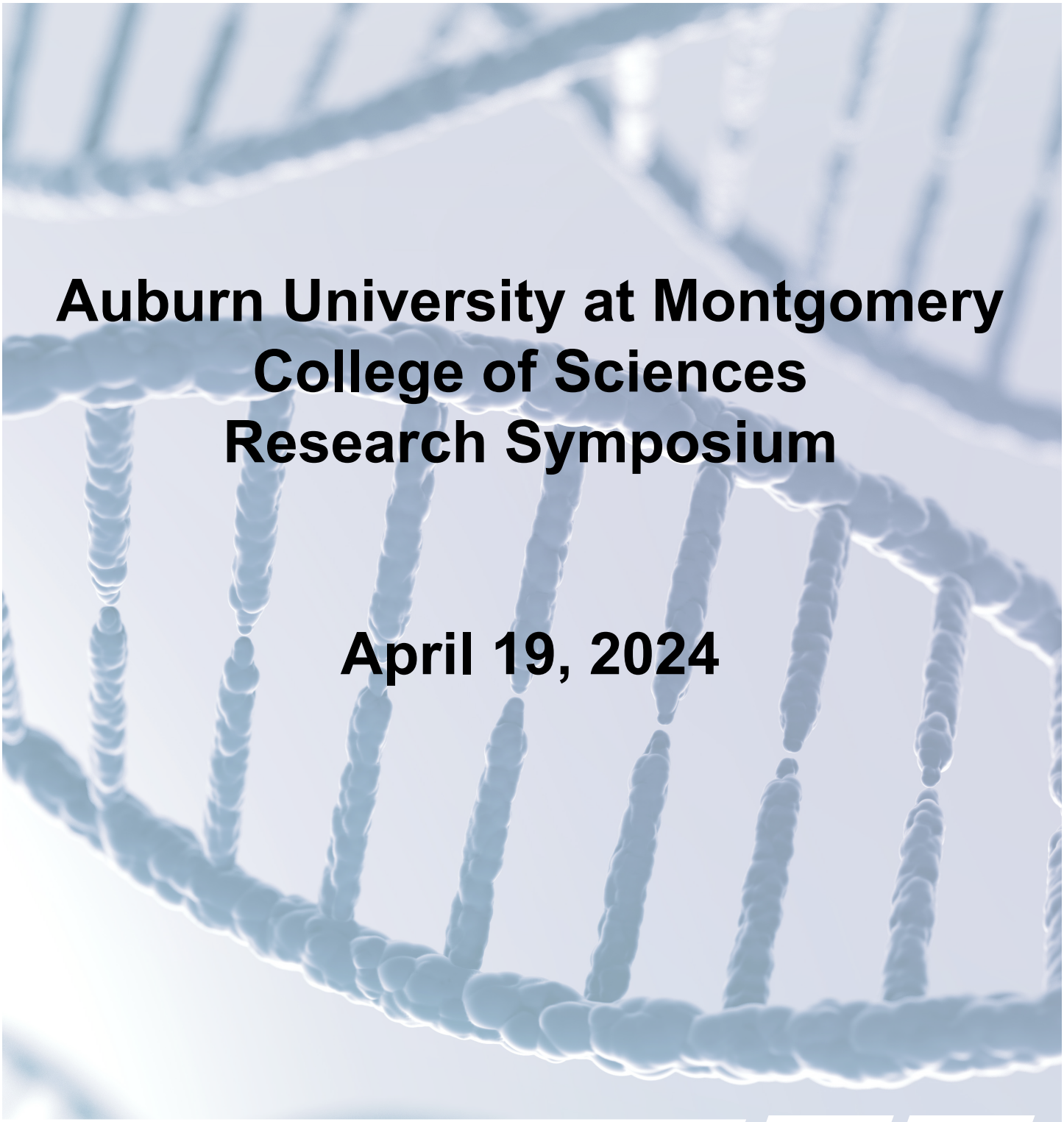


Auburn University at Montgomery
College of Sciences
Research Symposium

April 19, 2024

AUM | AUBURN UNIVERSITY AT MONTGOMERY

COLLEGE OF SCIENCES

Table of Contents

College of Sciences Dean's welcome message

I am thrilled to welcome you to the 2024 **"College of Sciences Research Symposium"** at Auburn University at Montgomery. The event name has changed, reflecting the fact that this year it is expanding to include graduate students as well as undergraduate student researchers/presenters. This continuous evolution reflects the growing importance of research and research experiences within the college and across campus, and will allow the event to continue its growth and diversity.

As we look forward to the completion of our new teaching and research building in early 2025, the College of Sciences will work even harder in the coming years to prepare our students for STEM careers in the region and across the globe. The new building, the front entrance of which is shown below, is a testament to the investment AUM is making in the sciences in the Montgomery region.

So please enjoy the posters, presentations, and atmosphere as we continue to move the college forward with student-directed research playing a leading role in this effort.

Douglas W. Leaman, PhD
Professor and Dean
College of Sciences
Auburn University at Montgomery

Keynote Speaker: Kent D. Bodily, Ph.D., BCBA, LBA

Assistant Professor of Psychology, Huntingdon College Department of Psychology and Criminal Justice
Clinical Supervisor, The Learning Tree, Inc.

Keynote Address Title:

From pigeons to people: How behavioral science informs clinical practice

Biography: Dr. Bodily credits his interest in psychology to his undergraduate training at Utah State University where he assisted with research on activity-based anorexia in rats and on the effects of scheduled reinforcement on pigeons' choices. He completed his M.S. and Ph.D. degrees in Experimental Psychology at Auburn University, where he studied the ability of pigeons to learn abstract concepts and developed virtual environment tools to investigate human spatial navigation. Dr. Bodily continued to investigate the factors that influence human spatial navigation and choice throughout his tenure at Georgia Southern University, where he managed a research lab with up to 8 active students at a time. Dr. Bodily completed the Applied Behavior Analysis postgraduate certificate program through Purdue University Global and became a Board Certified Behavior Analyst (BCBA) in 2022. He is a licensed behavior analyst in the state of Alabama (LBA). He is a fellow of the Psychonomic Society and member of the Comparative Cognition Society and Southeastern Association for Behavior Analysis. He served as the Conference Organizer for the Comparative Cognition Society and as President of the Southeastern Association for Behavior Analysis. Dr. Bodily has coauthored over 30 peer-reviewed journal articles and book chapters.

Dr. Bodily currently serves as Assistant Professor of Psychology at Huntingdon College and Clinical Supervisor of early intervention autism treatment at The Learning Tree, Inc. At The Learning Tree, Inc., Dr. Bodily has worked in the roles of Instructional Support Supervisor in Tallassee and as Clinical Director of the Montgomery clinic. He has overseen staff training, behavioral & skills assessments, and treatment plan development in residential services (11-21 years old) and in early intervention autism services (2-7 years old).

Schedule of events

Prior to 8:00 a.m. Faculty mentors supervise student poster setup.

8:00 am – 8:15 a.m.	Registration	Lobby, GH
8:15 a.m. – 8:30 a.m.	Opening Remarks – COS Dean Dr. Douglas W. Leaman	112 GH
8:30 a.m. – 10:00 a.m.	Poster Session I: Undergraduate (**odd numbered**) posters	112 GH
	Graduate posters	111 GH
10:00 a.m. – 11:40 a.m.	Oral Session I: Undergraduate	112 GH
11:50 a.m. – 12:30 p.m.	Lunch ("Welcome to Moe's!")	Lobby, GH
12:30 p.m. – 1:30 p.m.	Keynote lecture – Kent D. Bodily, Ph.D, BCBA, LBA Department of Psychology, Huntingdon College	112 GH
1:40 p.m. – 3:10 p.m.	Poster session II: Undergraduate (**even numbered**) posters	112 GH
3:20 p.m. – 4:20 p.m.	Oral Session II: Graduate	111 GH
	Undergraduate Demonstration	110 GH
4:20 p.m. – 4:30 p.m.	Break	Lobby, GH
4:30 p.m. – 5:00 p.m.	Awards Ceremony and Closing Remarks	112 GH

* All rooms are located in Goodwyn Hall

Oral presentation schedule

Oral session I (undergraduate): 10:00 a.m. – 11:40 a.m.

10:00 a.m. **Abstract U1:** Interdisciplinary Arduino Projects in Undergraduate Programming Education

Lead Presenters: Samuel Alford, Logan Davies

Other Authors: Lexi Brock, LaQuante Calloway, Larry Davis, Termerion Evans, Preston Hamilton, Duane Harris, William Judge, Jordan Julian, Imran Kochi, Matthew Middleton, Robert Mitchell, Aryan Anilkumar Patel, Donald Pearson, Omari Pinkett, Landon Sankey, Hyobeen Shin, Mostakim Sifat, Adam Sires, Sean Stanfield, Keia Strickland, Jun Thit, MOKSHITA VARMA VARADA RAJU, Divija Reddy Varkuti, Quan Vo, Christopher Williams, Dwight Williams, Goldton Williams, Kody Williams, Ryan Yang.

Mentor: Jesus Linares

Department: Computer Science and Computer Information Systems

10:20 a.m. **Abstract U2:** Structure-function Relationship of Infectious Hematopoietic Necrosis Virus Matrix (M) Protein: Elucidation of the Roles of Conserved Residues in Host Antiviral Responses

Lead Presenters: Kaleb Beasley and Lama Farris

Other Authors: Shelbi Rall, Jeffrey Ringiesn

Mentors: Douglas W. Leaman[1] and Haewon An[2]

Departments: [1]Biology and Environmental Sciences and [2]Chemistry

10:40 a.m. **Abstract U3:** How small is too small? Estimating minimum patch size for Bobwhite quail

Lead Presenter: Jacob Garrett

Mentor: Jerome Goddard II

Department: Mathematics

11:00 a.m. **Abstract U4:** The Effects of Price and Food Security on Nutritional Choices

Lead Presenters: Ay'lanna Turner and Charlesea Witherington

Other Author: Christopher Alex Ennis

Mentor: Jessica Stagner Bodily

Department: Psychology

11:20 a.m. **Abstract U5:** Enhancing Cloud Classification in Hyperspectral Imagery Through Patch-Origin Embedding and Machine Learning

Lead Presenters: Rachel Zheng, Brandon Phillip Boehm

Mentors: Hua Yan[1], Randy Russell[2], Olcay Kursun[1]

Departments: [1]Department of Computer and Computer Information Systems and [2]Department of Chemistry

Oral session II (graduate): 3:20 p.m. – 4:20 p.m.

3:20 p.m. **Abstract G1:** A Hand Gesture-Based Computer Control System

Lead Presenter: Vinay Alsa

Mentor: Tathagata Bhattacharya

Department: Computer Science and Computer Information Systems

3:40 p.m. **Abstract G2:** Secure Embedding Evaluation: Zero-Knowledge Proof Protocols for NLP Word Embeddings

Lead Presenters: Aditya Singh and Vishwajeet Jadeja

Mentors: Olcay Kursun[1] and Robert Underwood[2]

Departments: [1]Computer Science and Computer Information Systems and [2]Mathematics, Computer Science and Computer Information Systems

4:00 p.m. **Abstract G3:** KALI: A Hand Gesture-Based Approach to Control PowerPoint Presentation

Lead Presenter: Akil Kumar Vujjini

Mentor: Tathagata Bhattacharya

Department: Computer Science and Computer Information Systems

Undergraduate oral abstracts

Abstract U1

INTERDISCIPLINARY ARDUINO PROJECTS IN UNDERGRADUATE PROGRAMMING EDUCATION

Lead Presenters: Samuel Alford, Logan Davies

Other Authors: Lexi Brock, LaQuante Calloway, Larry Davis, Termerion Evans, Preston Hamilton, Duane Harris, William Judge, Jordan Julian, Imran Kochi, Matthew Middleton, Robert Mitchell, Aryan Anilkumar Patel, Donald Pearson, Omari Pinkett, Landon Sankey, Hyobeen Shin, Mostakim Sifat, Adam Sires, Sean Stanfield, Keia Strickland, Jun Thit, MOKSHITA VARMA VARADA RAJU, Divija Reddy Varkuti, Quan Vo, Christopher Williams, Dwight Williams, Goldton Williams, Kody Williams, Ryan Yang.

Mentor: Jesus Linares

Department: Computer Science and Computer Information Systems

Abstract:

This study explores the transformative impact of Arduino-based projects on undergraduate programming education and their broad spectrum of research applications. The Arduino microcontroller serves as a vital link between theoretical concepts and practical applications, a critical aspect often overlooked in traditional pedagogical approaches. By integrating Arduino-based projects into undergraduate curricula, students not only develop programming skills but also directly confront real-world challenges. These projects, spanning fields like biomedical science and sustainable agriculture, highlight the interdisciplinary potential of Arduino technology. Students undertook group research endeavors, resulting in a range of innovations, including "Helping Glasses" aiding the visually impaired, "BrainWave LCD Game" merging brainwave technology with gaming, "AI Seeds Spreader" for sustainable agriculture, “Coin sorter” for efficient currency handling, “Automatic Baby Gate” for enhanced child safety, “Baking Helper” for precise kitchen assistance, “Smart Hydrate” for personalized hydration monitoring, “Mental Health AI Supporter” for proactive mental wellness, and “Auto Volume Speaker” for dynamic audio experiences. These projects, alongside others showcased during this symposium, underscore the versatility of Arduino technology. Equipped with various sensors and actuators, Arduino projects captivate student interest and nurture a culture of innovation. Preliminary findings indicate the transformative impact of these projects, sparking students' passion for computer programming and encouraging exploration across technological and scientific domains. Further research is needed to evaluate the long-term effects of Arduino integration and to identify additional interdisciplinary research opportunities.

Abstract U2

STRUCTURE-FUNCTION RELATIONSHIP OF INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS MATRIX (M) PROTEIN: ELUCIDATION OF THE ROLES OF CONSERVED RESIDUES IN HOST ANTIVIRAL RESPONSES

Lead Presenters: Kaleb Beasley and Lama Farris

Other Authors: Shelbi Rall, Jeffrey Ringiesn

Mentors: Douglas W. Leaman[1] and Haewon An[2]

Departments: [1]Biology and Environmental Sciences and [2]Chemistry

Abstract:

Infectious Hematopoietic Necrosis Virus (IHNV) is a member of the *Rhabdoviridae* family that causes severe viral infection and disease in salmonids. During viral infection, the innate immune system is activated, including upregulation of type I interferons that mediate antiviral responses. We've shown that *Rhabdoviral* matrix protein (M) plays an important role in blocking cellular gene expression, and thus innate immune responses, by inhibiting host RNA polymerase II. IHNV M protein N-terminal deletions of greater than five amino acids (Δ5N, Δ10N, Δ20N) resulted in loss of protein stability/detection, and loss of anti-transcriptional activity. Interestingly, concomitant deletions at the C-terminus (i.e. Δ5NC, Δ10NC, Δ20NC) restored M protein detection and/or anti-transcriptional activity. We hypothesized that M half-life is regulated via an interplay the N- and C-termini such that protein ubiquitination within the C-terminus is prevented by interference by N-terminal residues that, when deleted, results in rapid protein degradation. Potential Lysine ubiquitination sites in the C-terminus were mutated to assess M protein structural stability. Point mutations of three lysines in the C-terminus (K190/193/195A) blocked M instability associated with N-terminus deletions (Δ5N and Δ10N) in a manner that was similar to that observed with the Δ5NC, Δ10NC, Δ20NC variants. These results strongly suggested that these residues are target sites for M protein ubiquitination, and thus impact M stability. Ongoing studies will assess direct ubiquitination of M on the implicated lysines. Future goals are to develop attenuated viral vaccine candidates involving targeted mutations within M to allow infected hosts to mount a better antiviral response.

Abstract U3

HOW SMALL IS TOO SMALL? ESTIMATING MINIMUM PATCH SIZE FOR BOBWHITE QUAIL

Lead Presenter: Jacob Garrett

Mentor: Jerome Goddard II

Department: Mathematics

Abstract:

Trait-mediated behavioral responses (an indirect effect) to other species can affect population dynamics significantly. One example of such a response is modification of emigration probability, which has the potential to change single species persistence, as well as interactions and community structure. Habitat loss and fragmentation due to anthropogenic activities creates landscape-level spatial heterogeneity where remnant patches are often surrounded by a hostile matrix. Matrix composition or hostility is an important component of a landscape and can have profound effects on species movement and boundary behavior, persistence of a single species, and coexistence of interacting species. In this talk, we will introduce a modeling framework to explore effects of harvesting-mediated emigration on population persistence and share some recent results.

Abstract U4

THE EFFECTS OF PRICE AND FOOD SECURITY ON NUTRITIONAL CHOICES

Lead Presenters: Ay'lanna Turner and Charlesea Witherington

Other Author: Christopher Alex Ennis

Mentor: Jessica Stagner Bodily

Department: Psychology

Abstract:

The price of food has been proposed as one mechanism for food selection, with evidence suggesting that men are more likely than women to pay a higher price when higher energy-dense foods are more expensive than lower energy-dense foods. The current research focused on whether monetary cost of food was associated with preference for foods that may be immediately reinforcing but have negative health effects in the long term. Participants were randomly placed into one of three conditions: Higher energy-dense foods priced higher than lower energy-dense foods, higher energy-dense foods priced less than lower energy-dense foods, and higher energy-dense foods priced the same as lower energy-dense foods. Via computer task, participants were presented with multiple simultaneous discriminations between two food items (one low and one high energy-dense) and allowed to select which they preferred. Following the food choice portion of the task, participants were asked to report their food security status, Body Mass Index (BMI), and their gender identification. The relationships between food choices and food price, food choices and food security, food choices and BMI, and food choices and gender identification will be discussed.

Abstract U5

ENHANCING CLOUD CLASSIFICATION IN HYPERSPECTRAL IMAGERY THROUGH PATCH-ORIGIN EMBEDDING AND MACHINE LEARNING

Lead Presenters: Rachel Zheng, Brandon Phillip Boehm

Mentors: Hua Yan[1], Randy Russell[2], Olcay Kursun[1]

Departments: [1]Department of Computer and Computer Information Systems and [2]Department of Chemistry

Abstract:

This study explores machine-learning techniques for hyperspectral cloud classification on our spectral image dataset captured by the Resonon PIKA XC2 camera, which spans 462 spectral bands. Our preliminary dataset comprises of 28 parent hyperspectral images (HSIs), each a substantial unlabelled image measuring 5000x1500 pixels. With the meteorological expertise within our project team, we hand-labeled pixels by extracting 10 to 20 sample patches from each parent image, each patch consisting of a 50x50 pixel field. This process yielded a collection of 380 patches, each categorically labeled into one of seven cloud and sky condition categories. Aiming to embed the inherent data structure while classifying individual pixels, we introduced an innovative technique to boost classification accuracy by incorporating patch-specific information directly into each pixel's feature vector. This enhancement involved calculating dense coding for patch membership and training a suite of binary classifiers—one for each bit of the dense code—resulting in an enriched 462-dimensional feature vector augmented with our embedding algorithm for patch identification. The posterior probabilities generated by these classifiers, which capture the unique attributes of each patch, were subsequently concatenated with the pixel's original spectral data to form an augmented feature vector. We then applied various machine learning algorithms to classify pixels, comparing the results with a baseline model devoid of patch-origin embedding. The results show that incorporating the spatial context along with the the spectral information inherent in hyperspectral images enhances the classification accuracy in hyperspectral cloud classification.

Undergraduate poster abstracts

Abstract U6

THE POWER OF KUDZU - IDENTIFYING SPECIFIC ROOT ENDOPHYTES TO PROMOTE CROP PRODUCTIVITY

Lead Presenter: Rachel Davenport

Other Authors: Robert W. Kiefer, Benedict C. Okeke

Mentor: Claudia Stein

Department: Biology & Environmental Sciences, College of Sciences

The invasive legume kudzu (*Pueriara montana var. lobata*) is one of the fastest growing and most noxious invasive plants in the US. The roots of legumes are associated with arbuscular mycorrhizal fungi and with rhizobia, which are nitrogen fixating bacteria located in the root nodules. Results from previous experiments indicate that these root endophytes associated with kudzu can have a growth promoting effect on some plant species, such as graminoids, while strongly suppressing the growth of other species, such as legume species native to grassland systems in Alabama. These results support the hypothesis that soil microbial effects are species specific and that different root endophytes might be at play.

We performed inoculation experiments in the greenhouse to assess the potential of specific strains of root endophytes (rhizobia and other growth promoting bacteria) isolated from kudzu to improve plant growth of different crop species. Preliminary results indicate that germination rates of crop species belonging to the poaceae increase when inoculated with a bacterial strain isolated from kudzu roots. In contrast, the isolated rhizobial strain did not affect germination rates of the legumes. Our results suggest, that specific root endophytic strains from kudzu have plant promoting properties and might be useful for the development of biofertilizers. Sustainably promoting agricultural productivity is crucial to support our growing human population. The use of biofertilizer is one practice that is more beneficial to plant and soil health compared to chemical fertilizers.

Abstract U7

MOLECULAR CHARACTERIZATION OF L-ASPARAGINASE PRODUCING MICROBES

Lead Presenter: Asya D. Davis

Other Authors: Katrina Vance, JoAnna Sheffield, Olivia Taylor, Joy Odoms, Christopher Kirk, and Andrea Barnett

Mentor: Benedict Okeke

Department: Biology and Environmental Science

Abstract:

L-asparaginase (L-Asparagine amidohydrolase, E.C. 3.5.1.1) is a biocatalyst that converts L-asparagine to aspartic acid and ammonia. L-asparaginase is a valuable enzyme used for the treatment of lymphoblastic leukemia (a type of cancer), prevention of acrylamide formation in heat processed foods and development of biosensor for asparagine. In our previous work, we demonstrated production of L-asparaginase in liquid culture by bacteria and fungi isolated from soil environments. Our present work focuses on molecular characterization of selected L-asparaginase producing bacteria and fungi using 16s ribosomal RNA gene and ITS DNA sequences, respectively. Purified PCR amplicons of 16s rRNA gene and ITS DNA were sequenced. GenBank Blast was used for homology and phylogenetic analysis. Bacterial isolate B1-6 was found to be most closely related to *Paraburkholderia caribensis* strain MNL-133 (100% homology). B1-7 is most closely related to *Pseudomonas mosselii* strain ABAP1 (99.88% homology). B1-10 was found to be related to *Priestia megaterium* strain W1156 (99.89% homology), whereas the closest match for BF1-10 was *Sporosarcina luteola* strain EB270 (99.55% homology). For our fungal isolates, F1-1 displayed 99.36% homology to *Mucor circinelloides* UWR_148. F1-7 is most closely related to *Mucor circinelloides* isolate FD (98.98 % homology), F2-3 showed 99.82 % homology to *Mucor janssenii* culture CBS:227.29. Future work will focus on cloning, expression, characterization of selected L-asparaginase genes and their potential inhibition of cell proliferation activity.

Abstract U8

THE EFFECTS OF A TOKEN ECONOMY ON IN-CLASS PARTICIPATION AMONG COLLEGE STUDENTS

Lead Presenter: Christopher Alex Ennis

Mentor: Jessica Stagner Bodily

Department: Psychology

Abstract:

Reinforcement theory states that the use of reinforcement following a behavior will increase the likelihood of that behavior occurring in the future. Positive reinforcement and token economies are a reinforcement system in which the learner earns tokens that can be traded in for desired reinforcers, are commonly used in educational settings to shape and maintain positive classroom behaviors. By the time students reach college, the type of reinforcement used by instructors is likely to be both qualitatively and quantitatively different from what students may have experienced early in their education. The current study conducted two experiments that both employed an ABAB design to examine the effect of a token economy on classroom participation. Undergraduate students enrolled in a college course at AUM were recruited as participants and were given a data sheet each day that instructed them to mark the sheet each time they participated. During "A" phases, participation was recorded. During "B" phases, participation was recorded, and participants could exchange three marks for a reward. Reward options included candy, school supplies, and various "play items." Results of the first experiment suggest that participation increased when reinforcement was available, while results of the second experiment suggest that participation did not increase when reinforcement was available. Further research is needed to determine the relationship between participation and reinforcement using rewards not related to course grades.

Abstract U9

EXPLORATION OF IMAGE PROCESSING AND COMPUTER VISON FOR RECOGNITION OF COLONIES OF COLIFORM BACTERIA IN WATER QUALITY ANALYSIS

Lead Presenters: Abria Gates, Torry Wilson

Mentors: Olcay Kursun[1] and Benedict Okeke[2]

Departments: [1]Computer and Computer Information Systems and [2]Biology and Environmental Science

Abstract:

Water pollution by pathogenic agents, notably bacteria and viruses, is a critical public health issue. The presence of Escherichia coli and other coliform bacteria in water indicates potential contamination by pathogens, as these bacteria originate from the gastrointestinal tracts of humans and animals. Coliforms are essential indicators of water quality, with contamination sources including sewage and fecal matter. Traditional methods for identifying coliform colonies on agar plates are time-consuming and costly, involving biochemical and molecular techniques. This research introduces an approach using two open-source image processing tools, ImageJ for image analysis and OpenCV for computer vision tasks, integrating machine learning (ML) and artificial intelligence (AI) techniques to streamline the analysis of E. coli and Citrobacter freundii colonies. While ImageJ assists in basic image processing and analysis, our focus on OpenCV includes exploring advanced preprocessing techniques. In this research, we used image binarization to convert images into binary images, blurring and connected component analysis to reduce noise, and the Hough Transform for circle detection. These preprocessing techniques are followed by ML classifiers such as Naive Bayes and Logistic Regression for predicting the presence of specific pathogens based on colony radii and shape descriptors. In our study, we analyzed two images, each containing multiple colonies of Escherichia coli and Citrobacter freundii. Using the two alternative methods, ImageJ and OpenCV, we detected colonies for the two distinct classes. We obtained over 90% accuracy through leave-one-out cross-validation. The proposed method is a potential rapid and cost-effective alternative for pathogen detection in water resources.

Abstract U10

SYNTHESIS AND PROPERTIES OF BIS (4-DIMETHYLAMINO)BENZOYLACETONE ETHYLENEDIIMINE AND ITS COPPER COMPLEX

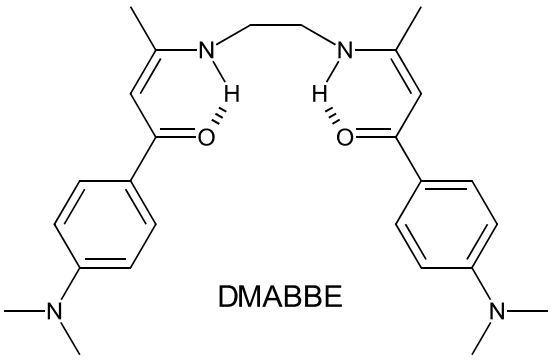
Lead Presenter: Michael Hayden

Mentor: Steven Arnold

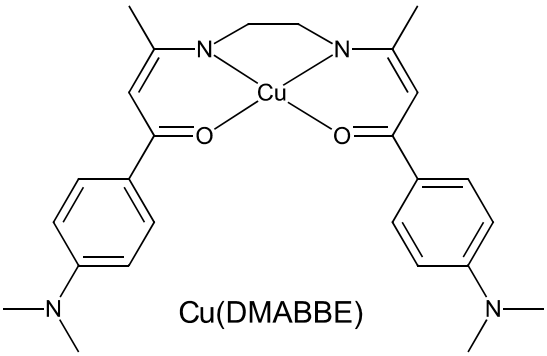
Department: Chemistry

Abstract:

Copper complexes are known to have antibiotic properties. Additionally, metal complexes of Schiff bases are known to be good catalysts. Schiff base copper complexes with high light absorptivity are under investigation for light harvesting in dyed solar cells. In this work, synthesis of bis (4-dimethylamino)benzoylacetone ethylenediimine (DMABBE) was carried out by adding a solution of ethylenediamine to a solution of 4-dimethylaminobenozylacetone. The reaction was allowed to react over 2 days. The product (DMABBE) is a light yellow solid. To our knowledge, this compound has not been synthesized previously. Identification was performed by ^{1}H and ^{13}C NMR spectroscopy. The copper complex was synthesized from Copper chloride dihydrate with DMABBE in methanol. Properties will include UV-visible spectrum and absorptivity.



DMABBE



Cu(DMABBE)

Abstract U11

OCEAN GENES: DISCOVERING THE FUNCTION OF UNKNOWN MEMBRANE TRANSPORTERS IN *RUEGERIA POMEROYI* VIA CURE

Lead Presenters: Kailey Higgins and Sarah Folmar

Other Authors: Vistoria Centurino, Alexze DeJarnett, Erin Dolan, Jerome Godwin, Julie Langdon, J. Ryan McMichael, Antonio Neal, McKenzie Powers, Madeline Kriston Shepard, Jeremy Schreier, William Schroer, J. Kyle Taylor, and Cristopher Webb

Mentors: M. Florencia Breitman[1] and Mary Ann Moran[2]

Departments: [1]Biology and Environmental Science, [2]Marine Sciences, University of Georgia

Abstract:

Carbon is the foundation of all organic molecules and plays a crucial role in climate change. Carbon can be incorporated into biomass, can be sedimented at the bottom of the ocean, or can be in the atmosphere as CO_2, making the Earth warmer along with other greenhouse gasses. Studying the oceans is crucial because that's where half of the Earth's photosynthesis happens; and in particular studying bacteria in the ocean is of extreme importance because they drive key steps in the carbon cycle. The bacteria *Ruegeria pomeroyi* is emerging as a model organism to understand carbon flux in the ocean. *Ruegeria pomeroyi* has a published genome and is easy to grow in the lab; colleges from UGA have been researching this organism from +20 years, and have developed ~4000 lines of mutants along with lab protocols for the discovery of genes that regulate metabolite uptake. In this work we describe the results of a Course-based Undergraduate Research Course that was conducting in Spring 2024 at Auburn University at Montgomery. In this study, we grew ~ 20 mutant *R. pomeroyi* bacteria that have unique disruptions in transporter genes for which the substrate taken up by the transporter is unknown, on a variety of substrates. We performed statistical tests to understand if growth was significantly different and we discussed results in light of available literature.

Abstract U12

GROUP-MEMBERSHIP EMBEDDINGS FOR ACCURATE PARKINSON'S DISEASE DETECTION FROM VOCAL BIOMARKERS

Lead Presenters: Justin Jackson, Benjermain Kim

Other Author: Dylan Hilliard

Mentor: Olcay Kursun

Department: Department of Computer and Computer Information Systems

Abstract:

Our study investigates the application of machine learning techniques for discriminating healthy individuals from those with Parkinson's Disease (PD), utilizing a dataset of biomedical voice measurements from 32 people, 24 of whom are diagnosed with PD. The dataset encompasses 195 voice recordings represented by 22 voice measures (e.g., jitter, shimmer, and formants) obtained from these subjects. A common approach with such datasets involves applying ML classifiers directly to individual recordings, often employing leave-one-group-out cross-validation to ensure that samples from the same individual are exclusively in either the training set or the test set, but not both. Alternatively, classifiers may be applied to features aggregated across an individual's voice samples (to encapsulate the variability and central tendencies of the voice measurements), utilizing statistical measures like the mean, maximum, and minimum for each feature, followed by leave-one-out cross-validation. However, these strategies fail to take full advantage of the group membership. We propose an embedding technique that incorporates the group membership for voice recordings through a classifier whose posterior probabilities serve as representations of the individual's vocal biomarkers, which are then concatenated with the original voice measures, crafting an augmented feature vector for each recording. Our findings, which extend the pioneering algorithm developed by our hyperspectral imaging group, underscore that incorporating individual-specific context significantly boosts classification accuracy. This advancement not only underscores the method's potential as a versatile tool in the telediagnosis of PD but also has potential in telemonitoring other neurological and communication disorders characterized by vocal biomarkers.

Abstract U13

DISCOVERING REPTILE AND AMPHIBIAN DIVERSITY IN AUM'S URBAN FOREST FRAGMENT: RESULTS FROM YEAR ONE OF THE AUM LONG-TERM ECOLOGICAL RESEARCH EXPERIMENT (LTERE)

Lead Presenters: J. Ryan McMichael and Lalah Shannon

Other Authors: Justin C. Bagley and Richard Chen

Mentor: M. Florencia Breitman

Department: Department of Biology and Environmental Science

Abstract:

Alabama has a rich and diverse herpetofauna with ~166 species and the highest diversity in the Southeastern Coastal Plain (SCP) biodiversity 'hotspot'. Many of these species are now threatened or endangered because of the impacts of urbanization and other human activities. Auburn University in Montgomery (AUM) is located in the city of Montgomery and has a ~250-acre secondary urban forest. Urban forests have emerged as habitats that can balance the negative effect of urbanization on diversity, and reptiles and amphibians are considered model organisms for studying ecological and evolutionary patterns, including ecosystem health and function in natural and urban areas. Here, we set out to understand the community composition of the AUM forest herpetofauna, as well as its genetic diversity under different management treatments (invasive species removal, prescribed burns, prairie habitat, and control). In this presentation, we will present the results of our first year of sampling the Long-Term Ecological Research Experiment (LTERE) studying herp diversity in the AUM forest using pit-fall trap surveys. So far, we have installed 8 functional traps in the forest and have undergo 13 periods (5 days each) of sampling. Specimens are identified, measured, and released. Our study will allow us to make recommendations regarding conservation, preservation, and management of habitats. In addition, our study allows for students and classes to work on campus on relevant ecological questions, increasing AUM student representation in science. In this work, we will present an update on the state-of-the-art of the LTERE, challenges encountered, and preliminary results.

Abstract U14

A KINEMATIC ANALYSIS OF OCTOPUS ARM SWIMMING

Lead Presenter: J. Ryan McMichael

Other Authors: Jim Barry, Joost Daniels, Kakani Katija, and Paul Roberts

Mentors: M. Florencia Breitman[1] and Christine Huffard[2]

Departments: [1] Department of Biology and Environmental Science and [2]Monterey Bay Aquarium Research Institute

Abstract:

Octopuses have a remarkable ability to manipulate their arms in essentially infinite degrees of freedom, yet culminate in a finite number of efficient, stereotyped movements honed by evolution. The locomotion and object manipulation abilities of the octopus' hydrostatic limbs are backed with incredible dexterity and range of motion, inspiring promising applications in areas such as robotics and prosthetics. Despite their widespread presence in research, little is known about the octopus' arm swimming motion, in which an octopus uses its 8 arms to execute a recovery (opening) stroke, and a power (closing) stroke to gain propulsion without using their siphon. Our study aims to provide a detailed analysis of the kinematics of octopus arm swimming from available Remotely Operated Vehicle video footage. We analyze a total of 14 videos of *Muusoctopus robustus* taken of an octopus community at the base of Davidson Seamount in Monterey Bay (CA). For this study, we quantify the duration of the recovery and power strokes of over 150 swimming cycles captured in video. A statistical comparison of individual arms and strokes were used to identify specific stereotypes in their motion. Results are discussed in light of available literature about biological efficiency of octopus arm swimming.

Abstract U15

ZERO-KNOWLEDGE PROOFS AND APPLICATIONS

Lead Presenter: Aditya Singh

Mentors: Olcay Kursun[1] and Robert Underwood[2]

Departments: [1]Computer Science and Computer Information Systems and
[2]Mathematics, Computer Science and Computer Information Systems

Abstract:

A *Zero-Knowledge Proof protocol* (ZKP) is a protocol in which a prover (Peggy) proves to a verifier (Victor) that she knows a certain piece of information without revealing any of the characteristics of the information. Thus, "zero" knowledge is revealed. A ZKP protocol satisfies two additional conditions: 1) *completeness*, i.e., if Peggy truly knows a piece of information, then Victor will be convinced of this fact, and 2) *soundness*, i.e., if Peggy does not know a piece of information, then the probability that she can convince Victor otherwise is negligible.

In this research we present a ZKP protocol that is based on the discrete exponential function defined on the group of units $U(Z_p)$ of the ring of integers modulo a large prime number p. We apply our ZKP protocol to an identification scheme due to C. P. Schnorr.

We also apply the protocol to high dimensional data inherent in the word embeddings used in Natural Language Processing.

In future research, we plan to improve the security of the identification scheme by replacing the group $U(Z_p)$ with a group of points that satisfy a Pell equation $x^2 - cy^2 = 1$ modulo a composite integer n.

Abstract U16

IDENTIFICATION OF NOVEL GENETIC MARKERS FOR THE SOUTHEASTERN AZALEA, *RHODODENDRON PRUNIFOLIUM* (ERICACEAE)

Lead Presenter: Isabella Soto

Other Author: Michael R. McKain

Mentor: Vanessa A. Koelling

Department: Biology and Environmental Science

Abstract:

The southeastern azaleas (genus *Rhododendron*, section *Pentanthera*) are a complex group of species that show evidence of rapid diversification and widespread hybridization. Species within the clade often have substantial morphological overlap but also show evidence of morphological differentiation and geographic separation along temperature gradients. To understand speciation in the southeastern azaleas, more genetic resources must be developed for phylogenetic and population genetic analyses. The objective of this study was to identify single nucleotide polymorphisms (SNPs) in *R. prunifolium* from sequence data. We isolated DNA from thirteen *R. prunifolium* individuals using a modified CTAB protocol followed by bead clean-up. We then prepared sequencing libraries for paired-end read sequencing using the Illumina method. Here we report the results of the sequence analysis and genetic marker identification.

Abstract U17

UTILIZING TRANSFORMER MODELS FOR CROSS-LINGUISTIC SENTIMENT ANALYSIS IN AFRICAN LANGUAGES

Lead Presenter: Robert Spicer

Mentor: Dr. Sutanu Bhattacharya

Department: Department of Computer Science

Abstract:

Sentiment Analysis is a crucial aspect of natural language processing (NLP) that has garnered significant research interest. However, the emphasis has predominantly been on languages with ample resources and data, leaving the study of languages with limited data, especially low-resource languages, in need of more focus. To tackle this gap, we introduce a transformer-based approach specifically designed for sentiment analysis in under-researched African languages, namely Nigerian Pidgin and Yoruba. Our method's efficacy was tested through our participation in the AfriSenti SemEval shared task 2023 competition, where our team, Bhattacharya_Lab, achieved remarkable results. We secured the top position out of 33 teams for the Monolingual Sentiment Classification in Nigerian Pidgin (Track 4) and were among the top 5 for Yoruba (Track 2). These outcomes underscore the capability of our transformer-based models to enhance sentiment analysis in languages with scarce resources. This research underscores the critical role of investigating NLP's potential in low-resource settings and the significant impact that transformer-based multilingual models can have on sentiment analysis for African languages like Nigerian Pidgin and Yoruba, highlighting the necessity for further exploration in this area.

Abstract U18

THE VALUE OF NON-EXPERT HERBARIUM COLLECTIONS FOR PROVIDING BIODIVERSITY INFORMATION

Lead Presenter: Amiya Whitson

Mentors: Vanessa A. Koelling, Claudia Stein

Department: Biology and Environmental Science

Herbaria represent important repositories of historical biodiversity information and with increasing digitization of these collections data are easily available to the global scientific community. Many herbaria are collected at smaller institutions where most specimens are collected by amateur botanists, plant enthusiasts, or students who have to complete an assignment. We predict that specimens mainly collected by non-experts will be a valuable resource to assess the distribution of nonnative and invasive plants, and thus could be used as an early warning system for invasive species in a region.

We digitized AUM's 42-year-old herbarium collection of about 1,500 specimens. The value of AUM's collection lays in the fact that 40% of the specimen were repeatedly collected from the same locality in different years, allowing us to assess changes in plant morphological traits, such as leaf size and plant height over time. About 25% of the collection consist of specimen nonnative to the southeastern US. By comparing current specimens with historical collections, we can assess changes in plant populations, track the spread of invasive species, and evaluate the impact of environmental changes on plant diversity. This information is crucial for making informed decisions for implementing effective conservation measures.

We are currently in the process of georeferencing every specimen in the herbarium and making data available via public databases. We will provide historical and geographical information about different plant species for future ecological research and contribute to our understanding of the natural world and support efforts to conserve and protect plant diversity.

Graduate oral abstracts

Abstract G1

LALITHA: A HAND GESTURE-BASED COMPUTER CONTROL SYSTEM

Lead Presenter: Vinay Alsa

Mentor: Tathagata Bhattacharya

Department: Computer Science and Computer Information Systems

Abstract:

This novel research is dedicated to creating an application called Lalitha that helps disabled people control an entire workstation only with their hand gestures. Lalitha has proved to be a great tool for providing brilliant user interaction and user satisfaction in terms of controlling the computer only with hand gestures. Especially, for people with disability, Lalitha would be an extremely useful tool. We incorporated Arduino, ultrasonic sensors, and software to create Lalitha. We tested our system with almost 300 people, and we got positive feedback about our application Lalitha. In a word, we can claim that Lalitha is simple to set up, easy to use and its performance is brilliant. We have provided all the details of this entire application in this paper. In the rapidly evolving field of human-computer interaction (HCI), Many different industries, from gaming and augmented reality to medicine and accessibility, might benefit from this interface, this research proposes using Arduino and infrared sensors to create a system that can be controlled by hand gestures, Here We use ultrasonic sensors to detect the hand gesture and measure the distance of the palm. Ultrasonic sensors work through the time-of-flight principle (ToF), Arduino is an open-source platform that provides an accessible and versatile way to create interactive electronic projects. It serves as the brain of the project. Hand gesture control provides novel approaches that increase efficiency and security in several sectors. In our project, we combine the concept of controlling PowerPoint presentations, and multimedia along with tab switching of various applications through various hand gestures. We designed Lalitha, a gesture-based recognition system that will identify gestures efficiently and control the device based on user instructions.

Abstract G2

SECURE EMBEDDING EVALUATION: ZERO-KNOWLEDGE PROOF PROTOCOLS FOR NLP WORD EMBEDDINGS

Lead Presenters: Aditya Singh and Vishwajeet Jadeja

Mentors: Olcay Kursun[1] and Robert Underwood[2]

Departments: [1]Computer Science and Computer Information Systems and [2]Mathematics, Computer Science and Computer Information Systems

Abstract:

This study presents an innovative machine learning (ML) algorithm tailored for zero-knowledge proof (ZKP) protocols, ensuring the secure evaluation of word embeddings for Natural Language Processing (NLP) tasks. Extending the applicability of ZKP protocols to high-dimensional data scenarios, our approach addresses the critical challenge of securely assessing word embeddings' quality while preserving data privacy. The protocol begins with Victor, the verifier, utilizing TF*IDF and logistic regression to determine important words representative of various contexts. Once identified, Victor securely transmits these words to Peggy, the prover, who applies Word2Vec (W2V) embeddings and masks them using the ZKP protocol. Peggy then securely transmits the masked embeddings back to Victor. Upon receiving the masked embeddings, Victor employs a Linear Support Vector Machine (SVM) to evaluate their quality. Leveraging SVM's capability for effective separation of embeddings belonging to different contexts, Victor ensures the reliability of Peggy's embeddings without compromising data privacy. Furthermore, we address the challenge of nonlinear separability in embedding space induced by the mod operation by employing polar coordinates, ensuring that the embeddings accurately capture semantic meanings even in masked vector spaces. Our proposed algorithm offers a robust and privacy-preserving method for evaluating word embeddings, facilitating secure assessments in high-dimensional spaces for NLP applications. Our experimental results demonstrate the effectiveness and applicability of our approach in preserving data privacy while ensuring the quality of word embeddings within ZKP protocols.

Abstract G3

KALI: A HAND GESTURE-BASED APPROACH TO CONTROL POWERPOINT PRESENTATION

Lead Presenter: Akil Kumar Vujjini

Mentor: Tathagata Bhattacharya

Department: Computer Science and Computer Information Systems

Abstract:

A PowerPoint presentation is an effective means of communicating information to an audience, often employing traditional tools like a mouse, keyboard, touchscreen, or pen. In contemporary times, hand gestures have emerged as a prevalent method of interacting with computer vision technology. Integrating hand gestures for task control can streamline the delivery process of PowerPoint presentations. We have developed an innovative application called KALI, which operates through hand gestures, facilitating presenters to seamlessly transition between slides, and annotate slides with drawings and erasures. By utilizing machine learning algorithms and OpenCV, we have enhanced our application to provide users with an interactive experience, aiming to simplify tasks and improve user satisfaction and usability. This paper offers a thorough examination of the current landscape of hand gesture systems tailored for PowerPoint presentations. It explores different types of hand gesture systems, detailing their respective advantages and disadvantages, and delves into the challenges hindering widespread adoption, highlighting areas requiring attention. Our research methodology involved surveying students at Auburn University at Montgomery to identify user needs. Insights gleaned from this survey have informed the development of a robust application that reduces reliance on keyboards, and clickers during classroom presentations. Furthermore, we outline plans to enhance KALI's functionality by incorporating features such as video streaming, volume control, and improved auditory elements, aiming to enhance the overall impact on users and audiences, reinforcing the utility of our gesture-based application. In summary, this paper provides a comprehensive analysis of hand gesture systems for PowerPoint presentations, offering insights into their development, usability, and potential for further improvement. Through the introduction of KALI and ongoing efforts to refine its features, we aim to transform the presentation experience, providing a more intuitive and engaging platform for presenters.

Graduate poster abstracts

Abstract G4

GANGA : A SMART BAG TRACKING SYSTEM WITH THEFT PROTECTION

Lead Presenter: Vinod Alabana

Mentor: Tathagata Bhattacharya

Department: Computer Science and Computer Information Systems

Abstract:

Travelers across various transportation sectors often face the distressing issue of luggage theft, leading to the loss of valuable possessions, including expensive items and critical documents. Recognizing the urgent need for a solution, "Ganga" steps in as a game-changer. Engineered to meet the demand for efficient baggage tracking, heightened security, and enhanced traveler convenience, this innovative solution capitalizes on the capabilities of a Raspberry Pi, crafting a holistic baggage tracking system that seamlessly integrates with the secure Blynk app. This advanced system boasts an array of key features, including real-time live location tracking, motion and tamper alerts, customizable boundary notifications, comprehensive travel history and route monitoring, and an intuitive Blynk app interface. "Ganga" incorporates a cutting-edge metal detection feature, bolstering security by effectively identifying metallic objects. The system employs essential components such as a Raspberry Pi, GSM module, GPS module, accelerometer/gyroscope sensor, and a buzzer. Cloud services play a pivotal role in enabling remote tracking, secure data storage, and convenient access via the Blynk app. "Ganga" stands as a comprehensive solution that revolutionizes the landscape of baggage security and traveler convenience.

Abstract G5

SIMPLIFYING PROTEIN STRUCTURE PREDICTION USING AN INTERACTIVE, EDUCATIONAL VISUALIZATION TOOL

Lead Presenters: Nathaniel Hughes*, Eric Graham

Mentor: Sutanu Bhattacharya

Department: Computer Science and Computer Information Systems

Abstract:

Advancements in contact map-based protein three-dimensional (3D) structure prediction are currently being driven by the evolution of deep learning algorithms. However, a current gap exists in the form of the lack of user-friendly software tools tailored for newcomers to this field. This study introduces GoFold, a novel, standalone graphical user interface (GUI) designed for beginners to perform contact map overlap (CMO) problems for better template selection. While many existing tools cater more to research needs or assume foundational knowledge, GoFold stands out by offering an intuitive, user-friendly platform with comprehensive tutorials. With its ability to visually represent the CMO problem, it allows users to input proteins in various formats and explore the CMO problem. The educational value of GoFold is demonstrated through benchmarking against the state-of-the-art contact map overlap method, map_align, using two datasets: PSICOV and CAMEO. GoFold exhibits superior performance in terms of TM-score and Z-score metrics across diverse qualities of contact maps and target difficulties. Notably, GoFold runs efficiently on personal computers without any third-party dependencies, thereby making it accessible to the general public for promoting citizen science. The tool is freely available for download for macOS, Linux, and Windows.

Abstract G6

DISHARI: A NOVEL GESTURE-BASED EDUCATIONAL APPLICATION FOR SPECIALLY CHALLENGED PEOPLE

Lead Presenter: Irshad Ali Mohammad

Mentor: Tathagata Bhattacharya

Department: Department of Computer Science and Computer Information Systems

Abstract:

This research explores the integration of advanced technologies, particularly hand gesture detection, and Generative AI, to create an inclusive educational tool called "Dishari" tailored for individuals with hearing and speech impairments. Traditional search engines often fail to address the specific needs of this speech and visually impaired demographics, leading to a gap in accessibility and inclusivity. Leveraging machine learning algorithms and computer vision technologies, Dishari interprets hand gestures captured via web cameras, translating them into sign language expressions and helping the users search for a particular keyword through the search engine. Furthermore, the incorporation of Generative AI enhances the search functionality, enabling users to input queries through both text and hand gestures. Through a comprehensive literature survey, we highlight the advancements in hand gesture recognition systems and the transformative potential of Generative AI in image and text-based search. Dishari marks a significant milestone in bridging the communication gap and fostering inclusivity by empowering individuals with hearing and speech impairments to navigate the digital landscape effectively.

Abstract G7

Effects of Ethnic Racial Identity on Resilience & Academic Engagement in Black College Students

Lead Presenter: Eryn Smith

Mentor: Clarissa J. Arms-Chavez

Department: Psychology

Abstract:

Students with exposure to Black educators may be more likely to succeed given the increased sense of belonging and representation. Research has found that perceptions of a more positive racial climate, increased support from educators, increased interracial interactions, and a stronger sense of school belonging resulted in increased levels of academic curiosity and academic persistence for young Black girls (Butler-Barnes et al., 2018). While it is difficult to be noted as a high-achieving Black student, research has found that it is achievable if they receive support and positivity from their school and administration (Butler-Barnes, et al., 2018). As research examining the effects of ERI and resilience on academic engagement has mainly focused on Black children within the K-12 system, the current study extends the findings to the higher education setting by examining the effects on college students. College educators are often not required to learn multiculturalism or diversity to teach in higher education despite it being important to understand the backgrounds of students to help better further the learning process. The current study's goal is to further the educational perspective of representation, belonging, resiliency, ethnic racial identity, and academic engagement among black college students. Results will be reported and discussed.

Abstract G8

A Survey on Retrieving Confidential Data Using Phishing Attack

Lead Presenter: Saiteja Veeramalla

Other Authors: Veeramalla, Saiteja; Tanniru, Vivek

Mentor: Tathagata Bhattacharya

Department: Computer Science and Computer Information Systems

Abstract:

Internet technology has improved the lives of individuals in a multitude of manners due to its broad use, namely social media sites and banking. Because of the advancement of Internet technologies, security threats to networks and IT infrastructure are always changing. One such serious problem is scamming, in which hackers attempt to obtain users' login information by using phony mail, bogus websites, or both. Businesses and academic organizations place high importance on developing defenses against phishing scams. Therefore, companies must place a high priority on end-user training while taking precautions against phishing dangers. In this research, we clone a popular website to place a phishing attack on a user. This paper has a high impact because we have mirrored highly secure web pages that use form validation for security. Once users come across our duplicate web page, they get fooled by the phishing portal and enter their secret information. Now the attacker uses this information to commit bigger crimes. But this paper is designed so that we can warn the world against this kind of phishing measures and save users from falling into the trap.