erin Vanderbunt, Southern Illinois University Edwardsville
Abstract/Project Intention:
Cognitive resilience, the ability to recover from productivity-impairing stressors, has recently been shown to increase determination, decrease stress, and increase academic and occupational performance with higher cognitive resilience. Similarly, meeting strength training and cardiorespiratory exercise guidelines have been shown to accompany increased cognitive function and better grade point averages (GPAs) in college students. However, the correlation between meeting physical activity standards and cognitive resilience has not been thoroughly analyzed, particularly in college students, an underrepresented demographic in physical activity benefits studies. This study looks at the relationship between meeting physical activity standards and cognitive resilience within a body of college students via a survey format. Physical activity standards were taken from the American Heart Association, and the Connor-Davidson 25 Point Resilience Scale (CD-RISC) was used to measure cognitive resilience. Questions used to gauge physical wellness were taken from the International Physical Activity Questionnaire (IPAQ). The results from this study plan to be used in a future study with the implementation of physical instruments, providing empirical data to solidify the correlations found. In addition, these findings can motivate physical activity curricula in higher education institutions, promoting the benefits of physical activity to students throughout the United States.

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

Title: Defined Benefits vs Defined Contribution Plan Defined Benefits Plan; Defined Contribution Plan; Annuitization; Retirement Wealth
Presenter: Rafael Rotger
Mentors: Feng Liang, University of Illinois Urbana Champaign;
Quiang Wu, Middle Tennessee State University
Abstract/Project Intention:
For public sector jobs such as university professors, there are two types of available retirement plans for their retirement package: The Defined Contribution (DC) and Defined Benefit (DB) plan. We will discuss the key differences between these plans, including their structure, benefits, and risks. One critical factor to compare these two plans is the Net Present Value (NPV). NPV is a way of calculating the value of future payments or benefits in today's dollars. We will compare the NPV offered by the DC and DB plans offered by the Illinois State University Retirement System to determine which plan is more valuable. We found that overall, DB plans came out much than the DC plans, even when the discount rate of the DB plan is 7%, due to the fact that DB plans provide predictable and secure income compared to DC plans However, over short service years, the DC plans are better for employees due to the DB plan's 5 years of vesting before DB plans can start earning, especially if the DC plan is well managed.

Session I - 9:35a.m. - 9:50a.m.

Project ID: PHYS 05
9:35a.m. – 9:50a.m.

Title: Parametrizing Doubly Charged Higgs Invariant Mass Histograms
Presenter: Surya Ninad Bhamidi
Mentor: Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The doubly charged Higgs boson is a beyond the standard model particle that arises in the Left-Right Symmetric Model. The invariant mass of this particle is a quantity related to the mass that is the same in every reference frame and is conserved, which makes it useful to measure. The same sign invariant mass histograms of a doubly charged Higgs boson were fitted at specific mass points. With the fitted functions, the goal is to be able to find a peak for any mass point, not only the specific mass points we have Monte Carlo data for. Many functions were used to fit the histograms. The functions obtained from the fits were parameterized in terms of mass. The parameterized functions can be used to perform an unbinned mass likelihood fit.

Project ID: MEDH 05
9:35a.m. – 9:50a.m.

Title: Design of Potential New Medications Based on the Atypical Antipsychotic Aripiprazole Using Computer-Aided Drug Design
Presenter(s): Johanna (Jojo) Germo
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Abilify, drug name Aripiprazole, is known to treat a multitude of mental disorders and behavioral impairments such as Bipolar I Disorder, schizophrenia, and irritability associated with autism. Using SeeSAR, a computer-aided drug design program, and the crystal structure of 5-HT2AR in complex with aripiprazole, novel molecules were designed to find stronger binding affinities to the enzyme. More than one hundred molecules have been designed through the manipulation of bond types, specific elements, and charge types. The novel molecules were imported to ADMETlab2.0 for further analysis of ADMET properties (absorption, distribution, metabolism, excretion, and toxicity). Data gathered from ADMETlab2.0 gives further insight into the effectiveness of the newly designed drugs' physicochemical properties.

Project ID: BIO 04
9:35a.m. – 9:50a.m.

Title: Amyloid-ß Oligomer Formations Over Time
Presenter: Maitreyi Pandey
Mentor: Kirsten Viola and Dr. William Klein, Northwestern University
Abstract/Project Intention:
Alzheimer's disease is a progressive, and often fatal, disease, and is the leading cause of dementia in older people (Chang et. al, 2003). Based on the amyloid-ß oligomer hypothesis, the brain damage that leads to Alzheimer's is due to soluble, ligand-like amyloid-ß oligomers (AßOs) (Lambert et. al, 1998, Gong et. al, 2003, Cline et. al, 2018). The aim of this experiment is to understand how time affects the formation of AßOs, specifically at physiological concentrations. Understanding the process of AßO formation will enable us to learn more about how the Aß protein changes from a non-toxic monomer to a neurotoxic oligomer. These experiments use amyloid-beta peptide film to create the samples with a concentration of 30 nanomolar Aß peptide. Eight samples were used, each flash-frozen at a certain time-point after initial sample preparation. A western blot was used to separate and identify the proteins based on the molecular weight of the structure. Results suggest that changes in structure begin at 10 minutes, with the structures organizing into trimers or tetramers after 24 hours. However, difficulty in imaging indicates that future experiments should continue with a higher protein concentration.

Project ID: ENGN 06
9:35a.m. – 9:50a.m.

Title: Autonomous Vehicles: Obstacle Detection
Presenter(s): Nikita Rudrapati
Mentor(s): Dr. Matthew Walter, Robotics Intelligence through Perception Lab, Toyota Technological Institute at Chicago
Abstract/Project Intention:
The purpose of this research is to develop an algorithm for the Duckiebot to detect obstacles in the Duckietown field. Autonomous vehicles rely on internal and external sensors to understand the surrounding environment. On the road, self-driving vehicles depend on image processing to identify cars and pedestrians. Through this research, the purpose is to prevent collisions between the Duckiebot and other robots on the game field using a vision algorithm. Linux, Python, machine learning, and a camera are used to navigate the robot and detect colors and objects.

Project ID: PHYS 14
9:35a.m. – 9:50a.m.

Title: The Effectiveness of a Localized b-Jet Veto for Improving Lepton Jet Reconstruction
Presenter(s): Jack Morby
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Using the identification of jets originating from b quarks, we eliminate a source of background in our search for the dark photon. These “b-tagged” jets often contain lepton pairs that are similar to the decay of dark photons. A veto against these jets further isolates the dark photon signal, aiding in analysis. The extent to which efficiency changes due to the veto is compiled. Additionally, b- tagged jets in proximity to other leptons are exclusively filtered which makes vetoing considered in a fewer number of necessary cases. The framework is updated with an “Info Map” to support adding variables, such as the b-jet tag, that are utilized during analysis.

Project ID: CMPS 04
9:35a.m. – 9:50a.m.

Title: Towards a Scientific Language Processing Model
Presenter(s): Ishan Buyyanapragada
Mentor(s): Dr. Tanwi Mallick, Argonne National Laboratory
Abstract/Project Intention:
Natural Language Processing is an effective tool for analyzing large volumes of text effectively. However, most scientific articles contain sophisticated language that can be difficult to understand effectively and quickly. To expedite this, I tuned a model that can quickly classify abstract datasets about scientific topics into specific subcategories. Using the ArXiv corpus with over 2.2 million abstracts, I created a dataset of climate change articles, on which I ran pretrained HuggingFace models. Using observational and quantitative data (ROUGE, Cosine SImilarity, etc.), I tuned the parameters of various keyword extraction models and analyzed the keyword frequency of the dataset. Then, using the BERTopic model with various embedding techniques (SentenceTranformers, spaCy, etc.), I classified the dataset into clusters which could be individually analyzed. I used abstractive and extractive summarization models on each cluster to concisely describe the general progress of particular climate change topics. Using dynamic topic modeling, I then plotted the prevalence of different topics over time, which provided insight into the interest in climate change topics over the past decade. This weakly-supervised algorithm allows analysts and researchers to quickly derive general conclusions about specific scientific topics and visualize their relevance in the scientific community over time.

Project ID: PHYS 23
9:35a.m. – 9:50a.m.

Title: Advanced Cold Molecule Electric Dipole Moment Experiment Automatic Laser Locking System
Presenter(s): Pietro Stabile
Mentor(s): Collin Diver, Northwestern University
Abstract/Project Intention:
The Advanced Cold Molecule Electron (ACME) Electric Dipole Moment (EDM) experiment seeks to place a more precise upper limit on the electron EDM than its predecessors. Part of this increased precision will result from using an External Cavity Diode Laser (ECDL). The Standard Model predicts an electron EDM that is too small to measure with current precision. The experiment will search for energy shifts in certain molecular states of a cryogenically cooled, laser-ablated beam of thorium monoxide in an electric field. These energy shifts would indicate the presence of a large electron EDM.

The experiment relies on optical mechanisms that transform lasers into stable, useful forms. Our investigation focuses on creating a system to automatically lock the frequencies of the experiment's lasers to a stable cavity, so they will interact correctly with the molecular beam. To do this, we implement the Pound-Drever-Hall (PDH) technique to generate an error signal from laser frequencies near the cavity resonances. The LabView program serves as a feedback loop that periodically analyzes the current PDH error signal, determines the new correct frequency offset, and re-locks the laser with that new offset. This way, we minimize the frequency drift of the lasers over time.

Project ID: BHVSO 05
9:35a.m. – 9:50a.m.

Title: More Trains Equals More Gains: Evaluating the Impact of Access to Public Transit on Poverty and Economic Productivity in Chicago

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

Abstract/Project Intention:
The Chicago "L" rail transit network connects the city's North, South, and West Sides, which have experienced different economic outcomes due to the historical circumstances affecting population and wealth distribution. Previous research on public transit systems worldwide mainly focused on the effect of urban policy and public transit accessibility on public transit demand. This paper examined the accessibility of each "L" station, analyzed the current economic impact of station accessibility on each of the city's neighborhoods, which are defined as community areas here for simplicity, and used the results of that analysis to pinpoint optimal locations to build new stations to maximize economic productivity in the city's most underserved communities. The paper concludes by drawing attention to the value that the Chicago "L" transit network and further transit development projects can bring to the city's economy. More research is needed on how increased public transit accessibility affects the economic productivity of each of Chicago's neighborhoods.

Project ID: BIZ INTRN 13
9:35a.m. – 9:50a.m.

Title: The Raspberry Pi-Powered Photobooth
Presentor(s): Daunovan McCullough
Business Mentor(s): Randle Carter, Mentoring Youth Through Technology
Abstract/Project intention:
Mentoring Youth Through Technology (MYTT) is a nonprofit focused on providing STEM opportunities and mentorship to youth in under-served communities. Over time, the project's focus became more specific and evolved from general software development into making a photo booth with the Raspberry Pi microprocessor. In the beginning of the project, the organization had the intern work on projects involving the interfaces of the Pi (i.e. the GPIO pins) and the camera module. After familiarization with the requisite libraries and hardware, the organization had him work on the design of the booth and implementing it with the Pi Booth library. The intern also added functionality to said library through making a plugin to allow sharing by email. This project also provided opportunities for hands-on experience with creating circuits and working with them. The intern's work benefits MYTT by serving as another example of their positive impact on youth and what they help to make possible.

Project ID: BIZ INTRN 17
9:35a.m. – 9:50a.m.

Title: Website Development with SafeStart Medical
Presentor(s): Evelyn Cunneen and Emily Karbowniczek
Business Mentor(s): Adila Esaak and Dr. Vazquez, SafeStart
Abstract/Project intention:
The company SafeStart is focused on solving the issues surrounding surgical safety through the use of an app that promotes patient engagement along with the reduction of delays and cancellations. SafeStart's goal is to prevent "never events" from occurring, which are incidents where a serious error is caused by improper safety procedures. Over the course of this business project, interns were tasked with developing a new website through the use of Wordpress. The goal of the new website was to create a modern design using an updated color palette, as well as a new product page that better highlighted the features of the SafeStart app in a professional manner. The most significant improvement that the company benefited from was the implementation of new plugins on their redesigned website, which encourage high user engagement and brings consumers to their application.

Project ID: MEDH 26
9:35a.m. – 9:50a.m.

Presenter(s): Faisel Patel
See Project ID: MEDH 29 (Session I 9:20a.m.)

Project ID: BIO 12
9:35a.m. – 9:50a.m.

Title: Wastewater-Based Epidemiology
Presenter(s): Ella Mixer
Mentor(s): Dr. Rachel Poretsky, University of Illinois at Chicago
Abstract/Project intention:
Wastewater-Based Epidemiology (WBE) has been utilized in various countries to control and address the spread of infectious diseases, such as the COVID-19 pandemic. This field aids public health officials in making real-time decisions as viral particles are present in the body residues of infected individuals, even those who are asymptomatic. WBE is a non-invasive and cost-effective technique that can be applied in regions with limited resources, as it does not require direct contact with infected individuals. However, there are differences in the laboratory methods employed to quantify and calculate the recovery of SARS-CoV-2 in wastewater samples. For instance, laboratories have reported a recovery of the spike-in proxy virus, bovine coronavirus (BCoV), above 100%. To further evaluate the efficacy of using a proxy virus to capture the degradation occurring between sample concentration and extraction in wastewater, a Bovine Rotavirus-Coronavirus vaccine stock was prepared at a 1:100 dilution and added to 3 triplicate samples, while the other set of triplicate samples were left unspiked. The emerging technology of digital polymerase chain reaction (dPCR) was used to detect and quantify the presence of BCoV in both sample sets. Environmental factors and farming practices are hypothesized to contribute to high recovery efficiency.

Project ID: MEDH 15
9:35a.m. – 9:50a.m.

Title: Evaluating the degrees of Cerebellar Ataxia on the Genetically Modified PCP2-MW through motor performances and various vivisection techniques

Presenter: Shivani Chirumamilla
Mentor(s): Dr. Marco Martina, Dr. Gabriella Sekerkova, Mr. Yen-Hsin Cheng
Feinberg School of Medicine, Northwestern University

Abstract/Project Intention:
Researchers use a technique called gene targeting, which involves introducing a new gene into the mouse genome and replacing a portion of the endogenous gene with the new gene. In the case of PCP2-MK mice, a modified version of the PCP2 gene is introduced to Purkinje cells in the cerebellum: allowing researchers to study the functions of the cerebellum and its associated neural circuits. The main purpose of this study is to analyze and study the effects of ataxia on this mouse model. Ataxia is a neurological disorder that affects a person's ability to control and coordinate movements. The symptoms of ataxia can vary depending on the underlying cause, but it generally includes: problems with balance and coordination, slurred speech, difficulty with fine motor skills, and tremors. Using techniques such as Rearing, Ledge Test, Footprint Analysis, Rotarod, and Immunostaining, we were able to study the behavioral changes in ataxic mice as well as to study the physical changes made within the brain structure itself. These findings determined a range of degrees in which ataxia can be represented. Determining the behavior and brain function of PCP2 mice may provide insight into the mechanisms underlying ataxia and potential treatments.

Project ID: BIZ INTRN 18
9:35a.m. – 9:50a.m.

Title: Art and Morale in Therapy
Presentor(s): Faelyn Rakow
Business Mentor(s): Dr. Jim Jorgenson, Taking Control
Abstract/Project intention:
Taking Control is a mental health therapy and psychiatry company which helps people access the mental health resources they need, including licensed therapists and nurse practitioners. The focus of the business project for Taking Control changed over time and included website management, digital project assistance, and providing creative input and media. Over the course of six months, the company provided opportunities to work with the therapists through making art for them, as well as opportunities to gain experience in web and artistic design through the development of company websites and creative processes. Over the course of the business project, the company benefited through the deliverance of art that represented each individual therapist working at Taking Control during my time working with them. The most significant impact of these deliverables was the individualized artistic portraits undertaken during the business project.

Project ID: BIZ INTRN 04
9:35a.m. – 9:50a.m.

Title: Interning With Local Government
Presentor(s): Sajal Shukla and Yoanna Georgieva
Business Mentor(s): Carl King and Behati Hart
Abstract/Project intention:
The organization of the City of Aurora strives to provide resources for community citizens. Our business project focused on reaching overall outcomes in a quick and efficient manner, with excellent results. This allowed us to gain skills in communication, knowledge of government and problem-solving through the course of multiple projects from assisting the company's grant writer to collecting data for an up-and-coming eviction dashboard. Homelessness has become a pressing crisis in Aurora with shelters like Hesed House exceeding their capacity. The fact that the four counties - Kane, Kendall, DuPage, and Will - that makeup Aurora have various ways of approaching evictions exacerbates the issue. In order to be able to better understand the state of the housing crisis, and thus, take steps to address it, we gathered data on evictions in the counties encompassing the City and created an easy-to-interpret display of the information. Our methods included filling out Freedom of Information Act (FOIA) requests, getting in touch with Circuit Court Clerks' offices, and reaching out to organizations that have done similar projects in the past. Our goal was to create a visualization of data surrounding evictions in Aurora so the City can take a holistic approach to manage evictions.

Project ID: CMPS 15
9:35a.m. – 9:50a.m.

Title: Using CAFQA Initialization For the Analysis of Spin Hamiltonians
Presenter(s): Bikrant Bhattacharyya
Mentor(s): Gokul Subramanian Ravi, University of Chicago
Abstract/Project intention:
The variational quantum eigensolver has been shown to be an efficient and accurate algorithm which can be implemented on NISQ era quantum computers. The variational quantum eigensolver relies on both classical and quantum computing, finding appropriate classical algorithms to combine with quantum computation will greatly improve the applicability of this algorithm.

Last year, Gokul Ravi and others demonstrated a novel classical bootstrap for state initialization called the Clifford Ansatz For Quantum Accuracy. Their work primarily focused on determining how effective CAFQA was for finding ground state energies in molecular chemistry problems.

This research project aims to further develop this technique by demonstrating how effective it is when applied to finding the ground state energies for variations of the Heisenberg Hamiltonian on one dimensional chains and two dimensional lattices. Furthermore, the original CAFQA algorithm will be extended to calculate arbitrary energy states rather than solely ground state energies.

Project ID: MEDH 33
9:35a.m. – 9:50a.m.

Title: Development of Y_2O_3:Eu@SiO2 Nanoparticle for Radiation-Enhanced Cancer Treatment

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

Abstract/Project Intention:
Yttrium oxide (Y_2O_3) has potential in cancer theranostics when combined with radiation to generate reactive oxygen species (ROS) that damage cells. Our goal is to create silica-coated Y_2O_3 nanoparticles (Y_2O_3:Eu@SiO_2) to improve tumor treatment through radiation. Y_2O_3:Eu nanoparticles (NP) were first synthesized and coated with silica shells. Their core sizes, shell thicknesses, and morphology were measured. Next, the antibody against tumor surface protein Interleukin13 receptor a2 (IL13Ra2) was conjugated to Y_2O_3:Eu@SiO_2 to produce NPs that target cancer (NP-AbIL13Ra2). An enzyme-linked-sandwich-assay was performed, and the NPs' ability to generate radiation-induced ROS was also confirmed. Y_2O_3:Eu@SiO2 has a shepherd shape with a mean core size of 133nm and a mean coating size of 7nm. NP-AbIL13Ra2 showed similar binding activity to purified IL13Ra2 antibody standard. NP-AbIL13Ra2 exhibited 2.3 fold higher ROS production compared to PBS only, with a ratio increase from 1 at 0 Gy to 4.24 at 8 Gy. The Y_2O_3:Eu@SiO2 nanoparticles have been successfully synthesized and are ready to be used as a theranostic agent with active functional groups. Further research will evaluate their potential in-vitro with cancer cells and in-vivo efficacy in animal tumor models to assess clinical applications.

Project ID: CMPS 16
9:35a.m. – 9:50a.m.

Title: Portfolio Optimization through Python
Presenter: Nethra Shanbhag
Mentor: Parth Shah, Cboe Global Markets
Abstract/Project Intention:
Portfolio optimization is the process of gathering the stocks most likely to create a well-rounded portfolio with the most opportunity to generate greater returns for its shareholders. Programming languages such as python can be used to calculate the volatility of certain stocks in order to reach an optimal portfolio. Certain packages and data readers found in Python are utilized for this purpose and this project focuses on creating a program that can take any existing portfolio and output results of how to optimize that portfolio. By analyzing several different aspects of the stock market, including volatility, we can determine optimal portfolios that take a variety of stocks into consideration when deciding how to optimize any portfolio.

Session II - 10:05a.m. – 10:20a.m.

Project ID: PHYS 06
10:05a.m. – 10:20a.m.

Title: Calculating and Displaying Limits of the Doubly Charged Higgs Boson at Different Branching Ratios
Presenter(s): Ivan Chen, Marcus Kubon
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The doubly charged Higgs boson (H++/H--) is predicted in many extensions of the Standard Model. When searching for the doubly charged Higgs, we look for its decay through a distinctive signal of a same sign lepton pair, which can appear in 6 unique combinations, ignoring combinations containing tau leptons. The rate at which each of those 6 appear relative to one another is known as the branching ratio, the values of which are unknown, and thus need to be considered individually. When experiments are conducted, if no evidence of the H++ is found, then a lower limit is set for the invariant mass. In this paper, we detail our method of calculating and visualizing different limits of the H++ mass at various values for potential branching ratios of the H++. We generate an example model by using toy values to create 2D cross-sections of a 3D histogram, using a color gradient to illustrate the branching ratios and their corresponding limits. Our model will be used when further analysis is complete to visualize the effect of branching ratios on experimental data.

Project ID: MEDH 06
10:05a.m. – 10:20a.m.

Title: The Synthesis of Cycloserine and market price analysis
Presenter(s): Maya Holland
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Tuberculosis, caused by Mycobacterium tuberculosis, a bacterial pathogen that attacks macrophages by puncturing the membrane resulting in cell apoptosis, has been known to be drug-resistant, leaving many patients at risk for a worsening condition. Cycloserine is a second-line treatment for Multi-drug resistant tuberculosis (MDR-TB) in which the cyclic analog to D-alanine targets alanine racemase and D-alanine ligase, blocking the formation of the bacterial cell wall. After an excessive price hike in 2015, initially a 2100% increase and currently a 110% increase, many could not afford treatment. This study drives to synthesize cycloserine for less than the listed price sold. This process is completed by multistep synthesis of cycloserine and then cost analysis. Described in the study are the results and cost analysis.

Project ID: ENGN 07
10:05a.m. – 10:20a.m.

Title: Pitching Biomechanics studied through A Developing Motion Capture Software
Presenter(s): Luis A. Hernandez Aguirre
Mentor(s): Dr Pranav Bhounsule, Daniel Torres, School of Engineering, University of Illinois at Chicago
Abstract/Project Intention:
My research aims to look at the biomechanics behind a baseball pitch. The focus of the study is not on the results of the experiment, but to prove that scientific research can be conducted using this software. FreeMoCap is a free online software in the alpha stage of development. Omitting the need to purchase equipment costing thousands of dollars, FreeMoCap only requires a minimum of three web cameras and their free source code to utilize motion capture. My research aims to use the software and augment it, to track the position of limbs in respect to time. By changing the initial starting position of the lower body and focusing torque from different muscles in the body, (hip, chest, or throwing shoulder rotation) we see different results by observing the velocity of the projectile.

Project ID: PHYS 15
10:05a.m. – 10:20a.m.

Title: Finding the Optimal ΔR Cut for Distinguishing Dark Photon Decay and Background Events
Presentors: Gavin O'Malley
Mentor: Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The phenomenon of dark matter has perplexed physicists for decades, and, in an attempt to find it, some physicists hypothesize a dark sector of particles. These particles interact little with Standard Model particles and have a new force analogous to electromagnetism carried by the dark photon. If this dark photon has enough mass, then it could decay into a tightly collimated pair of leptons. We analyze the cases of the dark photon having masses around 0.3 GeV or 0.9 GeV and compare Monte Carlo generated data and reconstructed data to search for the ΔR cut that can best distinguish dark photon decay events from the background Drell-Yan events. We report the optimal ΔR cut for each case to maximize signal and minimize background.

Project ID: CMPS 03
10:05a.m. – 10:20a.m.

Title: Microturbine Decarbonization with Machine-Learning Regression Modeling
Presenter: David Biruduganti
Mentors: Dr. Chandrachur Bhattacharya and Dr. Prasanna Balaprakash, 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 regression approaches to build a data-driven model of the microturbine system. The collected experimental data is used to train the machine learning models. This is then used to determine the optimal operational parameters of the microturbine that minimize harmful emissions while maximizing efficiency. This study determines how best to model the trends in the data, and it evaluates the effectiveness of diverse design strategies for a microturbine. This project also determines the extent to which CO2, CO, and NOx emissions are altered when hydrogen is used as a substitute for natural gas and will lead to future decarbonization prospects.

Project ID: BHVSO 03
10:05a.m. – 10:20a.m.

Title: Fertility Considerations in Early Pubertal Trans Youths' Decision-Making about Pubertal Suppression Treatment

Presenter(s): Luke Mauk
Mentor(s): Diane Chen, PhD, Ann & Robert H. Lurie Children's Hospital of Chicago, Feinberg School of Medicine, Northwestern University and Briahna Yuodsnukis, PhD, Ann & Robert H. Lurie Children's Hospital of Chicago

Abstract/Project Intention:
Gonadotropin-releasing hormone analogs (GnRHa) are considered standard-of-care treatment for gender dysphoria among early pubertal transgender youth. GnRHa suppress endogenous puberty, preventing the development of gender incongruent secondary sex characteristics. However, treatment with GnRHa also prevents the maturation of germ cells. Germ cell maturation is necessary for fertility. While GnRHa does not permanently impair fertility, as discontinuing GnRHa treatment would result in pubertal development resuming and the subsequent maturation of oocytes and sperm, most transgender youth pursue gender-affirming hormone treatment. The long term effects of GnRHa and cross hormone treatment on fertility potential is unclear. Recent studies have focused on how potential fertility implications of gender-affirming medical treatment impact treatment decision-making in an older cohort of pubertal transgender adolescents and their parents. No research to date has focused on how fertility implications of GnRHa affect treatment decision-making in a younger cohort of early pubertal transgender youth. To address this gap, we conducted semi-structured interviews with 10 transgender youth ages 9-13 to answer 3 key questions: (1) What do early pubertal transgender youth know about fertility?; (2) What do early pubertal transgender youth know about how GnRHa impacts fertility?; and (3) How, if at all, does their understanding of GnRHa impacts on fertility affect their decision making about GnRHa treatment? Interviews were transcribed and thematic coding is ongoing. The result of analyzing the interviews will help clinicians navigate counseling of transgender youth regarding decisions about GnRHa.

Project ID: PHYS 21
10:05a.m. – 10:20a.m.

Title: Acoustic Imaging for Nucleation events in a Scintillating Bubble Chamber Dark Matter

Presenter(s): Atharva Gawde
Mentor(s): Eric Dahl, PhD, Department of Physics and Astronomy, Northwestern University

Abstract/Project Intention:
One of the longest-standing fundamental questions in physics is the nature of dark matter. To address this problem, the Dahl Group's goal, in collaboration with the Scintillating Bubble Chamber (SBC) Collaboration, is to introduce and develop new nuclear recoil detection technology that combines two existing technologies: bubble chamber electron recoil rejection and liquid scintillator event-by-event energy resolution. This technique searches for WIMPs (Weakly Interacting Massive Particles), a leading dark matter candidate that would interact with normal matter by scattering elastically off atomic nuclei. The SBC Collaboration has suggested that a scintillating liquid argon bubble chamber be operated and analyzed at Fermilab for dark matter and neutrino studies. This contribution to the development of a scintillating liquid argon bubble chamber focuses on nuclear recoil sensitivity calibration to identify the lowest energy nuclear recoils while simultaneously excluding electron recoil events and background events. The Neutron Therapy Facility at Fermilab will be aid in developing reliable antimony-beryllium neutron sources, which are explored and modeled both experimentally and initially via simulations to ideal sources for optimal calibration. A machine learning model is being developed to interpret audio signals produced by bubble nucleation events, as the scintillating properties of the bubble chamber can cause interference with video and photographic imaging.

Project ID: CMPS 01
10:05a.m. – 10:20a.m.

Title: Implementation of AI into Human Activity
Presenters: Rohun Bakshi, Aiden Parnell, Matthew Zhang
Mentor: Dr. Phadmakar Patankar, Illinois Mathematics and Science Academy
Abstract/Project Intention:
With AI's endless capabilities, humans have found numerous applications for AI to assist in both complex and simple tasks to improve efficiency and productivity. After extensive research on AI and its uses, we created our bot using Google's Dialogflow CX Console. The purpose of this bot was to assist users in ordering food. This bot would be able to greet and direct the user around the options for ordering food. The bot uses natural language processing techniques to understand and interpret user input to provide accurate responses to the user and create precise food orders. Diagflow CX capabilities allowed the bot to integrate with backend systems and APIs to enable automated order placement and payment processing. The bot was tested numerous times, and as users placed more orders, it gathered data and insights to improve its understanding of the user's preferences and behavior. After carefully evaluating the AI's ability to assist people when coming to certain activities, we have deemed the bot competent to aid human activities. Overall, our results demonstrate the potential of AI to support and enhance human activities in various domains.

Project ID: ENVR 03
10:05a.m. – 10:20a.m.

Title: Saprotrophic Fungi in Restored Agricultural Plots
Presenter(s): Christian Cline, Sofia Zasiebida
Mentor(s): Dr. Jennifer Bell, Northern Illinois University
Abstract/Project Intention:
Saprotrophic fungi decompose organic matter in soil microbial communities. Fungi break down organic matter into individual compounds via extracellular enzymes. Next, the fungi absorb these nutrients for use and growth. We researched saprotrophic communities in a tallgrass prairie restoration. We looked to see if they differed between monoculture or polyculture plots and whether they differed across the years since restoration, between 2016 to 2021. This research will determine if saprotrophic communities are different among ten different tallgrass prairie plant species or across monoculture and polyculture plots.

Soil Samples were collected from 2016-2021 from the Morton Arboretum. DNA samples were weighed, then the DNA was extracted and isolated from the soil. Afterward, the extracted DNA underwent the process of polymerase chain reaction (PCR) before being sent off to be sequenced. We discovered that fungal communities were significantly different between years ($p = 0.001$) and between monocultures and polycultures ($p = 0.001$). This data is important because the area of saprotrophic fungi study is relatively understudied. This research will also help determine how individual plants shape the fungal communities in tallgrass prairies and how they respond to restoration.

Project ID: ENVR 02
10:05a.m. – 10:20a.m.

Title: Effectiveness of Machine Learning Applications in Environmental Engineering
Presenter(s): Nitya Jakka
Mentor(s): Brent Stephens, Illinois Institute of Technology
Abstract/Project Intention:
The use of machine learning (ML) algorithms to test effectiveness and expand applications in environmental engineering has become increasingly successful. ML algorithms have the advantage of being able to address nonlinear data successfully. Furthermore, environmental engineering has become increasingly data intensive, a challenge that has been met by rapid progress in the development of computational techniques for handling large data sets. Therefore, it is often feasible to create an ML model with adequate accuracy despite the largely variable sample size of data used in energy and environmental engineering. In this project, we explore the effectiveness of different ML techniques in replacing more conventional computational methods through applications in ongoing environmental engineering projects. Accuracy varied across projects depending on factors including the characteristics of the data and types of ML modeling techniques used.

Project ID: MEDH 21
10:05a.m. – 10:20a.m.

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

Presenter(s): Anisha Kolambe
Mentor(s): Dr. Rui Yi and Ms. Ayasa Michii, Feinberg School of Medicine, Northwestern University

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 including 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, with the knockout phenotype notably having a 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 show higher activity in DNA replication and mitosis for knockout mice, with future work concerning quantitative analysis and application to other techniques such as Single-cell RNA sequencing data analysis.

Project ID: MEDH 16
10:05a.m. – 10:20a.m.

Title: The dichotomy of NSD1 as an autophagic regulator in HNSCC
Presenter(s): Marguerite DiMarco
Mentor(s): Iuliia Topchu, Yanis Boumber MD, Feinberg School of Medicine, Northwestern University
Abstract/Project Intention:
Head and Neck Squamous Cell Carcinomas (HNSCCs) classify a diverse family of cancers that constitute the sixth most common type of human cancer in the world, with approximately 900,000 new cases annually. Current HNSCC treatments are highly toxic and carry significant side effects, so it is imperative we explore less invasive potential future drug targets. Nuclear-binding SET Domain 1 (NSD1) is a histone methyltransferase that, along with its paralogs NSD2 and NSD3, catalyzes lysine 36 dimethylation at histone H3 to maintain chromatin structure and regulate transcription. NSD1 mutations are present in 10-13% of HNSCCs and define a favorable prognostic subset of laryngeal HNSCCs. To investigate downstream/upstream signaling upon NSD1 depletion, we performed proteomic analysis (RPPA) and RNA sequencing of HNSCC cell lines Cal27 (tongue) and JHU 011 (laryngeal) with and without NSD1 depletion. RPPA data demonstrated autophagy-regulated gene ULK1 downregulation in both cell lines. RNA sequencing data nominated the upregulation of autophagic genes E2F2, ATG16L1, ATG9a, SRPX, and SQSTM1. To validate these results, we investigated Cal27, JHU011, and JHU 022 cell lines, transfected with control or NSD1 shRNA, by performing RT-QPCR analysis. Our results demonstrated upregulation of these genes upon NSD1 depletion and ULK1 gene downregulation; thus, we can conclude that NSD1 has a dual role as an autophagic gene regulator in HNSCCs.

Project ID: BIZ INTRN 19
10:05a.m. – 10:20a.m.

Title: Civil Engineering: Water main replacement in the City of Naperville
Presentor(s): Steven Espinoza
Business Mentor(s): Kevin Bardan
Abstract/Project intention:
The City of Naperville has many talented engineers that are constantly working and bettering the city of Naperville. Thanks to their various projects, this business project was able to focus on replacing a water main in a small roundabout in Naperville. Over the course of six months, the company and mentor provided the needed knowledge which was required for designing and knowing how and where to install the new water main. The mentor also provided the knowledge and guidance to pick out the best materials for the job for both creating a good replacement and staying within a reasonable budget. Overall, the best knowledge and experience gained was learning how to use a different software for designing floor plans and sewage systems, and also being able to come across real-world challenges such as time restraints and company budgets. Toward the end of the six months, the business mentor was also able to teach the basics of the JAVA coding language, and was able to lead a small exercise in creating the card game "21."

Project ID: BIZ INTRN 05
10:05a.m. – 10:20a.m.

Title: Urban Economic Policy with the Mayor's Office of Economic Development
Presentor(s): Pranet Swain
Business Mentor(s): Trevor Dick, Alex Minnella and David Dibo
Abstract/Project intention:
The Mayor's Office of Economic Development is currently working on implementing an EV-Ready Code in the City of Aurora Zoning Code that would require new buildings and homes to be equipped with charging infrastructure. This policy is a critical development in the City Govt.'s plan to position themselves as leaders in the green economy and therefore attract additional investment and development in the city, as the policy should add roughly $1.5M in local property value (in terms of equalized assessed value). With the influx of new investment should come additional housing and development for the City population. The policy also represents a critical development in the City Govt.'s plan to reduce local air pollution and improve quality of life for residents. My project has been focused on researching the feasibility of this policy for incoming developers in the city and analyzing the policy's consequences for local property values, housing, and development in the area.

Project ID: MEDH 38
10:05a.m. – 10:20a.m.

Title: Sickle Cell Awareness
Presentors: Sufiya Hussaini, Kosi Okeke, Muna Onwuameze
Mentor: Marwah Farooqui, University of Illinois at Chicago
Abstract/Project intention:
Sickle cell disease is an inherited blood disorder that affects the production of hemoglobin, a protein in red blood cells that carries oxygen throughout the body. Knowledge of sickle cell is very little even though it is a very common disease and research about sickle cell isn't always prioritized which led us into doing our own research to discover ways to spread awareness about sickle cell, specifically to adolescents. Our goal was to raise knowledge about sickle cell among ages fifteen to eighteen as well as testing which methods of teaching help students perform better, online versus in person. We hypothesized that students who participate in the in person learning will retain and gain more knowledge about sickle cell compared to those who did online because in person will most likely be more interactive and engaging. We first did a pre-survey to gather the general knowledge of sickle cell that these students have before we taught them. Then, 20 students did in person teachings where we performed a skit and had a discussion after as well as answering questions. Another group of 20 students participated in the online teachings where they watched a cartoon about sickle cell. After performing those two experiments, we gave the post survey right after which was the same as the pre survey. Our results from the post survey showed that the students who participated in the in-person learning gained more knowledge about sickle cell compared to those who did the online learning.

Project ID: MEDH 34
10:05a.m. – 10:20a.m.

Title: A Retrospective Analysis of 118 Adult Heart Transplant Centers from 2020 to 2022

Presenter(s): Kennedy Bray, Kevin Johnson, and Siddarth Bangaru
Mentor(s): Dr. David Onsager, Daniel Rodgers, and
Dr. Valluvan Jeevanandam, University of Chicago

Abstract/Project Intention:
The degree of a center's aggressiveness (Index of Aggression; IA) in procuring organs for transplantation has rarely been quantified. We aim to create a numerical metric that evaluates a center's IA and seeks to determine the relationship between IA and survival outcomes. We retrospectively analyzed 118 Adult Heart Transplant Centers in the United States between June 2020 to May 2022 using the Scientific Registry of Transplant Recipients (SRTR). The IA of a center was derived from the Donor's Infectious Risk (IR), Ejection Fraction (EF), Distance from Center (DC), Age, and Offers (> 50). IA was then calculated by obtaining the mean of all decile ranks for each center, where a value of 1 is the least aggressive and 10 most aggressive. There was no difference in survival observed between IA and survival at 1 year (HR, 0.9733; 95% CI, 0.9787 - 1.14; P = 0.0672) and 3 years (HR, 1.0113; 95% CI, .882-1.034; P=0.254). A higher IA was correlated with reduced 50th percentile wait times (rs = -0.537; 95% CI, 1.01-1.033; P<0.001). The aggression of a center (IA) to pursue a heart is not associated with worse post-transplant survival. In application, a center can maximize their IA without significantly impacting recipient mortality thereby providing quicker therapy that subsequently improves quality of care.

Session II - 10:20a.m. – 10:35a.m.

Project ID: PHYS 07
10:20a.m. – 10:35a.m.

Title: Automatic Histogram Generation for Multi-Channel Analyses
Presenter(s): Dean Cianciolo
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Graph automation is required in physics research because physicists sometimes need to look at hundreds of plots to get the results of an analysis. The analysis framework aims to create many different types of plots in a fast to write and easy to understand structure. It performs the many steps that need to be performed to make a plot. Among others, these steps include getting the proper histograms from a file is the first step, after which the plots must be formatted, and in some cases, event yields calculated for proper scaling. The script SuperPlot takes a specific channel and creates a plot of a type specified by the user. JumboPlot takes an analysis and can create multiple types of histograms for all channels and masses at once, publishing them to a website for simple visualization. JumboPlot has already been used to analyze differences between types of Monte Carlo for doubly-charged Higgs and Drell-Yan, and for visualization of expected signal compared to background. In the Monte Carlo analysis, it was able to validate that more precise Monte Carlo estimates were not far off previous generations, and generated the 36 different plots in less than 5 minutes from a single script.

Project ID: CHEM 03
10:20a.m. – 10:35a.m.

Title: The Effect of Janus-Kinase Inhibitors on the Neutralization of Eczema
Presenter(s): Nathaniel Huang
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
A common underlying factor in many cases of eczema, atopic dermatitis, is a weakened skin barrier via damaged barrier proteins such as filaggrin which causes a greater risk for infection. While treatments including Tofacitinib have already been developed, many of them are topical steroids that do not provide permanent recovery and can trigger side effects such as skin thinning. This study focused on the TYK2 and JAK3 Kinase domains alongside the drug Delgocitinib. SeeSAR is used to begin the analysis of these molecules from novel structures provided by Protein Database to understand a potentially optimized treatment. ADMETlab was used to research these new structures and to look at the interactions within absorption, carcinogenicity, toxicity regarding herG blockers, AMES toxicity, and respiratory toxicity. The improved molecules made from these programs displayed stronger binding affinity and were potentially more effective and safer.

Project ID: BIO 06
10:20a.m. – 10:35a.m.

Title: Testing the overexpression of a PNCTR through PNCs and the effect of the knockdown expression of proteins on PNC prevalence
Presenter(s): Cara Jacob
Mentor(s): Dr. Sui Huang, Feinberg School of Medicine, Northwestern Univ.
Abstract/Project Intention:
We are conducting experiments to investigate the effects of overexpressing a long-non coding RNA, known as PNCTR, in cells that typically exhibit low expression levels of PNCs, a metastatic cancer marker. Our objective is to determine whether augmenting the expression of PNCTR in these cells can increase the number of PNCs present. Our research is motivated by a prior study in which the authors observed a decrease in the quantity of PNCs present upon the elimination of PNCTR in cancer cells. Therefore, we seek to investigate whether the opposite scenario, where the introduction of additional PNCTR into cells, would result in an increase in PNCs. Additionally, we are concurrently screening a set of proteins to observe any changes in PNC prevalence when we reduce the levels of these protein expressions in cells. We aim to assess whether reducing the expression of these proteins could decrease the quantity of PNCs present in cells that typically express high levels of PNCs. This investigation will provide insight into the proteins contributing to the expression of PNCs and metastasis.

Project ID: PHYS 10
10:20a.m. – 10:35a.m.

Title: Integration of CMSSW software into the Analysis Framework
Presenter(s): Kevin Huang
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Previous versions of the codebase developed by the IMSA-CMS group have only allowed for data processing of Monte-Carlo events. The structure of the old codebase was built so that the analyzer object would receive a root file and process all events within the file. To implement the analytics of collision data within the codebase, the analyzer needed to be restructured to process events individually, as the event data module (EDM) format was structured to be passed into the analyzer as individual events rather than a root file. With the addition of an event data analyzer to call the analyzer and a python configuration that loads the data into the event data analyzer, data can now be analyzed through the cmsRun command. Now data can be analyzed without the modification of the analytical framework used by that of Monte-Carlo events.

Project ID: PHYS 16
10:20a.m. – 10:35a.m.

Title: Drell-Yan Background for Doubly Charged Higgs
Presenter(s): Zhengyu Pan
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
A variety of exotic models predict a doubly charged Higgs-like particle that can be pair-produced in hadronic interactions via a Drell-Yan-like mechanism. The H++ and H-- can each decay to a pair of like-sign leptons (muons or electrons in this study) with TeV-scale mass, providing a distinctive event signature. Within Monte Carlo Drell-Yan events, there is a substantial amount of high mass like-sign lepton pairs, similar to the signal of the doubly charged Higgs. I determined the causes of Drell-Yan background and constructed a background estimate from the results. After identifying the causes of Drell-Yan background, I found underlying factors of each cause in order to use other measurements to predict their rate.

Project ID: ENVR 01
10:20a.m. – 10:35a.m.

Title: Conceptual Life History and Habitat Suitability Models for the Greater Sage-Grouse *(Centrocercus urophasianus)*
Presenters: Manasa Balasubramanian; Annabelle Zhang
Mentor: Dr. Yuki Hamada, Argonne National Laboratory
Abstract/Project Intention:
The greater sage-grouse (Centrocercus urophasianus) have experienced extensive population decline across their range in the western United States and Canada due to habitat degradation and loss largely associated with land use change, including the development of clean-energy projects. Modeling the life history and habitat suitability of the species is a key tool in understanding how landscape changes could affect sage-grouse populations. A group of scientists at Argonne National Laboratory developed such models in 2012; however, those models have not been updated since then. We updated the models conceptualizing greater sage-grouse life-history and habitat suitability. The life history model separates sage-grouse by age (chick, juvenile, yearling, and adult) and sex (male, female), tracking major life events such as lekking, mating, brooding, and migration throughout the seasons. The habitat suitability models show requirements/preferences for individual sage-grouse survival and reproduction across various environmental factors. These updates in the models could inform policy decisions and development plans with sage-grouse conservation in mind.

Project ID: BHVSO 06

Title: Optimizing Commercial Video Advertising Cues

Presenter(s): Revanth Poondru
Mentor(s): Pradeep Chintagunta, The University of Chicago

Abstract/Project Intention:
This research project endeavors to investigate the efficacy of video advertising on consumer behavior for non-perishable, everyday consumer goods such as groceries. In light of the growing adoption of digital media, businesses have amplified their video content output to promote their products or services. Therefore, it is imperative to discern the impact of these advertising techniques on consumer behavior and purchase decisions. Prior studies have scrutinized either specialized goods like automobiles or specific advertising cues like logos. In contrast, this research adopts a comprehensive approach, scrutinizing various television advertising cues' effectiveness. The analysis encompasses emotional, informational, and overall television advertising cues, gauging their impact on consumer behavior, particularly for non-perishable, everyday consumer goods. The research is essential for businesses seeking to target their audience efficiently and for the wider discourse on the role of video advertising in the current digital milieu. The study's findings will provide valuable insights into video advertising's efficacy for non-perishable, everyday consumer goods and its potential to influence consumer behavior.

Project ID: ERSP 03
10:20a.m. – 10:35a.m.

Title: Optimum Temperature for Phosphomonoesterase Soil Enzyme Activity Assay
Presenter(s): Joshua Lee
Mentor(s): Andrew J. Margenot, Dept. of Crop Sciences,
University of Illinois, Champaign Urbana
Abstract/Project Intention:
Enzymes assays are highly valuable in biochemistry as they offer a method of measuring enzyme activity, which is an important factor when measuring soil quality and health. An important factor when running enzyme assays is the incubation process. In order to make sure that an enzyme is giving an accurate reading of its potential enzyme activity, the enzyme needs to be incubated at its temperature optima. Many enzymes, especially ones that inhabit mammals, are often kept at the body temperature of about 37 ℃, which is the reason many enzymes assays say to incubate the enzymes at a similar temperature. Because the enzymes that often inhabit soils are different from those that inhabit mammals, there is speculation on whether 37 ℃ truly reflects the temperature optima for all enzymes. Our research shows that the temperature optima is not consistent across all enzymes. When running the assay for soils that react with para-nitrophenol linked substrates, specifically phosphomonoesterase, there is clear evidence that the traditional 37 ℃ used during incubation is not reflective of the temperature optima for phosphomonoesterase which may be as high as 70 ℃.

Project ID: PHYS 24
10:20a.m. – 10:35a.m.

Title: Conformational Dynamics of Presequence Protease (PreP) and interactions with specific substrates
Presenter: Gabriella Kanallakan
Mentors: Nicky Bayhi and Dr. Wei Jen Tang, The University of Chicago
Abstract/Project Intention:
Presequence protease (PreP) is encoded by the Pitrm1 gene which is an essential gene in mice and the defect in the Pitrm1 gene is linked to several human diseases. Presequence Protease (PreP) is a 117kDA M16C metalloprotease that cleaves presequence peptides and degrades amyloid β(Aβ). PreP has a C and N domain connected by a linker region together. There is a hollow catalytic core inside PreP, where the substrate enters and the proteolyzed products are released. A better understanding of the conformational dynamics of PreP that governs how PreP recognizes sequences and amyloid beta will guide the therapeutic innovation toward maintaining mitochondrial protein homeostasis (mito-proteostasis) and the mechanisms involved in cleaving. To investigate PreP, we applied all-atom molecular dynamics (MD) simulations to characterize the conformational heterogeneity of PreP. We observed a “hinge” and “grind” motion between the domains, characterizing the structural basis of the motion. Next, coarse-grained simulations were applied to show how known substrates induced a transition between the open and closed states of PreP that allows substrate capture and release. This research provides insight into the substrate-protein interactions of PreP and lays a foundation for future analysis of additional substrates in hopes to produce PreP variant with new functions.

Project ID: CMPS 02
10:20a.m. – 10:35a.m.

Title: Using Machine Learning to Classify Heart Arrhythmias
Presenter(s): Manya Davis and Laasya Nagumalli
Mentor: Dr. Phadmakar Patankar,
Illinois Mathematics and Science Academy
Abstract/Project Intention:
The goal of the study is to research current technology being used to monitor heart rate patterns and learn how to incorporate machine learning to make current methods more effective and cost efficient.

This study utilizes a dataset containing records of patients' age, weight, height, etc. along with typical electrocardiogram (ECG) test data. The first analysis approach involved the use of python clustering, categorizing the patients into two clusters to help distinguish between healthy patients and those afflicted with some type of arrhythmia based on the results of their ECG.

The clustering technique was first performed on the entire dataset, and then performed along with Principal Component Analysis (PCA) in order to reduce the dimensionality of the dataset. Reducing the dimensionality promotes computational efficiency while also maintaining the dataset's variability when creating clusters.

The second approach utilizes neural networks, first without PCA and then with PCA, to categorize the patients according to the presence of arrhythmia. Upon the completion of both approaches, the study compares the results and corroborates the methods.

Project ID: MEDH 13
10:20a.m. – 10:35a.m.

Title: Impairments in bilateral reaching and grasping after stroke
Presenter(s): JJ Park
Mentor(s): Charles Bernat, M. Hongchul Sohn, Northwestern University
Abstract/Project Intention:
After stroke, patients experience a significant loss in performing activities of daily living (ADL). For example, with loss of voluntary control and abnormal joint coupling in the upper extremity, stroke survivors have great difficulty performing daily activities such as reach-to-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 currently lack a comprehensive understanding of how reach-to-grasp is impaired following stroke, especially during bi-manual tasks. The purpose of this project is to determine the impact of asymmetric arm impairments due to stroke on unilateral and bilateral reach-to-grasp movements. We hypothesized that among healthy participants, the upper limbs would be unilaterally symmetrical and kinematically equal during bilateral reaching, while the upper limbs would be unilaterally asymmetrical with comparable kinematics between post-stroke and healthy participants. As a first step towards this end, we present the initial development of the proposed approach and feasibility demonstrated in preliminary data from a healthy participant. 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 the participants' physical interactions with the object, measuring force and motion, with an IMU sensor measuring the speed and acceleration of the cube.

Project ID: MEDH 23
10:20a.m. – 10:35a.m.

Title: Role of Matrix Metalloproteinase Inhibitors on CMT-93 Wound Healing
Presenter(s): Edward Ning
Mentor(s): Dr. Ronen Sumagin, Feinberg School of Medicine, Northwestern University
Abstract/Project Intention:
Matrix metalloproteinase plays an important role in wound tissue regeneration, altering the wound matrix and mediating important responses to growth including angiogenesis and vasodilation. In specific, MMP2, MMP9, and MMP14 play major roles in wound healing through the regulation of angiogenesis and activation of proangiogenic cytokines as well as regulating the influx of immune cells. To test and see how MMPs affect wound healing, CMT-93s were grown and scratched using a P200 micropipette tip to administer a serum of DMEM complete media, MMP inhibitors (ranging from MMP2, MMP9, and MMP14), and placed in treated 24-well plates. Intervals of 8 to 14 hours were counted and after, images were taken to see how relative wound density and cell migration were affected by different inhibitors. Analysis from Fiji Software revealed that MMP2i (MMP2 inhibitor) was proved to have the greatest cell migration across the wound space as well as high values in relative wound density (the percentage of tissue regenerated compared to the original wound area) followed by MMP9i and MMP14i that had similar data; vehicle subject showed significant data as well. This data demonstrates the effect MMP inhibitors could potentially have on future wound growth in cancerous tissue.

Project ID: MEDH 17
10:20a.m. – 10:35a.m.

Title: The potential benefits of caffeine for diabetics
Presenters: Riman Doodin and Catherine Shi
Mentor: Dr. Yi Yang, Northwestern University
Abstract/Project Intention:

Caffeine has been known to benefit human health when taken in recommended dosages. With that information, the idea of possibly using caffeine to help people with different types of diabetes began to come about. If caffeine was taken at a dosage as "golden ratio" by diabetic patients, would it be able to help the patients in their daily life by using it as a natural stimulant to regulate their insulin levels? In order for us to explore this question, several previously published studies were looked at that were published prior to the beginning of our research. Due to the regulations and patients' health, a retrospective approach was taken in order to closely examine a possible dosage through past published medical studies.

Several published cases noted that diabetic patients who took about 150 to 180 milligrams of caffeine showed a decrease in insulin compared to days they didn't have any caffeine. However, this dosage was recommended for those who don't have Type II Diabetes as it had shown to increase insulin resistance, which in turn affected one's blood sugar levels. Thus, caffeine can be used to help with insulin management when taken at a "golden ratio" for certain diabetic conditions.

Project ID: HIST 01
10:20a.m. – 10:35a.m.

Title: Medicine and Indigenous Mexican Culture After the Conquest
Presenter(s): Aldo Magaña
Mentor(s): Dr. Eric Smith and Dr. Sheila Wille,
Illinois Mathematics and Science Academy
Abstract/Project Intention:
Historians have explained how Indigenous Mexican society changed throughout the colonial period: Indigenous people, particularly the Nahuas, adopted Spanish practices which were "close enough" to preexisting Indigenous practices. In language, Nahuatl initially acquired words for new, Spanish concepts by broadening the meaning of existing words through a "mistaken identity." Similarly, Nahua political and religious systems which were "close enough" to Spanish systems were preserved in many respects for a long time after the Spanish conquest, often with little more than a Spanish rechristening. In medicine, historians have suggested that Indigenous Mexican cultures incorporated an Old World hot-cold humoral system because of a resemblance to a dualism in the pre-Conquest Nahua worldview.

This project reexamines historians' arguments that an accident of similarity between various aspects of Indigenous and Spanish cultures led to an inevitable assimilation of native language, religion, politics, and medicine into colonial structures. Rather, in the face of colonization, Indigenous groups actively preserved what fundamental aspects of their cultures they could, especially in the case of medicine.

Project ID: BIZ INTRN 06
10:20a.m. – 10:35a.m.

Title: Ethical Hacking and Password Safety
Presentor(s): Conor Craddock
Mentor(s): Joseph Daniels, Illinois State Treasurer's Office
Abstract/Project intention:
Using a tool called Aircrack, along with another called Cain and Able, I aim to demonstrate the importance of ethical hacking in professional environments. Many times, organizations do maintain proper document security which, along with staff turnover, can introduce critical, password protected documents to security vulnerabilities; some of which could cripple an organization. My goal is to demonstrate the importance of vulnerability assessment as well as the ethical hacking processes involved.

Project ID: MEDH 39
10:20a.m. – 10:35a.m.

Title: JAG1-Mediated Signaling Promotes Lymph Node Metastasis in Breast Cancer

Presenter(s): Jerrick Li, Bhavya Vegesna
Mentor(s): Benjamin Gordon, University of Illinois Chicago (UIC)

Abstract/Project Intention:
Breast cancer (BC) patients have better outcomes when cancer is detected early, but metastasis remains a major cause of mortality. High levels of the Notch ligand JAGGED-1 (JAG1) has been linked with poor BC prognosis, and is associated with drug resistance and tumor recurrence. Furthermore, JAG1 is associated with lymph node (LN) metastasis, which is a reliable prognostic indicator. While these clinical correlations suggest that JAG1 plays a significant role in BC progression and metastasis, the exact process by which it occurs is not fully comprehended. We hypothesize that JAG1 promotes lymph node metastasis by signaling to lymphatic endothelial cells via Notch signaling. To test our hypothesis, we utilized multiple JAG1-high and matched low/negative breast cancer cell lines and injected them into the fourth mammary fat pads of mice. We then collected tumor-draining LNs, sectioned them, and then stained pancytokeratin to identify metastatic cancer cells. We also utilized lymphatic markers to identify regions of the LNs in which cancer cells invaded. After conducting microscopy analyses of LN sub-anatomical regions and peripheral lymphatic vasculature, we scored tumor invasion into lymphatic vessels outside of the LN (lymphovascular invasion) and metastasis within the LN. The results show that JAG1 promotes LN metastasis and lymphovascular invasion to the primary draining LN of the tumor in immunocompetent mice. These findings suggest a new function of JAG1 in promoting lymphovascular invasion, and targeting JAG1-mediated signaling may be a potential therapeutic strategy for preventing or slowing LN metastasis in breast cancer patients.

Project ID: MEDH 35
10:20a.m. – 10:35a.m.

Title: The Applications of Physics in Pancreatic Cancer Screening and Treatment
Presenter: Daniel Park
Mentor: Dr. Young-Kee Kim, University of Chicago
Abstract/Project Intention:
Pancreatic cancer is a dangerous and disproportionately lethal cancer. This is largely a result of its late diagnosis and difficulty in detection and treatment. In order to alleviate this, the applications of physics in pancreatic cancer screening and treatment must be further understood and explored. Of all the current imaging methods, CT and MRI have important connections to physics, and MRI has many prospects for improvement, including hyperpolarized metabolic MRI, which can provide a significantly more detailed image than a conventional MRI and could also possibly find early-stage tumors. In terms of treatment, the method that has the most connections to physics is radiation treatment. Pancreatic cancer treatment utilizes photon beams and not electron beams. There is, however, research being done to be able to use electron beams for pancreatic cancer– specifically, very high-energy electron (VHEE) beams. There is also research being done to make the necessary high-energy electron accelerators more compact and affordable. While there are methods to screen and treat pancreatic cancer, they are insufficient. More research is needed for early detection and effective treatment, and taking a physics perspective is important as it bridges a significant gap in information.

Session II - 10:35a.m. – 10:50a.m.

Project ID: PHYS 08
10:35a.m. – 10:50a.m.

Title: An Investigation of Lepton Jet Kinematics, Fakes, and Production from Dark Photons
Presenter(s): Jesus Fileto;
Mentor(s): Peter J Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Our current model proposes a decay mechanism of massive dark photons from the dark sector into two oppositely charged leptons. Our Higgs production mechanism produces two dark photons resulting in narrow lepton jets arising from these dark photons. Monte Carlo data is analyzed to find distinctive signatures of these lepton jets, such as transverse momenta and eta, that define their origin from dark photons. Furthermore, criteria are found that are able to distinguish fake lepton jets from backgrounds such as QCD and underlying events. Efficiencies are produced for leptons from dark photons in our detector to find reasonable cuts to improve lepton jet efficiency. Lastly, our methodology for producing reasonable simulation parameters with PYTHIA is verified and improved to increase our limits on the dark photon mass in the future.

Project ID: MEDH 07
10:35a.m. – 10:50a.m.

Title: Design and Synthesis of Analogs of Dasatinib as Potential Treatments for Chronic Myeloid Leukemia and Acute Lymphatic Leukemia
Presenter(s): Ellen Nguyen & Diya Kamath
Mentor(s): John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Danistab has demonstrated a quick molecular response and has proved itself to be useful in treating many cases of Chronic Myeloid Leukemia (CML) and Acute Lymphatic Leukemia (ALL). However, there has been no published research on how the alteration of the structure of Dansitab could increase binding affinity as well as the efficacy of its synthesis in our bodies. Using a computer aided we created novel compounds based on dasatinib and improved its ability to bind to proteins, enhancing its effectiveness, reducing needed material, and improving its ability to be synthesized. Our designed compounds included the improvement of the molecules polarity, bonding, compatibility, solubility, and toxicity. One of the most important factors that we focused on in our designs was the rate of human absorption (HIA) to see if our drug would be easily absorbed in the human body. This ultimately increased the affinity of our designed molecules with the binding site, escalating the possibility for inhibition and the efficiency in its synthesis.

Project ID: BIO 07
10:35a.m. – 10:50a.m.

Title: Modeling the Epidermal Barrier in Atopic Dermatitis with 3D Human Skin Organoids

Presenters: Gracelyn Daum, Sophia Syed Feinberg School of Medicine
Mentor: Dr. Bethany E Perez White, Feinberg School of Medicine
Northwestern University

Abstract/Project Intention:
The epidermal barrier is essential for maintaining skin homeostasis, yet the cellular signaling mechanisms that lead to its formation and function are relatively unknown. Perturbations in the epidermal barrier cause many different skin diseases, including atopic dermatitis. Our investigations will help define signaling mechanisms impacting the barrier in atopic dermatitis using a 3D human skin organoid model made from primary skin cells. To probe these mechanisms, we will determine expression levels of transcripts (mRNA) by quantitative polymerase chain reaction (qPCR). First, we had to ensure that known atopic dermatitis mRNA expression patterns were the same in our model. For example, the barrier protein filaggrin is downregulated in the skin of patients with atopic dermatitis. According to our qPCR data, our results align with patient data. We observed the same loss of filaggrin transcripts in our atopic dermatitis 3D organoid model. These results establish the validity of the model. The long-term goal of our studies is to investigate the potential of re-establishing the balance of signaling mechanisms as possible means of restoring the epidermal barrier and treating atopic dermatitis.

Project ID: ENGN 01
10:35a.m. – 10:50a.m.

Title: Removal of Aluminum Foil from Lithium-ion Battery Cathode in the Recycling Process

Presenter(s): Zuyu Liu
Mentor(s): Dr. Mark Carlson, Grant Bell,
Illinois Mathematics and Science Academy

Abstract/Project Intention:
Lithium-ion batteries (LIBs) are instrumental to a renewable future, but environmentally friendly methods of recycling must be developed. Aluminum foil is used as the current collector, and it must be removed prior to hydrometallurgical recycling to ensure the recovery of valuable metals. Current methods use organic solvents to remove the organic binder, which serves as an adhesive link between the aluminum foil and cathode material; alkaline leaching of aluminum foil; and thermal separation. We used 2.5 M NaOH leaching to determine the mass percentage of aluminum present in 18650 battery cathodes and looked to replace NaOH with compounds of lower toxicity. Reagent solutions were poured to barely immerse the cathode samples, which were often folded to reduce volume. Our results found that the mass percentage of aluminum in the cathode strip was 2.55% and reactions only happen under high pH conditions (pH > 13). The reaction is indicated by the release of hydrogen gas, and the duration is upwards of 20 minutes. Future studies should focus on finding new reagents that would be lower in toxicity, price, and time to ensure the efficient removal of aluminum.

Project ID: PHYS 18
10:35a.m. – 10:50a.m.

Title: Unidirectional Build Architecture: Refactoring a HEP Data Analysis Codebase
Presenter(s): Dheeran Wiggins
Mentor(s): Dr. Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Proposed beyond the Standard Model theories, such as various SUSY frameworks, posit the existence of non-Standard Model particles detectable in accelerator experiments through distinct event signatures. The object of our analysis concerns two such non-SM theoretical particles: the doubly charged Higgs boson ($H^{\pm\pm}$), a scalar boson with Drell-Yan and vector boson fusion production mechanisms, and the dark photon (γ_d), a dark sector gauge boson with Higgs and SUSY production mechanisms. Using collected tracking and calorimeter data from the CMS experiment, alongside simulated PYTHIA models, *pp* collision event data is sifted through series of statistical methods, identification algorithms, and filters to be coded and stored in the Data Collection directory. However, as the codebase expands, a single directory for such diverse tasks proves increasingly inefficient for code management and compilation times. We explore an alternative architecture for the $H^{\pm\pm}$ and γ_d searches through codebase refactoring, reorganizing the grouping and placement of methods, classes, and files. To this end, the *Data Collection* directory was refactored into seven task-specific directories—*Utility, Histograms, Modules, Filters, Plans, EventFiles*, and *Data Collection*—arranged with hierarchical include directives to prevent circular dependencies.

Project ID: BIO 03
10:35a.m. – 10:50a.m.

Title: Conceptual Life-History Models for the Desert Tortoise *(Gopherus agassizii)*
Presenter: Elizabeth Carlson
Mentor: Dr. Yuki Hamada, Argonne National Lab
Abstract/Project Intention:
The desert tortoise (Gopherus agassizii) is a species of concern in the southwest region of the United States, and is noted as declining in recent years. Successful conservation requires an understanding of the species' population dynamics. However, this collection of information is scattered throughout studies and models regarding the tortoise's life history does not exist. Thus, I developed conceptual life history models of the desert tortoise shaped by the species' life decisions based on age and sex. The population dynamics are determined from various factors of individuals including sex, size, and yearly climate. Adult male and female desert tortoises follow similar routines of winter hibernation and home ranges, though it diverges if a male is forced to leave its territory or if a female nests. The purpose of this conceptual life-history model is to develop an agent-based model (ABM), which simulates behavior and movements of the desert tortoise. It will help to understand the species responses to land development such as infrastructure construction and unexpected predators like the common crow, and to estimate population-level impacts of those changes. The desert tortoise ABM can be used to inform land development agencies about threats to desert tortoises to help conserve thei populations.

Project ID: BHVSO 07
10:35a.m. – 10:50a.m.

Title: Gender Breakdown of STEM Achievement at IMSA: Analysis of Student Grades from 2012-2016
Presenter: Shanan Riley
Mentor: Yana Gallen, University of Chicago
Abstract/Project Intention:
Research into STEM achievement for female students at the collegiate and high school level has shown that peer groups have a substantial impact on both performance and retention in high level STEM classes. The central question of this project is what factors significantly influence the performance of female students when measured against their male peers at IMSA, with a specific focus on math and physics courses. This project determines the extent to which student grades are impacted by various factors using publicly available records of student grades from the 2012-2016 academic years. Regression analysis of student grade points in individual courses as well as course type were run and demonstrated significant differences between male and female students. Additionally, course make up (percentage male vs female) and student grade level were assessed, also producing significant results. The conclusions from this project can inform future research into IMSA student performance and policy changes to address disparities in performance and enrollment.

Project ID: MEDH 08
10:35a.m. – 10:50a.m.

Title: Utilization of Computer-Aided Drug Design for the Treatment of Bipolar Disorder
Presenter: Karla Sanchez
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Nearly seven million adults in the United States experience bipolar disorder. Symptoms of this mental illness include extreme mood swings rapidly ranging from depressive episodes to periods of mania. Currently, mood stabilizers such as antidepressants and antipsychotics are used for the treatment of bipolar disorder alongside therapeutic options. One such treatment is the antipsychotic risperidone and its active metabolite 9-hydroxyrisperidone which are ~88% and ~77% protein-bound in human plasma, respectively. This project's intention was to design analogs of risperidone using computer-aided drug design with a program called SeeSAR. Thus far, there have been several designed molecules that bind better to the target protein and in turn, are theoretically more effective. This would mean that the medication would more effectively bipolar disorder.

Project ID: CMPS 09
10:35a.m. – 10:50a.m.

Title: SAGA GPS Scintillation and Navsol Data Handling and Storage Mapping for Repository Offloading Purposes

Presenter: Aarya Khapre
Mentor: Dr. Seebany Datta-Barua, Illinois Institute of Technology

Abstract/ Project Intention:
Online repositories host data collected for research purposes in multiple formats to align with the researchers' current data format. MIT's Madrigal Repository for upper atmospheric sciences has many sub-repositories that store data on specific regions of research. The CEDAR subrepository hosts some GNSS scintillation data, similar to data collected by Illinois Institute of Technology receivers in Poker Flat, Alaska. Observing the transition and the approaching peak of the 25th sun cycle will generate new data on upper atmospheric phenomena that will be stored on the server. To accommodate for the extra data, the existing data needs to be offloaded to the CEDAR repository.

This project focuses on researching the compatibility of existing IIT data with CEDAR formats and outlining the locations on the server to offload relevant data. Linux was utilized to search for the file locations from the backend of the server. Since the Space Weather Lab website can be used to request collected server data, php and HTML were used to analyze the front end of the lab website in phpMyAdmin to determine file locations. Data locations were obtained as file paths after front-end analysis and will be used to offload the relevant datafiles.

Project ID: BIO 10
10:35a.m. – 10:50a.m.

Title: Conformational dynamics of Mycobacterium tuberculosis M13 metalloprotease Zmp1 and how it interacts with potential substrates
Presenter: Vidyoot Senthilvenkatesh
Mentors: Nick Bayhi and Dr. Wei Jen Tang, The University of Chicago
Abstract/Project Intention
Tuberculosis (TB) is caused by a bacterium known as Mycobacterium tuberculosis (Mtb). During infection, Mtb secretes a variety of proteins to confuse the host's immune system including Zinc Metalloprotease 1 (Zmp1). Zmp1 inhibits phagosome maturation and host cell inflammation activation, both of which are vital during M. tuberculosis virulence. It has a hollow catalytic core in which peptides bind and are unfolded and repositioned for proteolysis. But it is unclear how Zmp1 does this, or what substrates it cleaves. To investigate these questions, we applied all- atom molecular dynamics (MD) simulations to characterize the conformational heterogeneity of Zmp1. In addition to the expected “hinge” opening of domain-1 (D-1) swinging away from domain 2 (D-2), we observed D-1 rotate, or “grind,” against D-2, and characterized the structural basis of this motion. We went on to use coarse-grained simulations to illustrate how various known substrates of Zmp1 are repositioned and unfolded inside this protein. Together, these studies teach us about how this enzyme works, and lay the foundation for future efforts to identify physiologically-relevant substrates and to engineer Zmp1 variants with new functions.

Project ID: MEDH 14
10:35a.m. – 10:50a.m.

Title: Blood Plasma-derived Exosomes as Potential Biomarkers for Painful Diabetic Neuropathy

Presenter(s): Arjun Cherukuri
Mentor(s): Dr. Daniela Maria Menichella, James Scott Coy-Dibley, Northwestern University

Abstract/Project Intention:
Painful Diabetic Neuropathy (PDN) is a debilitating complication that manifests in 25% of diabetic patients and is characterized by neuropathic pain, small-fiber degeneration, and the hyperexcitability of the dorsal root ganglion (DRG) neurons. In recent years, blood plasma exosomes (BPEs) have developed an emerging role as prominent intercellular messengers with a potential involvement in disease progression, but their study in PDN is lacking. BPEs facilitate cell-to-cell communication by releasing their cargo to destination cells, impacting their physiological and transcriptomic functioning. Using a well-established type II diabetes mouse paradigm, whereby wildtype mice are fed a high-fat diet (HFD) to induce PDN, pre-functional studies were conducted on exosomes isolated from blood plasma via size exclusion chromatography. BPEs were characterized using dynamic light scattering (DLS) to determine their size, electron microscopy (EM) for morphological analysis, and will undergo western blotting (WB) for known exosomal markers, such as the membrane-bound proteins ALIX and Syntenin along with aqueous CD81. DLS studies suggested an average exosomal size of 130 nm, which was confirmed with EM. Future work will focus on functional studies of BPEs on the DRGs along with using blood plasma collected from PDN patients for translational studies.

Project ID: MEDH 24
10:35a.m. – 10:50a.m.

Title: "Drug Seeking": Analyzing the Prediction of Drug Seeking Behaviors along Racialization and Minoritization Lines

Presenter: Obazuaye, Venus
Mentor: Dr. Faith Summersett-Williams, The Potocsnak Family Division of Adolescent & Young Adult Medicine, Ann & Robert H. Lurie Children's Hospital of Chicago

Abstract Project Intention:
With recent developments in healthcare, artificial intelligence (AI) has proven to become a tool in bedside care faster than many might have imagined, especially within the field of substance use treatment. Recommendations have already started to arise for how to utilize the tool to cut down on physician workload, but in making those recommendations, considerations were not made for the effects on minority patients. This study aims to conduct a scoping review of the literature that lies around examining differences in the prediction of drug seeking behaviors. It additionally seeks to understand the label "drug-seeking" on patients, based on racialization and minoritization with a special lens for intersectionality.

Ultimately, this research hopes to highlight the ways in which usage of artificial intelligence in substance use treatment should make considerations for minority patients beforehand and make suggestions for where research can be directed for to reduce labeling of patients as "drug-seeking".

Project ID: MEDH 19
10:35a.m. – 10:50a.m.

Title: Analyzing the Effects of pre-mRNA Strand on Nucleolar Structure
Presenter(s): Himani Kamineni
Mentor(s): Dr. Sui Huang, Emma Freeman, Feinberg School of Medicine, Northwestern University
Abstract/Project Intention:
The nucleolus is the center for ribosome production as well as a host of other cellular functions including genomic organization, cell cycle regulation, and cellular senescence. Previous anti-cancer drugs targeting the nucleolus are known to halt ribosomal transcription machinery, which is correlated with the disruption of nucleolar structure. To determine the key players that maintain the nucleolar structure and to identify potential targets for future drug treatments, other components of the nucleolus are under investigation. One such component is the pre-mRNA strand produced after transcription. UTP4 is a pre-mRNA processing factor that cleaves the pre-mRNA strand into smaller strands that later become the ribosomal 40s and 60s subunits. When this factor is knocked down, the long pre-mRNA strand is accumulated, and the nucleolus appears to be less likely to break up its structure even when transcription of the rDNA is inhibited. While further analyses must be conducted to fully understand the effects of retaining the long pre-mRNA strand, the preliminary experiments have shown a correlation between retention of the long pre-mRNA strand and the normal structure of the nucleolus.

Project ID: IND ST 03
10:35a.m. – 10:50a.m.

Title: Cornelia: Mother of the Gracchi and Imperial Roman Exemplum
Presenter(s): Ella Barnett
Mentor(s): Dr. Nicholas Cross, Illinois Mathematics and Science Academy
Abstract/Project Intention:
How did Cornelia, mother of the Gracchi, a relative of some of the most controversial figures in Roman history, and a woman actively engaged in the political and cultural struggles of her day, become a universal icon of motherhood and morality in the Roman Empire? She was honored by the Roman people with the only publicly voted statue of a woman of the Republic, and letters allegedly written by her were widely circulated and read long after her death. During and after the Augustan Era, she was renowned as a model of cautious advice, motherly teaching, and of moral and family values in line with the morality laws propagated by the first emperor, Augustus. Cornelia was appropriated by so many politicians not only because she was useful as a beloved figure to project their own ideals of behavior and opinion onto, but also because she had a unique place at the beginning of major cultural and political shifts in Roman history, and became a part of the fabric of Roman society.

Project ID: BIZ INTRN 07
10:35a.m. – 10:50a.m.

Title: Financial Products Research
Presentor(s): Avyay Duggirala
Mentor(s): Fernando Diaz and Maggie Owen, Illinois State Treasurer's Office
Abstract/Project intention:
The job of the office of the State Treasurer is to oversee the cash, debt and investments of the state while simultaneously cultivating good financial decision making among the constituency. I worked with the Illinois State Treasury's financial products team to learn about and contribute to the evaluation of different financial products and related services. The project(s) given to me consisted of multiple facets of finance and required me to work with the State Treasury's investment and education team. With the investment team, I worked on auditing an asset manager, who falsified their Sub-TA fee rates. With the education team, I worked on evaluating the efficacy of the Illinois Financial Wellness Hub, a new educational resource for all Illinoisans. It was also my responsibility to create detailed reports identifying the impact of different types of webinar styles on resource engagement. Fundamentally, I assisted the State Treasurer's office by evaluating the efficacy of their educational programs and marketing styles while concurrently playing a vital role in overseeing proper due diligence on asset management.

Project ID: ENVR 05
10:35a.m. – 10:50a.m.

Title: Promoting Environmental Justice by Using a Community-Based Approach to Design a Midwest Comprehensive Visualization Dashboard
Presenter(s): Alexandra Orantia
Mentor(s): Fabio Miranda and Sanjana Srabanti, Dept. of Computer Science, College of Engineering, University of Illinois at Chicago
Abstract/Project Intention:
Environmental justice advocates for the fair distribution of environmental benefits and harms among communities. To determine whether environmental justice is being upheld in a specific geographic region, it is necessary to identify any disparities in the spatial distribution of environmental degradation. In this study we implement a web-based visualization method to evaluate the spatial distribution of environmental burden and vulnerability to pollution sources. By working closely with a predominantly Latinx community in Chicago, Illinois, we demonstrate the effectiveness of our approach through a case study that identifies certain community areas that are likely to be disproportionately affected by environmental pollution from industrial roads.

Project ID: MEDH 36
10:35a.m. – 10:50a.m.

Title: Experimental Analysis of the Shinnery Oak Shrub Using High Resolution Unmanned Aerial Vehicle Imagery
Presenters: Lily Song
Mentor: Dr. Tong Chuan He, Guozhi Zhao, University of Chicago
Abstract/Project Intention:
The p53 gene plays a crucial role in regulating the cell cycle and preventing the development of cancer. In renal cancer, the p53 gene is often mutated, leading to uncontrolled cell growth and proliferation. Targeting the p53 gene with gene knockdown techniques has shown promise as a potential treatment for renal cancer. Adenoviruses have been used as a delivery method for gene knockdown in cancer cells, but their effectiveness in clear renal cancer cells has not yet been fully explored. We will use an adenovirus vector carrying a small interfering RNA (siRNA) targeting the p53 gene to deliver the gene knockdown payload to clear renal cancer cells. The siRNA will be designed to specifically bind to the p53 mRNA, leading to its degradation and suppression of p53 protein expression. We will compare the p53 gene knockdown efficiency and downstream effects on cell proliferation in clear renal cancer cells treated with the adenovirus vector to those treated with a control adenovirus vector lacking the siRNA payload.

Session II - 10:50a.m. – 11:05a.m.

Project ID: PHYS 09
10:50a.m. – 11:05a.m.

Title: Relationship between dark photon delta R and gamma
Presenters: Albert Han and Vikram Rao
Mentor: Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
The dark photon is part of a dark sector beyond Standard Model theory that aims to explain dark matter. The dark photon can interact weakly with the Standard Model via kinetic mixing, allowing the dark photon to decay into leptons. These leptons form lepton jets, pairs of opposite-sign, collimated leptons, because of their relativistic boost, gamma, from the dark photon's high mass. The purpose of this study is to analyze the relationship between gamma and ΔR, the angular distance between a lepton jet. We discover that gamma and ΔR are inversely proportional, using this relationship to determine the acceptance of ΔR and gamma. These results will translate a limit in cross-section to a limit on parent particle mass which will enable us to specify what range of parent masses are ruled out by our study, as a function of the dark photon's mass.

Project ID: CHEM 04
10:50a.m. – 11:05a.m.

Title: Finding an Alternative to Metformin
Presenter: Dominik Kozbiel
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Metformin is one of the oldest drugs that is still currently used, and it is the most prescribed drug for treating diabetes. While Metformin is incredibly inert (as a result of it being a biguanide), it does not bind to its binding site too strongly. Through my research, I have developed hundreds of alternatives to Metformin using computer aided drug design, the majority of which bind better than Metformin does. One particularly interesting result (and the molecule that binds to the site the strongest) has a strength that scales with the length of a hydrocarbon chain contained within, most likely as a result of a pocket in the binding site.

Project ID: BIO 08
10:50a.m. – 11:05a.m.

Title: Investigating the Role of TET2 Enzymes in the Proliferation, Differentiation, and Survival of Hematopoietic Stem Cells
Presenter(s): David Dickson
Mentor(s): Vipul Shukla, Ajay Abraham, Feinberg School of Medicine, Northwestern Univeristy
Abstract/Project Intention:
Ten-Eleven Translocation (TET) enzymes play a critical role in DNA demethylation, which is essential for mammalian development and differentiation. Recent research suggests that the absence of TET enzymes is associated with an increased risk of malignancies. Among the TET enzymes, TET2 is the most commonly mutated and the focus of our investigation. Using gene editing techniques based on clustered regularly interspaced short palindromic repeat (CRISPR), we aim to study the impact of TET enzyme removal from hematopoietic stem cells in mice. Our study builds on the findings of Dr. Vipul Shukla, whose research has shown that TET deficiency disrupts mature B cell homeostasis, leading to oncogenesis characterized by the accumulation of G-quadruplex and R-loop structures. Through our work, we hope to gain a deeper understanding of the role TET enzymes play in the proliferation, differentiation, and survival of hematopoietic stem cells in mice and identify potential therapeutic strategies.

Project ID: CHEM 05
10:50a.m. – 11:05a.m.

Title: Potential Treatments for Mycetoma Using Synthesized Ferinamol Derivatives
Presenters: Ireland Morgan; Damilola Tabiti
Mentor: Dr. John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Eumycetoma, or fungal infections of mycetoma, plague third world countries. The symptoms of this disease include lesions with fistulae and abscesses filled with pus on the limbs, which sometimes need amputation. The current treatment methods of antifungal antibiotics and antifungal therapy of eumycetoma are currently not very effective. This project's intention is to synthesize derivatives of Fenarimol, an antifungal agent, to be used as a method to combat eumycetoma. The process involved isolating the fenarimol fungicide using various purification methods, such as column chromatography and thin layer chromatography. This project's goal is to synthesize and purify a medicinal compound that will help fight fungal infections of mycetoma. This project has successfully synthesized and purified a compound to be tested for usability as a potential treatment for fungal infections of mycetoma.

Project ID: PHYS 19
10:50a.m. – 11:05a.m.

Title: Multivariate analysis for detecting lepton jets
Presenter(s): Kevin Zhang
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Effective identification of dark photon-generated lepton jets has always been difficult to perform through standard cuts-based procedures. The possibility of solving this problem using multivariate analysis (MVA) methods has been tested. The initial list of input parameters included the total transverse momentum, azimuthal angle, pseudorapidity, number of particles, and jet width of each jet. The leading particle transverse momentum and difference in transverse momentum between the leading and runner up particles were later also found to increase model effectiveness. Various MVA classifiers (including neural networks and boosted decision trees) were trained on Monte Carlo simulations, tested on Run II data (jet width < 0.5), and validated with Run II data (jet width > 0.5). The resulting ROC curves, along with plots of the aforementioned input parameters and the distribution of model prediction on testing data is presented.

Project ID: CMPS 06
10:50a.m. – 11:05a.m.

Title: Runtime Comparative Analysis of Java and Python Programs with Algorithms of Different Time Complexities
Presenter(s): Ellen Guan
Mentor(s): Yun Wang, Bradley University
Abstract/Project Intention:
Runtime, one of the crucial metrics for evaluating program performance, differs between Java and Python programs due to their inherent differences, where Java is statically typed and both compiled and interpreted, while Python is dynamically typed and only interpreted. Our study investigates the extent to how features of Java and Python impact execution time of four programs with algorithms of different complexities (O(1), O(n), O(n*log(n)), and O(n2)). In our experiment, we found that the traditional (one-pivot) Quicksort algorithm in Java runs 10 to16 times faster than the one in Python for input sizes ranging from 100,000 to 1,500,000. Additionally, this study discusses how to speed up a Python program of Quicksort using the external library Numpy and Python's standard library module 'array'. After updating Quicksort in Python, its speed has become significantly faster than Java's built-in Dual-Pivot Quicksort for input sizes larger than 1000, by a factor of 7 to 9 times. This improvement, as an example, explains why Python is favored in data science and machine learning, despite being slower than Java in general. This study concludes that the choice between Python and Java depends on the specific use cases.

Project ID: BHVSO 08
10:50a.m. – 11:05a.m.

Title: Availability of suboxone films and naloxone nasal spray in pharmacies in Cook County, IL

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

Abstract/Project Intention:
In the years following the COVID-19 pandemic, there have been significant waves of opioid overdose deaths due to the disruption to daily life that has impacted individuals susceptible to substance abuse. The US has taken action in combating the rise in opioid overdose deaths by improving access to life-saving medications: Suboxone (buprenorphine/naloxone) and NARCAN (naloxone) nasal spray effectively reduce overdose deaths. However, studies have reported significant barriers to accessing these medications at the local level i.e., at pharmacies. To date, no studies have investigated the Chicago area. This study assesses the availability of suboxone and Narcan at pharmacies in Cook County. We determine what neighborhood-level factors predict the availability of these medications and if neighborhood overdose rates are associated with the availability of these medications at local pharmacies. We conducted phone calls to local pharmacies and inquired about their availability of both the brand and generic versions of Suboxone films. We also inquired about the availability of naloxone. Our hypothesis was that Suboxone and Narcan nasal spray will be unavailable in many community pharmacies, representing an undue burden for patients at a dangerous moment in their recovery.

Project ID: CHEM 06
10:50a.m. – 11:05a.m.

Title: Design and Synthesis of Potential Treatments for Leishmaniasis
Presenter: Jadesola Suleiman
Mentor: John Thurmond, Illinois Mathematics and Science Academy
Abstract/Project Intention:
Leishmaniasis is a parasitic disease found in 88 countries, a majority of which are located in the tropic or subtropics, earning it the title of a neglected tropical disease (NTD). The disease is primarily characterized by fevers, enlarged spleens, weight loss, and swollen glands. This study was done in collaboration with the Drugs for Neglected Disease Initiative (DNDi) and the University of Otago. Three analogs of DNDi's lead compound were synthesized and purified for this study. Afterward, nuclear magnetic resonance (NMR) was completed to characterize the compounds' structures and NMR predictors were run to confirm structures. All compounds synthesized will be sent to our collaborators for biological testing and the results will be used to design and synthesize more potent compounds in the future.

Project ID: CMPS 10
10:50a.m. – 11:05a.m.

Title: Presence of Anti-Uyghur Influence Operations in Xinjiang
Presenter: Ryan Li
Mentor: Dr. Courtland VanDam, Lincoln Laboratory,
Massachusetts Institute of Technology
Abstract/Project Intention:
The purpose of this study is to analyze patterns of Twitter to determine the existence of influence operations and their relation to the current narrative of Uyghur oppression in Xinjiang. Our analysis focuses on the Twitter Moderation Research Consortium (TMRC) of flagged accounts marked as spam, or "persistent platform manipulation campaigns," consisting of over 2,048 accounts and 31,269 tweets. We analyze influence operations using natural language processing libraries, specifically sharp changes in topics, frequency of tweets, and sentiment of tweets. Namely, we generated word clouds, Latent Dirichlet Allocation topic models, and sentiment analysis graphs to answer our research questions. We found a targeted impact against Uyghur Muslims in Xinjiang as tweet sentiment from the region sharply drops at keystone anti-Xinjiang and anti-Chinese events in the media as topics shifted to Uyghur oppression in the region, indicating a coordinated attempt at shifting the controversial narrative and the sentiment surrounding it.

Project ID: ENVR 04
10:50a.m. – 11:05a.m.

Title: Experimental Analysis of the Shinnery Oak Shrub Using High Resolution Unmanned Aerial Vehicle Imagery

Presenter: Lily Song
Mentors: Chuck Cannon and Colby Borchetta, Morton Arboretum

Abstract/Project Intention:
The Shinnery Oak (Quercus havardii) is an endangered short clonal deciduous shrub native to the Great Plains of North America. The species play a keystone role in its community, yet over one million acres of the Shinnery Oak have been eradicated. The species' restoration is vital to biodiversity, the well-being of endangered species in the community, erosion control, and livestock production. Therefore, revegetating areas that supported the plant is an important conservation concern. Yet, little research has been done on the disappearing species ecology. Long term research is being planned on natural populations, including the use of routine aerial surveys. This is a new research technique for this type of research, so it is exploratory without established methods for this particular purpose. This work aims to: (a) find and explore ways remotely sensed image data captured with Uncrewed Aerial Vehicles(UAV) can be used to study this critical species, (b) assess the accuracy and resolution needed to carry out the proposed analyses, (c) establish a workflow for the proposed analysis. Agisoft Metashape photogrammetry software was used to generate the 3D model and orthomosaic used for analysis. A DJI Phantom 4 drone was used to take aerial photographs of study sites in the North Central Plains of western Texas. Photos of the area were taken over three different time periods: June 2021, January 2022, and March 2022. To optimize the image collection and data extraction, we focused on three clones of varying size and shape. Three clones were analyzed to compare differences in canopy size, color, and height resulting from seasonal changes. We are currently in the early stages of our investigation, so the orthomosaic will b used to analyze distances between mottes, sizes, and shapes of mottes through R packages Furthermore, error points and point density were compared to assess the accuracy of each dat set.

Project ID: CMPS 14
10:50a.m. – 11:05a.m.

Title: Machine Learning Diagnosis of Chronic Rhinosinusitis
Presenter(s): Irene Liu
Mentor(s): Claus Peter Richter, Feinberg School of Medicine, Northwestern Univeristy
Abstract/Project Intention:
Chronic Rhinosinusitis (CRS) is a nasal disease characterized by inflamed mucosa and paranasal sinuses for at least 12 consecutive weeks. The disease requires 12+ weeks of characteristic symptoms, nasal endoscopy, and/or a computed tomography scan which are frequently inaccessible in primary care. This project introduces an easier method to screen for CRS using a patient's speech patterns, signal processing algorithms, and machine learning.

Signal processing algorithms were used to inform on features suitable to be fed into a machine learning algorithm. To select the most robust signal processing algorithm, 21 participants' speech were recorded twice, first with their nose obstructed and then non-obstructed. After selecting the best signal processing algorithm, another set of 42 CRS symptomatic patients was used to test an initial trial run of the algorithm. The time waveform provided the highest accuracy of 67%, sensitivity of 77%, and specificity of 57%.

The initial trial run resulted in a 66% accuracy, 69% sensitivity, and 62% specificity. The current method acts as a baseline for future testing, showing that the time waveform extracts the most representative features for CRS diagnosis. In the future, more training data will increase the algorithm's accuracy and allow for more powerful machine-learnin approaches.

Project ID: MEDH 27
10:50a.m. – 11:05a.m.

Title: Examining Clinical Factors Pre and Post Biofire BCID Implementation
Presenter: Kenith Taukolo
Mentor: Dr. Janna Lynn Williams, Division of Infectious Disease at Northwestern
Abstract/Project Intention:
Bloodstream infections (BSI) represent approximately 40% of hospital-acquired (HA) cases and 20% of ICU-acquired cases. Furthermore, bloodstream infections are known to be associated with higher mortality, as one study showed a 14% increase in mortality in HIV patients with positive blood cultures. Due to the widespread susceptibility to BSIs, it requires a way to properly and quickly diagnose and identify the correct antibiotic for medication. So, beginning in 2021, Northwestern University Hospitals in the Chicagoland area began to switch to Biofire Blood Culture Identification 2 (BCID2) in order to better analyze these blood samples in a quicker time frame. This investigation examined clinical factors such as length of stay, mortality, and accurate decision of antibiotic both before and after implementation of BCID2 in hospitals. After analyzing one-hundred patient charts (fifty pre and post implementation), the research showed that while the length of stay and accurate antibiotic determination is roughly similar pre and post implementation, other clinical factors greatly improved post-implementation. For example, time between blood culture order and test result as well as time between blood culture order and correct antibiotic determination decreased significantly under BCID2. However, a greater number of samples should be analyzed before a final decision is made regarding the efficacy of BCID2.

Project ID: MEDH 20
10:50a.m. – 11:05a.m.

Title: Using the Poco-synthetic Polymer Graft for Urinary Bladder Regeneration

Presenters: Karra, Vikram; Rajinikanth, Nachiket
Mentors: Dr. A. Sharma, Dr. T. Sharma, Lurie Research Center

Abstract/Project Intention:

Bladder augmentation cystoplasty has been the gold standard for treating pediatric patients with developmentally abnormal urinary bladder. This procedure functions by using bowel tissue to increase bladder capacity while reducing spasticity for the patient. The rigorous surgical procedure poses unwanted long-term issues such as malignant transformation, excessive mucus production, electrolyte imbalances, and perforation. The method, considered effective, still reports a reoperation rate for complications of 30.43%. Another method involves the small intestinal submucosa and is used successfully in bladder regeneration by utilizing an unseeded graft. Total bladder replacement is often difficult with SIS, however due to the finite size of the regenerated tissue. Bone marrow derived mesenchymal cells exhibit the ability to use cell-seeded scaffolds. MSCs are implanted into the bladder and have demonstrated the ability to act as immunomodulators, creating a protective mechanism to counter localized inflammatory response (an effect of typical bkladder augmentation). BM MSCs can regenerate a smooth muscle portion of the bladder wall, providing another benefit to MSCs. Data about the MSCs yielded a new method for urinary bladder regeneration, which employs the use of MSCs to derive a poco-synthetic polymer graft acting as a scaffold for regeneration o the bladder wall.

Project ID: BIZ INTRN 20
10:50a.m. – 11:05a.m.

Title: UIC Urban Health Club
Presentor(s): Ayati Lala
Business Mentor(s): UIC Urban Health Club
Abstract/Project intention:
The UIC Urban Health Program Urban Health Club (UHC) is an initiative that aims to bridge the gap between high school students and healthcare careers. The program's primary objective is to expose students to various health professions and career pathways. Through in-person community events, interviews, and research, students participating in the program have the opportunity to identify health disparities within their community. This information is then compiled into digital media formats, such as infographics, that help raise awareness about these issues. Over the course of six months, the UHC provides students with a comprehensive curriculum that includes opportunities to meet various health professionals. Additionally, the UHC provides students with training and certifications that help them become better prepared for their future roles in healthcare. These include Naloxone administration and the opportunity to become COVID-19 vaccine ambassadors. This role involves helping promote vaccination and educate people about its importance. Finally, UHC offers students opportunities to attend discussions about health policies and wellness clinics. Through these events, students learn more about the factors that impact health outcomes and the policies that can improve them. Students compile this information into infographics, which can be shared with the community to promote awareness and education.

Project ID: BIZ INTRN 08
10:50a.m. – 11:05a.m.

Title: Malware Detection for the ABLE Program
Presentor(s): Aditi Kumar
Mentor(s): Joseph Daniels, Illinois State Treasurer's Office
Abstract/Project intention:
The Illinois State Treasurer's Office runs the ABLE program which allows individuals with disabilities to build financial wellness without losing federal benefits. However, many people who use the ABLE program require assistance to navigate technology and this assistance does not always come from those who are sufficiently technologically literate. People with disabilities are targeted digitally as they are often overlooked by cybersecurity threat models. With technology being such a vital and rapidly growing element of daily life, federal legislation needs to improve the security standards for accessibility, specifically website security where attackers target this vulnerable audience. The State Treasurer's Office provided resources to gain knowledge about cryptography, machine learning and cybersecurity in order to create tools to extract and detect malware that is embedded into documents. These tools can be implemented into the ABLE program to protect sensitive information.

Project ID: CMPS 08
10:50a.m. – 11:05a.m.

Title: Human Body Detection with Occlusion
Presenter(s): Aditya Prashanth
Mentor(s): Rui Chen, Changliu Liu, Robotics Institute, Intelligent Control Lab
Carnegie Mellon University
Abstract/Project Intention:
The purpose of this design experiment was to attempt to determine the accuracy/possibility of using Kalman filters to approximate a human's location when blocked by an occlusion/obstacle. This could potentially be implemented in the field of human-robot interaction to allow humans and robots to collaborate without interference. The outcome of this research project could similarly result in more accurate measurements for human body detection.

This project consists of the following two different procedures: 1) design steps of the solution, 2) testing final design iteration. In order to construct the hypothetical solution to the project, the first procedure must be followed, while to test the solution, the second procedure must be followed. Each procedure is extremely descriptive, explaining the several steps to building and testing the experimental solution precisely.

Based on the results of the experiment, the problem statement was proved inconclusive due to both positive and negative results. Throughout all the data collected and graphs constructed, the Kalman filter's average mean-squared errors were never concretely/always lower than those of the ZED depth camera. The project's findings reveal the inconclusive and ambiguous behavior of the Kalman filter, indicating more trials and testing is needed for a concrete determination.

Project ID: MEDH 37
10:50a.m. – 11:05a.m.

Title: Differences in admission characteristics of ICH patients with and without coagulopathy
Presenter(s): Rithik Thekiniath
Mentor(s): Ali Mansour, University of Chicago
Abstract/Project Intention:
Coagulopathy is a medical condition in which the body's blood clotting mechanisms are impaired or disrupted. This can result in abnormal bleeding or clotting, which can be life threatening if not promptly diagnosed and treated. This is especially true in serious injuries such as intracranial hemorrhaging for penetrating brain injuries. The intent of this analysis is to determine what variables are statistically different in populations that suffer from medical coagulopathy and those that are not. A list of significant variables often measured in medical scenarios pertaining to patient bodily and mental functions are included in the data set and are then tested using various statistical tests appropriate to their respective data trends in order to determine specific values. For effective and accurate analysis, a database was used with over 40,000 patients with data pertaining to all the variables and whether coagulopathy was noted. Once data was tested, variables that suggested high correlation are analyzed to see the cause for their respective change with coagulopathy. Understanding these relationships can help to identify risk factors, predict outcomes, and develop more effective treatments. The wide range of health complications affected by coagulopathy allows for improvements in understanding and studying to be significant.

Session III - 11:25a.m. – 11:50a.m.

Project ID: MATH 02
11:25a.m. – 11:50a.m.

Title: The Isomorphy Classes of the Special Orthogonal Group of Low Dimension in Characteristic 2
Presenter(s): Shiqi Cheng
Mentor(s): Dr. Ellen Ziliak, Benedictine University
Abstract/Project Intention:
In 1926, Cartan introduced the concept of real symmetric spaces as a class of homogeneous Riemannian manifolds, where a symmetric space is defined as the homogeneous space G/H with G a reductive group and $H=G^{\theta}=\{g\in G|\theta(g)=g\}$, the fixed-point group of an n-automorphism. Of special interest are automorphism of order 2, also called involutions. In this project we focused on classifying the involutions for the $SO(3,\mathbb{F}_{2^k})$ and $SO(4,\mathbb{F}_{2^k})$. Our results should provide a base case for the general theory for n-dimensional matrices.
Note: The above math text can be compiled using LaTeX.

Project ID: MEDH 12
11:25a.m. – 11:50a.m.

Title: The Effect of Cutaneous Electrical Stimulation on Hypertonia in Chronic Hemiparetic Stroke

Presenter(s): Shreya Chakraborty and Yina Wang
Mentor(s): Julius P.A. Dewald[1,2], Hendrik A. Dewald[1,3], and M.Hongchul Sohn[2]

Afflilations:
1) Dept. of Physical Therapy and Human Movement Sciences, Northwestern Univ.
2) Dept. of Biomedical Engineering, Northwestern Univ.,
3) Dept. of Biomedical Engineering, Case Western Reserve Univ.

Abstract/Project Intention:
Cumulating evidence suggests that upregulation of corticoreticulospinal pathways following a stroke-induced loss of corticobulbar projections drives spinal motoneuro hyper-excitability. In turn, individuals with stroke experience increased muscl tone (i.e., hypertonia) and associated hyperactive stretch reflexes (i.e., spasticity). It has been shown that applying low-intensity (sub-motor-threshold) electrical stimulation to the skin reduces spasticity in individuals with hemiparetic stroke, as quantified by reflex torque responses at the elbow (Dewald et al., 1996). The purpose of this study was to determine whether cutaneous electrical stimulation can reduce hypertonia, as measured from background muscle activity. To this end, we measured hypertonia while the participant (N=1) was sitting relaxed ('Baseline', 10 minutes) with the arm fully supported (shoulder abduction 80°, shoulder flexion 0°; elbow extension 110°), before and after applying low-intensity stimulation to skin over the biceps muscle (20Hz, 0.1ms pulse duration, for 10 minutes). As a control, a sham trial was included (10 minutes, stimulation amplitude reduced to 0 within the first 1 minute) . The procedure was repeated on two separate days, with the order of the sham and stimulation trials switched. Hypertonia expressed in biceps muscle was quantified using a time-based surface electromyography (EMG) metric previously developed to capture the duration of active state of muscle relative to true relaxation (Sohn et al., 2022). Our preliminary results showed that hypertonia was indeed reduced after cutaneous electrical stimulation compared to following the sham trial in both days ($p<0.05$). The results from this experiment can be used to develop new treatments for hypertonia and associated stretch reflex hyperexcitability.

Project ID: MEDH 30
11:25a.m. – 11:50a.m.

Title: Knocking Out the β-catenin from Induced Astrocytes using CRISPR/Cas9 Lentiviral Approach

Presenter(s): Amogh Shetty
Mentor(s): Srinivas D. Narasipura, PhD; Tanner Shull, MPH; and Lena Al-Harthi, PhD, Rush University

Abstract/Project Intention:
Astrocytes are one of the most abundant cell types in the central nervous system (CNS), playing an important role in regulating glutamate uptake, neuroinflammatory response, blood brain barrier permeability, and neuronal health. In the past decade, hiPSCs (human induced pluripotent stem cells) were successfully demonstrated to differentiate into induced astrocytes (iAs), and recently have been shown to robustly express the Wnt/β-catenin pathway. The pathway is an important pro-survival that has been seen to regulate vital functions in primary astrocytes, such as glutamate uptake, immunoinflammatory response, and viral transcription. To further investigate the pathway's role in astrocytes, we attempt to knock out β- catenin from the astrocytes. CRISPR/Cas9 knockout was previously attempted via plasmid transfection but was unsuccessful. Here, we attempted CRISPR/Cas9 knockout via a lentiviral approach. Lentiviruses were produced using third generation packaging systems and from 293 T-cells. Knockout cells were selected with puromycin. Two guide RNAs were tested in addition to control, scramble guide RNA. While western blot showed successful knockout with one of the guide RNAs, NGS only showed a success rate of ~1 successful knockout among ~30,000 cells in the correct spot. The protocol, which was adapted from a protocol to knock out genes in intestinal cells via lentiviruses, may have to be modified to yield more successful knockout efficacy.

Session III - 11:55a.m. – 12:20p.m.

Project ID: CMPS 07
11:55a.m. – 12:20p.m.

Title: Space-Time Conflict Spheres for Constrained Multi-Agent Motion Planning
Presenter(s): Anirudh Chari
Mentor(s): Mr. Rui Chen and Dr. Changliu Liu,
Robotics Institute, Carnegie Mellon University
Abstract/Project Intention:
1.3 million people are killed in road accidents each year, and 94% of these accidents are caused by human error. This has motivated advancements in autonomous vehicle technology, and more recently, connected autonomous vehicles (CAVs). CAVs communicate location and intention information with each other over the air, and the prospect of cooperative planning within a system of CAVs promises greater safety and efficiency in travel. CAV cooperative planning can be formulated as multi-agent motion planning (MAMP), and we propose a space-time conflict resolution approach for MAMP. We formulate the problem using a novel, flexible sphere-based trajectory representation. We then compose discrete-time procedures while evading discretization error and adhering to kinematic constraints in generated solutions. Theoretically, we prove the continuous-time feasibility and formulation-space completeness of our algorithm. Experimentally, we demonstrate that our algorithm matches the performance of the current state of the art with respect to runtime and solution quality, while expanding upon the abilities of current work through accommodation for both static and dynamic obstacles. We evaluate our algorithm in various unsignalized traffic intersection scenarios using CARLA, an open-source vehicle simulator. Results show significant success rate improvement in spatially constrained settings and performance that scales well among increasingly complex scenarios.

Project ID: MEDH 25
11:55a.m. – 12:20p.m.

Title: A local ancestry-based assessment of common variants to finetune risk profiles of Parkinson's disease (PD)
Presenter(s): Dhruv Patel
Mentor(s): Steven Lubbe and Bernabe Bustos, Feinberg School of Medicine, Northwestern Univ.
Abstract/Project Intention:

Parkinson's disease (PD) is a severe neurodegenerative disease resulting from complex interactions between genetic and environmental factors. Past studies have estimated the genetic heritability of PD at around 24-60%, but they have examined samples of European ancestry as genetically homogenous.

Historical trends, however, find that Northern and Southern European tribes interbred between 440 and 1,080 CE, leading to 2-100 different genetic ancestors in Europe today. We examined such local variation, specifically at the chromosomal level, which PCAs overlook. With a merged, pruned, and harmonized dataset from the 1000 Genomes Project and the POPRES: Population Reference Sample, this study conducted ADMIXTURE, which found most significant individual ancestries at K=14 (with $p < 0.05$ and $Fsp > 0.15$ as significant thresholds). Logistic regression was then performed for the first 10 PCs with LAMP-LD, building a hidden-Markov model with a window of 100 variants.

We found that each individual obtains 34% of ancestry from North Europe and 66% from the South. A Manhattan plot found that variants were significant on chromosomes 4, 6, 15, and 17 for North Europe and 15 and 16 for South Europe.

Project ID: PHYS 01
11:55a.m. – 12:20p.m.

Title: Automatic Datacard Generation and Significance Estimation with Punzi Criterion for Higgs Analyses
Presenter(s): Gautham Anne
Mentor(s): Peter Dong, Illinois Mathematics and Science Academy
Abstract/Project Intention:
In order to perform a statistical analysis of Higgs searches, datacards are used to encode the observed and expected events after event selection to discriminate between signal and background. We developed a framework to incorporate into our analysis group's framework to automatically generate datacards. In addition, we utilized the Higgs Combine Tool to test combining multiple generated datacards. In the past, our group's selection cuts were based on the standard significance = S/sqrt(B) formulation. However, this method is dependent on a-priori expectations of limit settings to assert that a discovery has been made. We instead used the Punzi criterion, developed by George Punzi, as a better estimate of the significance. Simple, approximate formulas were derived and used for Poisson counts with background, with the suggested values for parameters (a=5).

Presentation Schedule Reference List | IMSAloquium 2023

Student First	Student Last	Session	Time	Category ID
Nishna	Aerabati	I	9:05a.m.	BIZ INTRN 11
Rashmi	Alawani	I	8:50a.m.	BHVSO 01
Aaliyah	Ali	I	9:05a.m.	BHVSO 04
Fredy	An	I	8:50a.m.	ERSP 01
Gautham	Anne	III	11:55a.m.	PHYS 01
Umika	Arora	I	8:50a.m.	ERSP 01
Sreevardhan	Atyam	I	8:50a.m.	PHYS 02
Rohun	Bakshi	II	10:05a.m.	CMPS 01
Manasa	Balasubramanian	II	10:20a.m.	ENVR 01
Siddarth	Bangaru	II	10:05a.m.	MEDH 34
Ella	Barnett	II	10:35a.m.	IND ST 03
Dean	Barrow	I	9:05a.m.	PHYS 03
George	Bayliss	I	9:20a.m.	PHYS 04
Mia	Benitez	I	8:50a.m.	ERSP 01
Surya	Bhamidi	I	9:35a.m.	PHYS 05
Bikrant	Bhattacharyya	I	9:35a.m.	CMPS 15
David	Biruduganti	II	10:05a.m.	CMPS 03

Rylie	Bozarth	I	8:50a.m.	BIO 01
Divya	Brahmbhatt	I	9:35a.m.	MEDH 33
Kennedy	Bray	II	10:05a.m.	MEDH 34
Ishan	Buyyanapragada	I	9:35a.m.	CMPS 04
Michael	Capriotti	I	9:20a.m.	BHVSO 02
Edgar	Carlos	I	8:50a.m.	ENGN 02
Elizabeth	Carlson	II	10:35a.m.	BIO 03
Shreya	Chakraborty	I	9:05a.m.	IND ST 01
Shreya	Chakraborty	III	11:25a.m.	MEDH 12
Sindhu	Chalasani	I	8:50a.m.	MEDH 03
Anirudh	Chari	III	11:55a.m.	CMPS 07
Bhavyaa	Chauhan	I	9:20a.m.	BIZ INTRN 03
Ivan	Chen	II	10:05a.m.	PHYS 06
Shiqi	Cheng	III	11:25a.m.	MATH 02
Arjun	Cherukuri	II	10:35a.m.	MEDH 14
Shivani	Chirumamilla	I	9:35a.m.	MEDH 15
Komal	Chivukula	I	9:05a.m.	CHEM 02
Divya	Choudhary	I	8:50a.m.	BIO 01
Dean	Cianciolo	II	10:20a.m.	PHYS 07

Christian	Cline	II	10:05a.m.	ENVR 03
Conor	Craddock	II	10:20a.m.	BIZ INTRN 06
Kelly	Cruz	I	8:50a.m.	BIO 01
Melanie	Cuenca	I	8:50a.m.	BIZ INTRN 01
Braeden	Cullen	I	9:20a.m.	BIZ INTRN 03
Evelyn	Cunneen	I	9:35a.m.	BIZ INTRN 17
Gracelyn	Daum	II	10:35a.m.	BIO 07
Manya	Davis	II	10:20a.m.	CMPS 02
Aadi	Desai	I	9:05a.m.	CMPS 12
David	Dickson	II	10:50a.m.	BIO 08
Marguerite	DiMarco	II	10:05a.m.	MEDH 16
Riman	Doodin	II	10:20a.m.	MEDH 17
Nooriyah	Doriwala	I	9:20a.m.	BIZ INTRN 12
Shaan	Doshi	I	9:05a.m.	CMPS 12
Jeff	Duan	I	8:50a.m.	MATH 03
Avyay	Duggirala	II	10:35a.m.	BIZ INTRN 07
Steven	Espinoza	II	10:05a.m.	BIZ INTRN 19
Jesus	Fileto	II	10:35a.m.	PHYS 08
Atharva	Gawde	II	10:05a.m.	PHYS 21

Yoanna	Georgieva	I	9:35a.m.	BIZ INTRN 04
Jazmyne	Germo	I	9:20a.m.	MEDH 04
Johanna	Germo	I	9:35a.m.	MEDH 05
Samuel	Go	I	9:35a.m.	BHVSO 05
Laya	Gopalakrishnan	I	8:50a.m.	ERSP 01
Ellen	Guan	II	10:50a.m.	CMPS 06
Ellen	Guan	I	8:50a.m.	PHYS 20
Pranit	Guntupalli	I	9:05a.m.	MEDH 18
Akshat	Gupta	I	9:05a.m.	MATH 04
Srihari	Gurugubelli	I	8:50a.m.	BIO 02
Shria	Halkoda	I	9:20a.m.	BIZ INTRN 03
Aubrey	Hall	I	9:05a.m.	MEDH 11
Albert	Han	II	10:50a.m.	PHYS 09
Luis	Hernandez Aguirre	II	10:05a.m.	ENGN 07
Maya	Holland	II	10:05a.m.	MEDH 06
Madhav	Hota	I	9:20a.m.	CMPS 05
Kevin	Huang	II	10:20a.m.	PHYS 10
Nathaniel	Huang	II	10:20a.m.	CHEM 03
Sufiya	Hussaini	II	10:05a.m.	MEDH 38

Cara	Jacob	II	10:20a.m.	BIO 06
Rohan	Jain	I	8:50a.m.	PHYS 11
Nitya	Jakka	II	10:05a.m.	ENVR 02
Catherine	Jenks	I	9:05a.m.	PHYS 12
Kevin	Johnson	II	10:05a.m.	MEDH 34
Saul	Juarez	I	8:50a.m.	ERSP 01
Diya	Kamath	II	10:35a.m.	MEDH 07
Himani	Kamineni	II	10:35a.m.	MEDH 19
Gabriella	Kanallakan	II	10:20a.m.	PHYS 24
Emily	Karbowniczek	I	9:35a.m.	BIZ INTRN 17
Vikram	Karra	II	10:50a.m.	MEDH 20
Sara	Kashyap	I	9:20a.m.	PHYS 22
Aarya	Khapre	II	10:35a.m.	CMPS 09
Anthony	Kholosenko	I	9:05a.m.	ENGN 03
Anisha	Kolambe	II	10:05a.m.	MEDH 21
Caroline	Kowal	I	9:20a.m.	PHYS 13
Dominik	Kozbiel	II	10:50a.m.	CHEM 04
Sridevi	Krothapalli	I	8:50a.m.	ERSP 01
Marcus	Kubon	II	10:05a.m.	PHYS 06

Aditi	Kumar	II	10:50a.m.	BIZ INTRN 08
Jayant	Kumar	I	9:05a.m.	ERSP 02
Ayati	Lala	II	10:50a.m.	BIZ INTRN 20
Ayati	Lala	I	8:50a.m.	MEDH 22
Janelle	Le Roy	I	9:20a.m.	IND ST 02
Joshua	Lee	II	10:20a.m.	ERSP 03
Kevin	Lemus	I	8:50a.m.	ENGN 02
Emerald	Lendi	I	8:50a.m.	ERSP 01
Jerrick	Li	II	10:20a.m.	MEDH 39
Ryan	Li	II	10:50a.m.	CMPS 10
Michelle	Li	I	9:05a.m.	BHVSO 04
Irene	Liu	II	10:50a.m.	CMPS 14
Irene	Liu	I	9:20a.m.	MEDH 29
Rebecca	Liu	I	9:20a.m.	BIZ INTRN 03
Zuyu	Liu	II	10:35a.m.	ENGN 01
Charles	Ludwig	I	8:50a.m.	BIZ INTRN 14
Ilan	Lunken	I	8:50a.m.	ENGN 02
Aldo	Magana		10:20a.m.	HIST 01
Luke	Mauk	II	10:05a.m.	BHVSO 03

Daunovan	McCullough	I	9:35a.m.	BIZ INTRN 13
Raven	McKelvin	I	8:50a.m.	BIZ INTRN 09
Ella	Mixer	I	9:35a.m.	BIO 12
Ryan	Mojzis	I	9:20a.m.	BIZ INTRN 16
Jack	Morby	I	9:35a.m.	PHYS 14
Ireland	Morgan	II	10:50a.m.	CHEM 05
Meera	Mutharasan	I	8:50a.m.	CHEM 01
Laasya	Nagumalli	II	10:20a.m.	CMPS 02
Ashwin	Nair	I	8:50a.m.	CHEM 01
Ellen	Nguyen	II	10:35a.m.	MEDH 07
Edward	Ning	II	10:20a.m.	MEDH 23
Venus	Obazuaye	II	10:35a.m.	MEDH 24
Claire	O'Brien-Dull	I	9:05a.m.	PHYS 12
Kosi	Okeke	II	10:05a.m.	MEDH 38
Gavin	O'Malley	II	10:05a.m.	PHYS 15
Muna	Onwuameze	II	10:05a.m.	MEDH 38
Alexandra	Orantia	II	10:35a.m.	ENVR 05
Zhengyu	Pan	II	10:20a.m.	PHYS 16
Sreekeerthi	Panchagnula	I	9:05a.m.	MEDH 01

Maitreyi	Pandey	I	9:35a.m.	BIO 04
Daniel	Park	II	10:20a.m.	MEDH 35
JaeJun	Park	II	10:20a.m.	MEDH 13
Jesse	Park	I	9:05a.m.	ENGN 03
Aiden	Parnell	II	10:05a.m.	CMPS 01
Dhruv	Patel	III	11:55a.m.	MEDH 25
Faisal	Patel	I	9:35a.m.	MEDH 26
Faisal	Patel	I	9:20a.m.	MEDH 29
Dorothy	Peters	I	9:05a.m.	BIZ INTRN 15
Cole	Plepel	I	9:05a.m.	MATH 01
Aditya	Prashanth	II	10:50a.m.	CMPS 08
Nachiket	Rajinkanth	II	10:50a.m.	MEDH 20
Faelyn	Rakow	I	9:35a.m.	BIZ INTRN 18
Vikram	Rao	II	10:50a.m.	PHYS 09
Kavya	Reddy	I	8:50a.m.	CHEM 01
Ethan	Remedios	I	8:50a.m.	BIZ INTRN 14
Tia	Rice	I	8:50a.m.	ERSP 01
Shanan	Riley	II	10:35a.m.	BHVSO 07
Rafael	Rotger	I	9:20a.m.	MATH 05

Nikita	Rudrapati	I	9:35a.m.	ENGN 06
Karla	Sanchez	II	10:35a.m.	MEDH 08
Vidyoot	Senthilvenkatesh	II	10:35a.m.	BIO 10
Nethra	Shanbhag	I	9:35a.m.	CMPS 16
Amogh	Shetty	III	11:25a.m.	MEDH 30
Catherine	Shi	II	10:20a.m.	MEDH 17
Sajal	Shukla	I	9:35a.m.	BIZ INTRN 04
Megan	Sia	II	10:50a.m.	BHVSO 08
Benedict	Simmons	I	9:05a.m.	BIZ INTRN 02
Raghav	Sinha	I	9:20a.m.	CMPS 13
Einsteinia	Socrates	I	8:50a.m.	BIZ INTRN 10
Joshua	Solone	I	8:50a.m.	BIZ INTRN 14
Lily	Song	II	10:50a.m.	ENVR 04
Lily	Song	II	10:35a.m.	MEDH 36
Pietro	Stabile	I	9:35a.m.	PHYS 23
Mojadesola	Suleiman	II	10:50a.m.	CHEM 06
Danica	Sun	I	9:20a.m.	BHVSO 02
Sumedha	Surubhotla	I	9:05a.m.	MEDH 09
Jai	Sutaria	I	9:20a.m.	ENGN 05

Pranet	Swain	II	10:05a.m.	BIZ INTRN 05
Sophia	Syed	II	10:35a.m.	BIO 07
Damilola	Tabiti	II	10:50a.m.	CHEM 05
Kenith	Taukolo	II	10:50a.m.	MEDH 27
Rithik	Thekiniath	II	10:50a.m.	MEDH 37
Vignesh	Tiruvannamalai	I	9:20a.m.	MEDH 02
Sachleen	Tuteja	I	8:50a.m.	MEDH 10
Nandana	Varma	I	9:05a.m.	MEDH 28
Sahil	Veeravalli	I	9:20a.m.	BIO 11
Bhavya	Vegesna	II	10:20a.m.	MEDH 39
Renaldo	Venegas	I	8:50a.m.	MATH 03
Kohl	Vonder Haar	I	9:20a.m.	MEDH 31
Yina	Wang	III	11:25a.m.	MEDH 12
Julius	Wardlow	I	9:20a.m.	ENGN 04
Dheeran	Wiggins	II	10:35a.m.	PHYS 18
Malcolm	Wilson-Ahlstrom	I	8:50a.m.	PHYS 02
Elaina	Xiao	I	8:50a.m.	CMPS 11
Sofia	Zasiebida	II	10:05a.m.	ENVR 03
Annabelle	Zhang	II	10:20a.m.	ENVR 01

Kevin	Zhang	II	10:50a.m.	PHYS 19
Matthew	Zhang	II	10:05a.m.	CMPS 01

Mentor List | Student Inquiry and Research

Argonne National Lab
Prasanna Balaprakash
Chandrachur Bhattacharya
Maury Goodman
Yuki Hamadan
Ravi K. Madduri
Tanwi Mallick
Lauren Valentino

Benedictine University
Ellen Ziliak

Bradley University
Yun Wang

Carnegie Mellon University
Rui Chen

Illinois Institute of Technology
Seebany Datta-Barua
Brent Stephans

Kaneland Allergy & Asthma Center
Sakina Bajowala

Ann & Robert H. Lurie Children's Outpatient Center
Kai Lee Yap

Ann & Robert H. Lurie Children's Hospital
Diane Chen
Faith Summersett-Williams

Massachusetts Institute of Technology
Courtland VanDam

Morton Arboretum
Chuck Cannon

North Central College
Frank Harwath

Northern Illinois University
Wesley Swingley

NorthShore Univeristy HealthSystem
Jubao Duan

Northwestern Univ., Evanston
Randall Berry
Keith Burns
Noshir Contractor
Eric Dahl
Collin Diver
Pulak Dutta
Carola Frydman
Julia Gaudio
Yoram Lithwick
Paul Umbanhowar
Kirsten Viola

Northwestern, Feinberg
Angel Alvarez
Yanis Boumber
Julius Dewald
Sohn Hongchul
Sui Huang
Caroline Le Poole
Steven Lubbe
Marco Martina
Daniela Menichella
Bethany Perez-White
Seth Pollack
Claus-Peter Richter
Arun Sharma
Vipul Shukla
Ronen Sumagin
Janna Williams
Yi Yang
Rui Yi

Rush University
Srinivasa Narasipura

Southern Illinois Univ. Edwardsville
Erin Vanderbunt

The University of Chicago
Mark Applebaum
Crystal Bae
Chin-Tu Chen
Pradeep K. Chintagunta
Yana Gallen
Tong-Chuan He
Valluvan Jeevanandam
Yong-Kee Kim
Ali Mansour
Gokul Subramanian
Ryan Robinett
Daniel Rodgers
Amanda Seccia
Wei-Jen Tang

Toyota Technical Institute at Chicago
Matthew Walter

University of Illinois
Feng Liang

University of Illinois at Chicago
Naiche Adler
Pranav Bhounsule
Emma Childs
Marwah Farooqui
Fabio Miranda
Rachel Poretsky

University of Michigan
Parth Shah

IMSA
Jessica Amacher
Sowmya Anjur
Grant Bell
Mark Carlson
Peter Dong
Evan Glazer
Joe Golab
Eric Hawker
Phadmakar Patankar
Eric Smith
John Thurmond
Sheila Wille

IMSA, Independent Study
Nicholas Cross

Mentor List | Business Internship Program

4170 Trading
John Aston
Kyle Campbell

APS
Harish Anathapadmanabhan

City of Aurora
Trevor Dick
Behati Hart
Carl King

City of Naperville
Kevin Bardan

Illinois State Treasurer
Joe Daniels
Fernando Diaz
Maggie Owen

IMSA, IN2 Independent Study
Jean Bigger
Steve Goldblatt

Independent, Computing Consultant
Doug Strain

MYTT
Randle Carter

Neelyx Labs
Shyam Saladi

Network Perception
Atul Boharra

PM Construction & Contracting, LLC
Stephanie Busic

SafeSTart Medical, Inc.
Richard Vazques

Take Control Counseling
James Jorgenson

University of Illinois at Chicago
Urban Health Club Staff

Cover designed by Ashana Das, IMSA student, April 19, 2023.