2024 SURP Faculty Mentor Applications

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2	Hisham Kholidy	UAV-to-UAV Communication Security
3	Zahid Akhtar	Exploring Intrusion Detection Systems: A Comparative Study for Optimal Cybersecurity Defense
4	Zahid Akhtar	Unmasking Deception: A Deepfake Detection Endeavor
5	Margarita Orlova	Foraging preferences across caste and species in wild bumblebees
6	Margarita Orlova	Role of learning and experience in queen-worker communication in social insects
7	Andrea Dziubek	Modeling and Numerical Simulation using Geometric Mechanics and NGSolve
8	Daniel Jones	Analysis of Electroencephalography (EEG) Data
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27	Ana Jofre	Building a content management system for the Gannett Gallery website
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29	Priyangshu Sen	Next-generation single-carrier waveform design for reliable link establishment at Terahertz and mmWave frequencies
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31	Mahmoud Badr	Privacy-Preserving Electricity Theft Detection using Federated Reinforcement Learning
32	Arjun Singh	Characterization of a THz channel propagation through an in-house developed wireless communications testbed
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34	Arjun Singh	Near-Field THz Propagation modeling and antenna design
35	Ahmed Abdelaal	Deicing of Wind Turbine Blades Using Thermal Heating
36	Kazi Imran	Additive Manufacturing of Fiber Reinforced Composites
37	Amir Fariborz	Parallel Computing in Quantum Chromodynamics
38	Gunyaz Ablay	Personal carrier wheeled mobile robot design
39	Zhanjie Li	Fire performance simulation of steel members under post-earthquake fire
40	Ahmed Abdelaal	Heated Pavements for Ice-Snow-Free Roads
41	Steve Schneider	Generating and Capturing Generative AI Conversations for future analysis and assessment

Research on Utica Campus

Professor Hisham Kholidy
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NCS, College of Engineering
Associate Professor

Project Title: (1)5G and Cloud Core Security.

5G is introducing a world of opportunities for the consumer market with much speed and bandwidth. This project specifically contributes toward the development and validation of a proactive cyberdefense framework to self-protect a multitenant large-scale SDN/NFV enabled Cloud of 5G networks against cyberattacks in a timely, dynamic, and accurate way. To this end, this proposal uses the deception, adversarial machine learning, and modeling and analysis techniques to provide the following capabilities.
(i) a dynamic vulnerability analysis and threat modeling approach based on the 5G attack vector.
(ii) a deception-based moving target architecture to dynamically patching software, making it more robust against anti-deception efforts.

Student Skills / Requirements: Programming using C, C++, and/or Java with some experience about server setup and cloud computing.

Professor Hisham Kholidy
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NCS, College of Engineering
Associate Professor

Project Title:(2) UAV-to-UAV Communication Security

Unmanned aerial vehicles (UAVs) are anticipated to significantly contribute to the development of new wireless networks that could handle high-speed transmissions and enable wireless broadcasts. This project studies the security of the UAV communication with regard to 5G and beyond networks. We harness the machine learning, blockchain, and federated learning techniques to protect the UAV communication

Student Skills / Requirements: Programming using C, C++, and/or Java with some experience about server setup and cloud computing.

Professor Zahid Akhtar
akhtarz@sunypoly.edu
Department of Network and Computer Security, College of Engineering
Assistant Professor

Project Title: (1) Exploring Intrusion Detection Systems: A Comparative Study for Optimal Cybersecurity Defense.

This undergraduate project aims to evaluate and compare various Intrusion Detection Systems (IDS) to identify their strengths, weaknesses, and effectiveness in detecting and mitigating cyber threats. Through comprehensive testing and analysis, the project will assess popular IDS solutions, considering factors such as detection accuracy, false positive rates, adaptability to evolving threats, and resource efficiency. The findings of this study will contribute valuable insights for cybersecurity practitioners, aiding them in selecting the most suitable IDS for their specific organizational needs.

Student Skills / Requirements: Basic Cybersecurity knowledge, Python or any programming language

Professor Zahid Akhtar
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Department of Network and Computer Security, College of Engineering
Assistant Professor

Project Title: Unmasking Deception: A Deepfake Detection Endeavor

This project centers on the critical issue of deepfake detection, addressing the rising threat of manipulated media content. Through an exploration of cutting-edge methodologies in artificial intelligence and machine learning, the project aims to evaluate and compare various techniques for identifying deep fake videos. The research will focus on factors such as accuracy, robustness, and efficiency in order to contribute insights into the development of more effective tools and strategies for countering the proliferation of deceptive synthetic media.

Student Skills / Requirements: Python or any programming language

Professor Margarita Orlova
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Arts and Sciences
Assistant Professor

Project Title: (1) Foraging preferences across caste and species in wild bumblebees.

This project seeks to examine the foraging habits of several wild species of bumblebees. We will focus on differences in phenology between closely related species and examine differences in nutritional preference between queens, workers and males from each species, as well as the potential changes in these preferences with the progression of the colony life cycle. To this end we will observe and collect samples of foraging bumblebees and food plants from several field sites on campus as well as from several off-campus sites (with DEC permission). We will examine the circadian nature of foraging patterns of different castes as well as the effects of weather and seasonal blooming patterns on bumblebee foraging activity.

Student Skills / Requirements: No fear of insects, absolutely no allergies to insect stings or other outdoor materials, such as pollen. Willingness and physical to work in the field for long period of time, walk long distances and carry equipment.

Professor Margarita Orlova
orlovam@sunypoly.edu
Biology, Arts and Sciences
Assistant Professor

Project Title: (2) Role of learning and experience in queen-worker communication in social insects

This project seeks to examine whether learning and memory play a part in the perception of queen pheromones in social insects and how the role of learning differs across species with different social structure. We will examine the effects of developmental conditions and neuropharmacological intervention on perception of queen signals by workers and uncover the molecular pathways responsible for this process. I plan to achieve these goals by rearing bees in manipulated environments with controlled exposure to different chemical and behavioral components, pharmacologically manipulating neural pathways responsible for learning and memory and observing the results of such manipulation on queen-worker interactions, and worker brain gene expression.

Student Skills / Requirements: No fear of insects, absolutely no allergies to insect stings or other outdoor materials, such as pollen. Willingness to work in the field and in the lab and perform physical tasks (e.g., carrying parts of hives).

Professor Andrea Dziubek
dziubea@sunypoly.edu
Mathematics and Physics/ COAS
Associate Professor

Project Title: (1) Modeling and Numerical Simulation using Geometric Mechanics and NGSolve

Methods from Differential Geometry are key in Continuum Mechanics and for Numerical Methods. We model problems from solid mechanics, fluid mechanics, and electromagnetism and write them in different notations (vector/tensor notation, differential form notation, as complexes). Then we solve those equations numerically, using NGSolve. NGSolve is a modern finite element software, which is especially useful for mixed methods. It integrates mathematical modeling, mesh generation, numerical simulation, and visualization.

Student Skills / Requirements: Calculus III, Linear Algebra, Physics, familiarity with Differential Geometry, Programming (Python), LaTeX an advantage.

Professor Daniel Jones
jonesd5@sunypoly.edu
College of Engineering
Associate Professor

Project Title: (1) Analysis of Electroencephalography (EEG) Data

EEG is used to measure and evaluate the electrical activity in the brain using electrodes placed on the scalp. We have collected EEG data from dozens of participants in the modern EEG laboratory at SUNY Poly in Utica. Signals were measured with 256 sensors at 1,000 Hz while participants viewed images and provided push-button responses. This project aims to analyze the data in order to understand the spontaneous neural activity of the brain in response to the images.

Student Skills / Requirements: General computer skills for analyzing data, Excel, experience with (or desire to learn) MATLAB and related programming environments, self-motivated, ability to work independently and in small teams.

Professor Shing Chi Leung
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Mathematics and Physics (CoAS)
Assistant Professor of Physics

Project Title: (1) Using Machine Learning in Magnetar Light Curve Classification

Magnetars are neutron stars with very strong magnetic field but their properties are poorly known due to the extreme environment. Magnetars form after the collapse of massive stars between 10 – 25 solar masses; while at the meantime, the collapse creates the supernova explosion. Astronomers found that the magnetar can continue to power the supernova explosion, making its luminosity evolution different from ordinary supernova. This project aims at studying the footprint of magnetar on the luminosity evolution. In this project the participant student will build numerical models to generate a catalogue of magnetar light curves. Then the student will build machine learning to extract features from the light curve catalogue and then apply the model to real magnetar data. This project is suitable for students who are interested at experiencing and applying machine learning in physics and want to know more about astrophysics.

Student Skills / Requirements: Numerical integration, algorithmic thinking, basic-intermediate Python or similar languages (Python preferred), conceptual understanding in basic machine learning approaches.

Professor Shing Chi Leung
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Mathematics and Physics (CoAS)
Project Title: (2) Neural Network Approach in Equation of State Computation

In astrophysics simulations especially those related to compact star, tabulated equation of state is used to describe the thermodynamics relation among variables such as pressure, density and temperature. However, the procedure involves the slow numerical interpolation and iteration for solving the highly non-linear equations for these variables. It becomes favourable to apply machine learning to resolve this bottleneck in simulations. In this project, the participating student will develop the necessary neural network model to perform the numerical task. The neural network will be responsible as the solver of the equation of state. The student will compare the neural network performance and speed compared to the traditional numerical iteration approach. This project is suitable for students who are interested at experiencing and applying machine learning in physics and want to explore computational physics.

Student Skills / Requirements: Cygwin or Linux, Numerical interpolation, algorithmic thinking, basic-intermediate Fortran (or similar language like C++) and Python, conceptual understanding in basic machine Learning Approach

Professor Shing Chi Leung
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Mathematics and Physics (CoAS)

Project Title: (3) Numerical Simulations of Massive Star and its Explosion

Recent observation of the Perseus Cluster shows that the chemical abundance does not match with canonical supernova yield model. It suggests that some stellar evolution processes are not accurate modeled and require revision. The project consists of two parts: first, students will study the evolution process by numerical simulations. The participating students will extract how stellar processes in massive stars depend on these processes. In the second half of this project, students will perform hydrodynamics simulation explode the stars and compute the nucleosynthetic yield. This project is suitable for students who are interested at applying scientific programming for research and want to explore numerical astrophysics.

Student Skills / Requirements: Cygwin or Linux, Good grasp in physics, scientific programming, algorithmic thinking, completed PHY202 or beyond, basic-intermediate Fortran, Python for visualization

Professor Shing Chi Leung
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Mathematics and Physics (CoAS)
Project Title: (4) Nuclear Matter Properties and Neutron Star Statistics

Neutron star is the end point of stars with an initial mass between 10 – 25 solar mass. It has a central density as high as 1015 g/cc, where the nuclear (strong) interactions dominate the material properties. Because of the extreme environment the detailed physics and the actual properties are not well understood and there are numerous variations of the nuclear matter equation of states. In this project, the participating student will build the automated pipeline in building the equation of state tables from given database, and then analyze the behaviour of neutron star under different equation of states. The students will analyze and classify the nuclear matter equation of state dependence of the neutron star. This project is suitable for students who are interested in computational physics and scientific writing.

Student Skills / Requirements: Good grasp in physics, scientific programming, algorithmic thinking, completed PHY202 or beyond, basic-intermediate Python

Professor Shing Chi Leung
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Mathematics and Physics (CoAS)
Project Title: (5) Numerical Models of Carbon Burning in White Dwarf

Type Ia supernova is the explosion of the carbon-oxygen white dwarf due to thermonuclear runaway. In some models, the explosion requires the detonation waves to spread across the white dwarf and consumes the fuel to release the energy. However, recent literature has suggested that the ignition can be more diversified than what is expected in canonical models. In this project, the participating student will use hydrodynamics simulation to study carbon burning in the Type Ia supernova setting. The student will simulate the detonation and its nuclear reactive processes and study its parameter dependence. The student will explore the robustness of the detonation condition and its parameter dependence. This project is suitable for students who are interested in computational physics and scientific writing.

Student Skills / Requirements: Cygwin or Linux, good grasp in physics, scientific programming, algorithmic thinking, completed PHY202 or beyond, basic-intermediate Fortran (or similar language like C++) and Python

Professor Aarthi Sekaran
sekaraa@sunypoly.edu
College of Engineering
Assistant Professor

Project Title: (1) Analysis of Dual Rotor Vertical Axis Wind Turbine for Large-scale Offshore Energy Generation

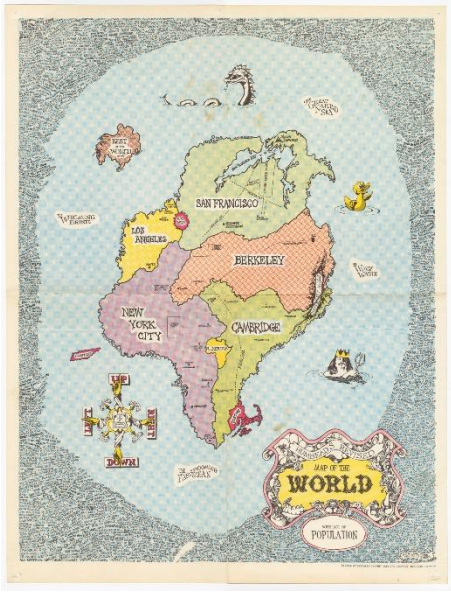
The growth of wind energy is increasing rapidly over the past few decades with offshore wind showing significantly better performance compared to other offshore renewable energy sources such as tidal, wave, or ocean thermal systems. Although horizontal axis wind turbines (HAWT) are recognized for their self-starting abilities and high tip-speed ratios, an increasing interest in vertical axis wind turbines (VAWT) is documented owing to their cost-efficiency and reduced noise levels in operation. The objective of this study is to establish a comprehensive parametric analysis of dual rotor VAWT for offshore applications. The study will be carried out via CFD simulations and matched experiments of scaled, proposed combined rotors, resolving the aerodynamic effects of wind interactions on the two vertical axis wind turbine rotors. The study will specifically investigate the performance of different blade combinations and examine the ideal spacing configuration to
(1) mitigate self-starting problem and
(2) increase the power performance versus the tip speed ratio working range. The resulting configuration will serve as a basis for designing large-scale offshore wind farms from a flow-physics based perspective.

Student Skills / Requirements: Junior or Senior ME student, Fluid Mechanics, Programming

Professor Ana Jofre
jofrea@sunypoly.edu
Department of Communications and Humanities, College of Arts and Sciences
Assistant Professor

Project Title: (1) Revising Humbead's Revised Map of the World

This work is in collaboration with Historian Michael Kramer at SUNY Brockport, who is working on assembling a digital history of the Berkeley Music Festival scene of the late 1960s. This particular project aims to breathe new life into Humbead's Revised Map of the World, created in 1968 by Earl Crabb (nicknamed "Humbead") and his close friend, the musician and poster illustrator Rick Shubb, who set out to draw a geographical representation of their cultural world. For example, the imaginary map puts the country of New York City next to the country of Los Angeles on the continent of Pangea, and sets the rest of the world on a small island. Their illustration provides a map of their cultural and social lives, and it includes an explicit list of over 1000 names (famous,



fictional, and unknown) around the margins. Our project will robustly curate the geographic and "demographic" data on the map and activate it with a set of interactive visualizations.

Student Skills / Requirements: front-end web-development skills, JavaScript, design skills

Professor Abolfazl Karimpour
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Civil Engineering/College of Engineering
Assistant Professor

Project Title: (1) Estimation of Micromobility User Origin-Destination Patterns Using Point of Interest Data

In response to the increasing prevalence of e-scooters worldwide, there is a growing imperative to comprehensively understand various facets of e-scooter trips and their implications for urban mobility. This project focuses on a specific aspect of e-scooter trips – the influence of point of interests (POIs), such as restaurants and shopping malls, on trip distribution. Through statistical modeling, we aim to estimate and analyze the trip distribution, identifying key contributing factors. Utilizing data gathered from the Yelp API, our study will provide insights into the origin-destination matrix for e-scooter trips in the city of Louisville, KY.

Student skills / requirements: Civil Engineering/Computer Science

Professor Abolfazl Karimpour
karimpa@sunypoly.edu
Civil Engineering/College of Engineering
Assistant Professor

Project Title: (2) Enhancing Truck Rest Area Efficiency through Incident-Based Data Analysis for Strategic Optimization

Distracted driving and fatigue stand as significant contributors to motorized vehicle crashes nationwide. This study aims to leverage data sourced from Wayze to optimize the strategic placement of rest areas, drawing insights from historical data. The locations of rest areas will be sourced from 511NY, while incident data will be collected through the Wayze app. The outcomes of this research hold the potential to assist State Departments of Transportation (DOT) in enhancing their ability to pinpoint optimal rest area locations, contributing to improved road safety.

Student skills / requirements: Civil Engineering/Computer Science (Knowledge of R or Python)
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Professor Yu Zhou
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Engineering/Engineering
Associate Professor

Project Title:(1) Control of Robotic Composite Prepreg Layup Process

Robotic composite prepreg layup processes use robot manipulators to pick and place prepreg plies (fabrics pre-impregnated with resins) to produce composite laminates. One major challenge is to control the robot manipulator to follow the planned path accurately and apply the layup force uniformly during the continuous layup process for each ply and each laminate and throughout the process of mass production, in order to attain consistent product quality. This summer project will explore the control of the layup trajectory and force during a robotic prepreg layup process using a Baxter robot. The tasks mainly include designing, programming, and implementing a control approach for the process, setting up and performing experiments to assess the control law, and documenting the research process and results.

Student skills / requirements: Python programming, Ubuntu OS, understanding of robot manipulator kinematics

Professor Jiayue Shen
shenj@sunypoly.edu
Engineering Technology
Assistant Professor

Project Title: (1) fabrication of a flexible pressure sensor

This project focuses on the fabrication of a flexible pressure sensor designed to detect and measure pressure variations. The sensor will be constructed using flexible materials, allowing for adaptability to curved surfaces and applications in diverse fields. The goal is to create a reliable and cost-effective flexible pressure sensor for potential integration into wearable devices, medical applications, or other contexts where conformability and sensitivity to pressure changes are essential.

Student skills / requirements: Preference will be given to students who have successfully completed either CHE110 or CHE130, the college chemistry courses.

Professor Vijaykumar Ramalingam
ramaliv@sunypoly.edu
Department of Chemistry
Assistant Professor

Project Title: Design and synthesis of Mechanically interlocked Rotaxane molecules.

Mechanically interlocking molecules (MIM) are an excellent combination of covalent and mechanical connections, as well as exhibiting distinct dynamics features. Within this molecule comprises limited molecular mobility. Rotaxanes are classified as interlocked molecules because of their constrained movements caused by the two stoppers at each terminal. Mechanically interlocked molecules are composed of linear threading molecular species and acyclic molecular component interconnected by a noncovalent link. MIM's dynamic features stem from the macrocyclic ring's ability to easily migrate from one stopper to another due to the fact that it is not covalently linked to the rod. To control molecular mobility, the functionality and polarity of the end groups, ring, and linear components can be modified. However, the focus is the synthesis of Rotaxanes. Firstly, the threading of the molecule is composed of 1,6 dibromohexane linear molecules(rod) with triphenylphosphine species stoppers at both ends. Chemical reaction between 1,6 dibromohexane and triphenylphosphine in the microwave reactor yield mono-salt and di-salt. Subsequently, macrocycliccompounds or moving species such as Cucurbit(6)uril, Beta-cyclodextrin, Crown ether, Cyclophane, and Calixarene were combined with mono-salt and triphenyl phosphine to produce Rotaxanes.

Student Skills / Requirements: General chemistry

Professor Byeongdon Oh
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College of Arts and Sciences
Assistant Professor

Project Title: Race and Class Disparities in the US COVID-19 Baby Bust and Rebound

During the COVID-19 pandemic, the US fertility rate declined, primarily influenced by foreign-born women, while US-born women experienced a notable increase in fertility rates following a slight decrease (Figure 1. Bailey et al., 2023). However, prior studies have not explored whether fertility rates vary based on women's socioeconomic backgrounds, including class and race. This study aims to investigate the intersectionality of race and class in changes in US fertility rates from 1968 to 2022, with a specific focus on the COVID-19 pandemic. One student will collaborate with the faculty member to analyze extensive datasets from the National Vital Statistics System (https://www.cdc.gov/nchs/nvss/birth_methods.htm#anchor_1551744577970) and the American Community Survey (https://www.census.gov/programs-surveys/acs). Another student will work with the faculty member to conduct an extensive literature review using AI tools (e.g., Litmaps, Elicit, and ResearchRabbit). In addition to presenting the poster at SUNY Poly, the two students will have the opportunity to apply for presenting research findings at a national conference, such as the Population Association of America 2025 annual meeting (April 9 - 12, 2025 | Washington, D.C.) (https://www.quirks.com/events/paa-2025-annual-meeting), and co-author a peer-reviewed paper.

Student Skills / Requirements: One student will be responsible for data analysis using R or STATA, while the other will conduct a literature review using AI.

Professor Asif Ahmed
ahmeda3@sunypoly.edu
Department of Engineering
Assistant Professor

Project Title: Sustainable Infrastructure Development: How to Minimize Carbon Emissions in Civil Engineering Projects

The global imperative to address climate change necessitates a paradigm shift in the way civil engineering infrastructure projects are conceived, designed, and implemented. This project aims to study the approaches that significantly reduce carbon emissions associated with such projects by adopting a comprehensive and sustainable approach. Focused on integrating cutting-edge technologies, innovative materials, and advanced construction methodologies, our initiative seeks to document the ways that minimize the environmental impact of infrastructure development while enhancing long-term resilience. By systematically analyzing the entire project life cycle of successfully implemented projects, from planning and design to construction and operation, we will pinpoint opportunities for emission reduction. Key focus would be on the Green Design Integration, Advanced Construction Technologies, Renewable Energy Integration, Smart Infrastructure Management, and Community Engagement and Education. The project will also focus on the economical viability option of sustainable infrastructure development.

Student Skills / Requirements: Dedicated Students from any discipline

Professor Shing Chi Leung
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Department of Mathematics and Physics
Assistant Professor

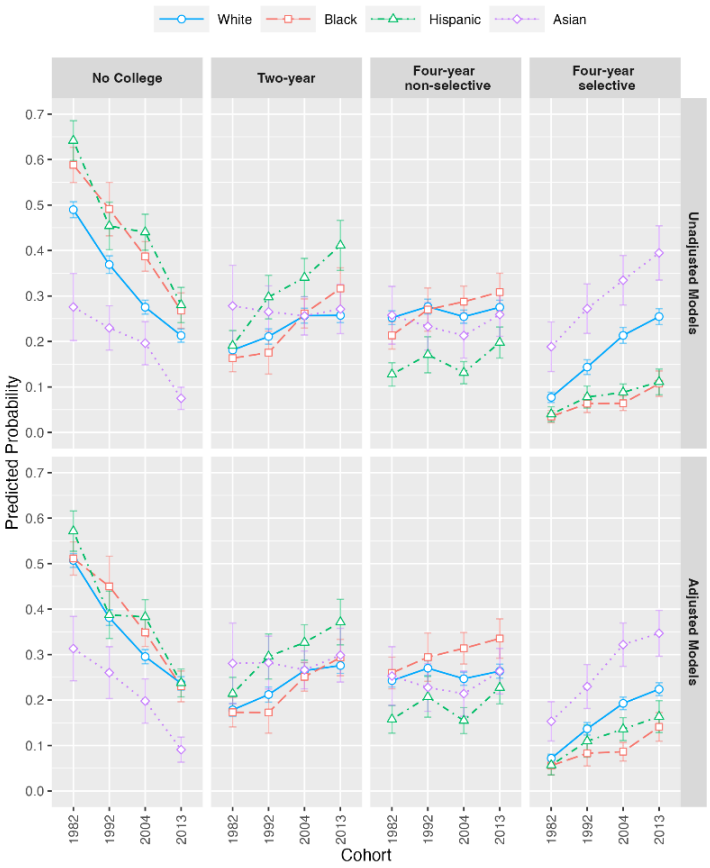
Project Title: Dynamical Simulations of Neutron Stars

Neutron star is the end point of stars with an initial mass between 10 – 25 solar mass. It has a central density as high as 1015 g/cc, where the nuclear (strong) interactions dominate the material properties. One feature of interest is the glitch event, where the rotation of a neutron star suddenly increases. In this project, the participating student will build the code to simulate dynamically how the glitch forms by considering the vortex unpinning model. The students will derive the correlations among glitch size, glitch frequency and the neutron star. This project is suitable for students who are interested in computational physics and scientific writing.

Student Skills / Requirements: Good grasp in physics, scientific programming, algorithmic thinking, completed PHY202 or beyond, basic-intermediate Python

Professor Byeongdon Oh
ohb@sunypoly.edu
College of Arts and Sciences
Assistant Professor

Project Title: The Evolution of Race, Class, and Gender Inequality in Higher Education from the 1980s through the 2020s



Recent policy changes in college admission, such as the spread of race-based affirmative action bans and the abolition of mandatory standardized testing requirements, have raised concerns about the potential increase in undesirable inequality in higher education. This project examines the evolution of race, class, and gender inequality in the US higher education system, following the findings from the faculty mentor's recently accepted peer-reviewed research on racial inequality in higher education from the 1980s through the 2010s (Figure 1). A student mentee will work with the faculty member to conduct an extensive literature review using AI tools (e.g., Litmaps, Elicit, and ResearchRabbit). In addition to presenting the poster at SUNY Poly, the student mentee will have the opportunity to apply for presenting research findings at a national conference, such as the Population Association of America 2025 annual meeting (April 9 - 12, 2025 | Washington, D.C.) (https://www.quirks.com/events/paa-2025-annual-meeting), and co-author a peer-reviewed paper.

Student Skills / Requirements: Literature review using AI (e.g., Litmaps, Elicit, ResearchRabbit, etc)

Professor Kristina Boylan
boylank@sunypoly.edu
College of Arts and Science
Associate Professor

Project Title: Creating Collaboratively Across Visual Elements: Developing Techniques for Twin-Vision Book Composition

Twin vision books have translucent pages or adhesive overlays on printed pages, to provide blind and visually-impaired readers both the book text and alt-text descriptions of images in Braille. These books afford shared reading experience among sighted and blind or visually-impaired readers, with the text and images/descriptions available simultaneously and sequentially as they read. However, these books are not widely available, with most produced only on request by publishers or subcontracted manufacturers, or by volunteer organizations that use expensive embosser printers to produce the adhesive sheets or translucent pages. Even fewer options exist for people to make their own twin-vision books, which could enhance family and classroom storytelling and narration experiences, recording and sharing self-composed personal narratives (think: family histories, travel diaries, yearbooks), academic work (e.g. nonfiction reports) and creative works (e.g. illustrated stories, comics). The CCAVA project envisions combining different composition technologies (shared documents accessible via screen, screenreader or refreshable Braille tablet, Braille translators), with experimentation to find ways to affordably and accessibly produced translucent Brailled pages, in order to produce instructions and templates for manuscript production to be shared on the project website. The student will research available resources and use their capacities with 3D asset production to find ways to produce Braille letters on translucent surfaces accessible via home, school, and local Makerspace equipment, and will assist in creating prototype manuscripts as well as instructions and templates to share the best practices with other interested authors.

Student Skills / Requirements: Comfortable with computer-assisted design, 3D printing and other 3D modeling techniques, interest in writing and illustrating (audience a/o producer), and in making content more accessible.

Professor Ana Jofre
jofrea@sunypoly.edu
Department of Communications and Humanities / College of Arts and Science
Assistant Professor

Project Title: Visual History of Progressive Education

In this project, the student will research the movement of progressive education, featuring figures such as John Dewey, Adolph Ferriere, and Ovide Decroly. The topic will cover the time period from the 1850s to the early 1960s, and the focus of this project will be on collecting photographs (of major figures, of classrooms, etc) and other imagery (such as artworks) relating to the topic. One goal for the summer will be to gather a large collection of images, tag them, and organize them. By the end of the summer, the student will create a visual essay (which doesn't need to use all the photos collected) on the history of progressive education.

Student Skills / Requirements: Humanities research skills: knowing how to use library databases, knowing how to find things google won't find.

Professor Ana Jofre
jofrea@sunypoly.edu
Department of Communications and Humanities / College of Arts and Science
Assistant Professor

Project Title: Building a content management system for the Gannett Gallery website

The goal of this project will be to build and install a custom lightweight content management system for the Gannett Gallery website with server-side javascript. Here is the website: https://gannettgallery.org/

Student Skills / Requirements: JavaScript, database management

Professor Priyangshu Sen
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College of Engineering, Electrical and Computer Engineering
Assistant Professor

Project Title: Measurement of the channel profiles and metrics to understand the THz channel propagation characteristics in the indoor environment.

To establish a reliable communication link, it is crucial to understand the channel and its propagation characteristics. At THz frequencies, channel characteristics change with minor environmental variations, making it increasingly necessary to consider them. In this project, the undergraduate student will work under the professor's supervision to measure and characterize the THz band channel properties and estimate the metrics considering the indoor environment. Week 1 - 2: The undergraduate student will undergo in-depth training in channel sounding techniques, as well as the importance of wireless channel metrics such as path loss, k-factor, delay spread, and angular spread. Week 3 - 4: The student will understand and integrate the MATLAB-based channel sounder on the THz testbed. We will also characterize the hardware frequency response, which will be used for calibration and to remove hardware dependencies from channel measurements. Week 5 - 7: The team will collect the data in different indoor environments. Week 8 - 10: The student will analyze captured data to estimate channel metrics. The results will be documented for presentation and publication in high-impact conferences or workshops.

Student Skills / Requirements: Second, third or higher year ECE student with prior experience in MATLAB, familiarity with the software-defined radio technology

Professor Priyangshu Sen
senp@sunypoly.edu
College of Engineering, Electrical and Computer Engineering
Assistant Professor

Project Title: Next-generation single-carrier waveform design for reliable link establishment at Terahertz and mmWave frequencies.

Upper mmWave and Terahertz (THz) band communication is seen as a crucial technology for next-generation communication systems (6G and beyond) to address the problem of limited bandwidth and boost data rates. However, the use of high-frequency bands presents challenges due to high path loss, small wavelength, and limitations of the underlying device technology. To establish reliable communication and pave the way for next-generation systems, innovative solutions for the physical and medium access control layers are required. Among other sections, the current research provides prime importance on developing a new waveform that can withstand THz and mmWave frequencies, enabling a reliable communication link. In this project, the undergraduate student will work on designing the next-generation single-carrier waveform under the professor's supervision. Week 1 - 2: The undergraduate student will go through intensive training in contemporary single-carrier waveform technologies as well as some innovative solutions for THz frequencies. MATLAB will be utilized as a simulation tool to observe the performance of the schemes. Week 3 - 4: The student will develop the software-defined backbone for the communication system for the THz testbed housed at the Advanced Communication Electronics and Sensing (ACES) Laboratory at the ECE department. Week 5 -

6: The student will work on the improvement of the performance of the single carrier waveform schemes through simulation. In this case, hardware and channel impairments will be considered, and mitigation techniques will be applied to improve the performance. Week 7 - 8: Student will observe the performance of the scheme on the testbed in a real environment. Week 9 - 10: Student will analyze the results and document the outcome for presentation as well as publication in a high-impact factor conference/workshop.

Student Skills / Requirements: Second, third or higher year ECE student with prior experience in MATLAB, familiarity with the software-defined radio technology

Professor Mahmoud Badr
badrm@sunypoly.edu
Network and Computer Security Department/College of Engineering
Assistant Professor

Project Title: Securing Smart Power Grids: Innovative Strategies for Detecting Electricity Theft Zero-Day Cyber Attacks

Smart power grids are vulnerable to electricity theft cyber-attacks, wherein malicious consumers hack their smart meters to downgrade the reported electricity consumption readings in order to reduce their electricity bills. This poses a serious problem, causing billions of dollars in losses to electric utility companies and degrading the performance of power grids. While existing supervised machine learning-based electricity theft detectors have proven successful against known attacks, they have failed to detect new attacks. Therefore, in this project, we will investigate innovative one-class classification approaches for detecting zero-day attacks.

Student Skills / Requirements: Python Programming, Machine Learning (preferred, but not a must)

Professor Mahmoud Badr
badrm@sunypoly.edu
Network and Computer Security Department/College of Engineering
Assistant Professor

Project Title: Privacy-Preserving Electricity Theft Detection using Federated Reinforcement Learning

Smart power grids are vulnerable to electricity theft cyber-attacks, wherein malicious consumers hack their smart meters to downgrade the reported electricity consumption readings in order to reduce their electricity bills. The existing machine learning-based electricity theft detectors suffer from suffer from high false positive rates and do not protect the consumers' privacy. Therefore, in this project, we will investigate a federated reinforcement learning (FRL)-based detector, where multiple reinforcement learning (RL) agents are deployed at multiple consumers who collaborate with the electric utility company to train a global detector depending on federated learning (FL).

Student Skills / Requirements: Python Programming, Machine Learning (preferred, but not a must)

Professor Arjun Singh
singha8@sunypoly.edu
Department of ECE, Engineering
Assistant Professor

Project Title: Characterization of a THz channel propagation through an in-house developed wireless communications testbed

Terahertz (THz) frequencies are expected to play a critical role in the next generation of wireless communications. However, on the one hand, there is a lack of technology that can operate at THz frequencies and on the other, there is a lack of characterization and modeling of the propagation of THz waves. In this project, the student will be provided with hands on training on a custom developed state-of-the-art THz testbed, and then work in a team to collect, process, and analyze datasets to measure and characterize the THz channel. The target at the culmination of the project will be to publish the findings in a high impact journal (such as IEEE transactions) or a very high impact conference (such as IEEE ICC), as a part of which the student will also be taught to write a research paper. The student will work in the research group of the professor and collaborate with other students as well as professors. The tentative plan is outlined as follows: Week 1-2: Extensive tutorial and onboarding of the hardware and its operation. Learning to utilize the testbed. Week 3-4: In-depth training on channel sounding and a refresher on MATLAB. Week 5-7: Collection of data in different scenarios (both indoor and outdoor), with different conditions (blockages, people, etc.). Processing and converting data into channel metrics (path loss, delay, K-factor). Week 7-10: Continue with processing and analysis of data, major focus on the development of the research publication.

Student Skills / Requirements: Sophomore and higher ECE students, with some prior experience in MATLAB and basic knowledge of signals and systems.

Professor Narayan Sharma
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Biology and Chemistry/ College of Arts and Sciences
Associate Professor

Project Title: Single Nucleotide polymorphism of CYP2A13 gene and it's effect on lung cancer susceptibility.

Cytochrome P40 (CYP) is a collective term that is used to describe heme containing enzymes, which catalyze the oxygenation of drugs, environmental toxicants and cancer causing compounds. CYP2A13 is a functional member of CYP2A gene subfamily of human CYP and is selectively expressed in the respiratory tract. CYP2A13 genetic polymorphism may be associated with inter individual differences in susceptibility to tobacco related cancer. The aim of this study was to identify any single nucleotide polymorphism of the CYP2A13 gene, which may change the catalytic efficiency of the corresponding enzyme product for various carcinogens including cigarette smoke. The results of this study will help us better understand why some tobacco smokers are more susceptible to lung cancers and also may help in rational designing of better drugs to cure lung cancers.

Student Skills / Requirements: 3rd -year Biology students.

Professor Arjun Singh
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Department of ECE, Engineering
Assistant Professor

Project Title: Near-Field THz Propagation modeling and antenna design

Terahertz (THz) frequencies are expected to play a critical role in the next generation of wireless communications. However, the likelihood of near-field communications renders traditional wireless communication models incorrect. As such, there is a need to develop a near-field link budget, and based on that, decide the optimal size of radiating antennas for a given distance. In this project, the student will closely work with the professor to develop and verify a near-field cognizant communication model, that can be utilized to estimate the received power in near-field settings. The student will utilize this theory to develop the design for a large near-field antenna, which, once obtained, will be utilized with the in-house developed THz testbed for experimental verification of the theory. The target at the culmination of the project will be to publish the findings in a high impact journal (such as IEEE transactions) or a very high impact conference (such as IEEE ICC), as a part of which the student will also be taught to write a research paper. The student will work in the research group of the professor and collaborate with other students as well as professors. The experimental verification onboard the testbed, being subject to the time it takes for the antenna to be delivered, is not a part of the present scope within the 10 weeks but can be continued as an RA or as a SURP project in the future. The tentative plan for the present project scope is outlined as follows: Week 1: Refresher on electromagnetic theory and wireless communication models, such as the link budget. Week 2: Extensive refresher on MATLAB. Week 3-5: Derivation of a novel near-field path loss model through Gaussian beamforming evaluation. Week 6-8: Development of optimal antenna measurements for a link up to 10m, sending the antenna design for fabrication at machine shop. Week 7-10: Major focus on the development of the research publication, while continuing with the prior tasks if pending.

Student Skills / Requirements: Junior and higher ECE students, with some prior experience in MATLAB, signals and systems, and prior knowledge of electromagnetic theory.

Professor Ahmed Abdelaal
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Department of Engineering Technology, College of Engineering
Assistant Professor

Project Title: Deicing of Wind Turbine Blades Using Thermal Heating

Ice and snow buildup on wind turbine blades can have a negative impact on energy production and may even cause damage to the wind turbine structure. To mitigate this problem, several deicing and anti-icing methods have been developed for wind turbine blades. These methods range from manual removal of ice or snow to the use of drones. This project aims to investigate the effectiveness of electrical heating in deicing the blades and to explore new methods of heating wind turbine blades as an active or passive deicing strategy. The tasks involved in this project include researching current technologies of thermally heating wind turbine blades, 3D printing of wind turbine blades, installing electrical heating elements, and conducting experiments to evaluate the proposed solutions.

Student Skills / Requirements: Thermodynamics and Fluid Mechanics, Ability to conduct lab/experimental work, proficient in using Excel.

Professor Kazi Imran
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Department of Engineering Technology
Assistant Professor

Project Title: Additive Manufacturing of Fiber Reinforced Composites

Additive manufacturing is an emerging concept which is extensively used to make prototype of complex geometry. One of the primary limitation these protype having insufficient mechanical properties. To overcome this issue fiber reinforced composite is introduced in additive manufacturing. Current technologies have significant challenges in fiber placement, sizing the fiber and optimize the process parameters. In this research main objective is to fabricate fiber reinforced polymeric composite with enhanced mechanical and electrical properties.

Student Skills / Requirements: N/A

Professor Amir Fariborz
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Department of Mathematics/Physics
Professor

Project Title: Parallel Computing in Quantum Chromodynamics

I have extensive ongoing computations in elementary particle physics in the domain of Quantum Chromodynamics (QCD). I have many codes in Maple (with number of lines in the range of 1000-5000 lines), as well as many codes in FORTRAN, but none of them are formatted for parallel computing. In this project, students who have an excellent knowledge of parallel computing, and are also familiar with computation software Maple, will parallelize some of these codes and test them for benchmark comparison with the un-parallelized versions.

Student Skills / Requirements: An excellent knowledge of parallel computing, as well as familiarity with computational software Maple (or Mathematica and/or Matlab) are required. Please do not apply for this project if you do not have these qualifications.

Professor Gunyaz Ablay
ablayg@sunypoly.edu
Department of Engineering Technology, College of Engineering
Associate Professor

Project Title: Personal carrier wheeled mobile robot design

A solution can be creating a path-finding robot that will follow the individual. A static mounted camera will be used to estimate the distance and bearing of the person of interest by tracking an article of clothing printed with QR code via OpenCV. Combining the obstacle and goal direction data, a path-finding/SLAM algorithm will be employed to direct and move the robot through terrain via a grid map.

Student Skills / Requirements: 3rd-year, 4rd-year, control design, embedded system design

Professor Zhanjie Li
liz1@sunypoly.edu
Department of Engineering
Professor

Project Title: Fire performance simulation of steel members under post-earthquake fire

We will conduct a series of pre-testing simulations of the fire response of the Cold-Formed Steel (CFS) members and components by taking into account the different post-earthquake damage levels to aid test setup. In particular, damage levels of various finish and nonstructural systems have significant impacts on the thermal behavior and load-bearing capacity of the CFS components. The parametric finite element (FE) models will range from the CFS member level to the high-fidelity component level using shell finite elements through thermal-structural analyses to understand the potential structural response, deformations, and stability during fire.

Student Skills / Requirements: Matlab, civil or Mechanical student

Professor Ahmed Abdelaal
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Department of Engineering Technology, College of Engineering
Assistant Professor

Project Title: Heated Pavements for Ice-Snow-Free Roads

Ice and snow can make driving conditions hazardous and can endanger road safety. Traditional methods of removing or melting ice and snow, such as using salt, are expensive and have harmful environmental impacts. In this study, we aim to investigate a cost-effective heated pavement system that can efficiently prevent or remove ice and snow, ensuring safer roads. Two different heated pavement systems using heated pipes and electrical heating systems will

be designed which will be attached to a conductive concrete specimen. The project will involve setting up the system, installing sensors, and analyzing the data to evaluate the effectiveness of the systems.

Student Skills / Requirements: Willingness to conduct hands on research, Excel, Basic Engineering Skills.

Professor Steve Schneider
steve@sunypoly.edu
College of Arts and Science
Professor

Project Title: Generating and Capturing Generative AI Conversations for future analysis and assessment

This project invites 2-4 students to participate on a team that seeks to (1) document how people interact with generative AI tools like ChatGPT and Bard, and (2) develop an environment that fosters systematic analysis of our interactions. In effect, we will be studying ourselves. We will archive our conversations, noting noteworthy experiences and refining methods for in-depth analysis. In addition, we will investigate the evolving landscape of tools for archiving and analysis, review relevant literature across academic and professional spheres, and assess the ethical and societal implications tied to these activities. We will draft a submission to the SUNY Poly Institutional Review Board, outlining methods for ethically collecting archives from students participating in future research projects, and implementing necessary safeguards to maintain confidentiality and anonymity, thereby laying the groundwork for responsible and insightful AI research.

Student Skills / Requirements: Interest in tools like ChatGPT and Bard to generate conversations, and willingness to extensively use ChatGPT, Bard and other generative AI tools daily. Interest in reading about and documenting artificial intelligence, and its applications in education, especially higher education. Experience in HTML, CSS and/or Javascript helpful but not necessary.