

ISEC 2023

13th IEEE Integrated STEM Education
Conference

Kossiakoff Center
Johns Hopkins University (Applied Physics Laboratory)
Laurel, Maryland, USA
Saturday, March 11, 2023

Program Book



Updated 3/16/23

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IEEE PCJS acknowledges Johns Hopkin University/APL, Princeton University and SEAS for their continued support towards the previous IEEE STEM Conferences.

We also appreciate very much the contributions of the volunteer reviewers, session chairs, conference staff, and “friends of the conference.” The conference benefits greatly from the gifts of your time, skills, and knowledge. We would like to acknowledge the following IEEE officers for their support of the 2023 IEEE Integrated STEM Education Conference. {[Select and Click to see current information](#)}

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CALENDAR of EVENTS – MARCH 11, 2023

- 9:00am – 9:15am - **Introduction**
- 9:15am – 9:45am - **Keynote Speaker 1 – Mr. Joseph McGettigan**
“The Need for STEM Education and What You Can Do”
Mr. Joseph McGettigan
Director, USNA STEM Center for Education and Outreach
United States Naval Academy
- 9:45am – 10:15am - **Keynote Speaker 2 – Dr. Rosalyn Hobson Hargraves**
“What we can do to promote Access, Equity, Innovation, and Excellence in Undergraduate STEM Education!”
Dr. Rosalyn Hobson Hargraves
Division Director, Division of Undergraduate Education (DUE),
Directorate for STEM Education (EDU)
National Science Foundation
- 10:15am – 10:30am **BREAK**
- 10:30am – 11:00am - **Keynote Speaker 3 – Dr. Dwight Carr**
“The importance of developing the STEM Identity of vulnerable student populations”
Dr. Dwight Carr
APL STEM Program Manager
Johns Hopkins University (Applied Physics Laboratory)
- 11:00am – 11:30am - **Keynote Speaker 4 – Dr. Dwight Carr**
“Why Public Perception Matters”
Dr. Kathleen Deloughery
Deputy, Enduring Sciences Branch
Technology Centers Division
DHS Science & Technology Directorate
Homeland Security
- 11:30am – 1:10pm - **Lunch Break / K-12 Poster Session / Exhibits / Campus Visit**
- 1:10pm – 2:40pm - **Workshop Presentations (90 min) / Parallel Sessions**
- 2:40pm – 2:50pm - **BREAK**
- 2:50pm – 5:00pm - **Full Paper Presentations / WiP Presentations / Parallel Sessions**

KEYNOTE SPEAKER

Mr. Joseph McGettigan

“The Need for STEM Education and What You Can Do”



Joe McGettigan retired from active duty in 2009 and has served as the Director of the US Naval Academy STEM Center for Education and Outreach since 2020. He was raised in Pennsauken New Jersey and attended the US Naval Academy with the class of 1980 graduating with a Bachelor's degree in Naval Architecture. His shipboard assignments were aboard the USS Miller (FF-1091) where he served as the Anti-submarine Warfare Officer and the Auxiliaries and Electrical Officer, and the USS Belleau Wood (LHA-3) where he served as the Combat Systems Officer. He is a qualified Surface Warfare Officer and a qualified Engineering Duty Officer. His Shore assignments included Puget Sound Naval

Shipyard, Officer in Charge of Mobile Technical Unit Fifteen, Naval Undersea Warfare Center, and numerous positions at Naval Sea Systems Command. His major acquisition assignments included Program Manager for the Advanced Combat Direction System and he served as the Program Manager for AEGIS foreign military sales managing sales with Japan, Spain, Norway, South Korea and Australia. He commanded the Surface Combat Systems Center in Wallops Island, VA, the Naval Surface Warfare Center in Dahlgren, VA, and was the Director of the Engineering and Weapons Division at the US Naval Academy. He retired after 30 years of service in 2009. Following his Military career, he became a Director for BAE Systems and then came back to Government service as a Division Director at Naval Sea Systems Command overseeing the Navy's technical authority. In 2012 he accepted a position as a Senior Vice President with Kratos Defense. He holds a Master's Degree from the Naval Postgraduate school in Undersea Warfare Technology and a Master's Degree from the Naval War College in National Security and Strategic Affairs.

At the USNA STEM Center we execute various outreach programs for students from K-12 as well as their teachers in an effort to get more of today's youth interested in pursuing engineering and science degrees in college. It has been recognized for many years now that there are not enough people with technical degrees to fill all of the positions that DoD has requiring those degrees.

KEYNOTE SPEAKER

Dr. Rosalyn Hobson Hargraves

“What we can do to promote Access, Equity, Innovation, and Excellence in Undergraduate STEM Education!”



Dr. Rosalyn (Roz) Hobson Hargraves is Division Director for the Division of Undergraduate Education (DUE). The Division of Undergraduate Education, in the NSF Directorate for Education and Human Resources, strengthens STEM education at two- and four-year colleges and universities. Dr. Hargraves is a Professor of Electrical and Computer Engineering at Virginia Commonwealth University and previously served as an Intermittent Expert for NSF's Directorate for Education and Human Resources. She began her term as NSF division director for DUE on August 1, 2021.

In addition to STEM education, Dr. Hargraves' research interests also include diversity, equity, and inclusion in higher education, machine learning, biomedical signal and image processing, and the role of science and technology in international development. Dr. Hargraves received her Bachelor's, Master's, and Doctorate degrees in Electrical Engineering from the University of Virginia. During her 25 years at Virginia Commonwealth University (VCU), Dr. Hargraves co-founded the VCU College of Engineering Department of Electrical Engineering, and has served in numerous leadership roles, including Associate Vice President for Inclusive Excellence, the Director of the Virginia Commonwealth University - University of KwaZulu Natal International Partnership, Associate Dean in the College of Engineering, and Interim Co-chair in the School of Education Department of Teaching and Learning.

Dr. Hargraves has published over sixty peer reviewed conference and journal publications, been awarded two patents, given over 60 lectures/seminars domestically and internationally and served on expert panels across the United States. She has consulted with private industry in the area of machine learning and co-founded a start-up, SPT (Signal Processing Technologies), based upon her research in biomedical image processing. She has been awarded sponsored research grants as PI, co-PI, or senior personnel totaling over \$25 M from federal, state, foundation, and industrial sources primarily in the area of STEM education and training. Throughout her career she has served on over 80 review committees, conference organizing committees, professional,

university, school and department committees. Her professional service has included membership on two National Academies Committees, and she currently is elected to serve on the American Council on Education Council of Fellows board, the Bon Secours Richmond Health System Board, and as a Richmond Memorial Health Foundation Trustee.

Dr. Hargraves has been recognized nationally for her mentoring, teaching, leadership, and diversity initiatives. From 2019-2020 she was one of 38 academic leaders selected for the nationally renowned American Council on Education (ACE) Fellowship, the premier comprehensive leadership development program in American higher education. In 2003-2004 she served as an American Association for the Advancement of Science Diplomacy Fellow at the U.S. Agency for International Development (2003-2004). Among her numerous awards, she received the 2018 National Association for Ethnic Studies Robert L. Perry Mentoring Award and 2006 Dr. Hargraves was named Engineer of the Year by the Richmond Joint Engineers Council.

KEYNOTE SPEAKER

Dr. Dwight Carr

“The importance of developing the STEM Identity of vulnerable student populations”



In 2011, to address our nation’s critical challenge of creating a workforce educated and trained in science, technology, engineering, and mathematics (STEM), APL launched a STEM Program Management Office to help inspire, engage, and educate the next generation of STEM professionals. Led by Program Manager Dwight Carr, Ed. D., APL’s STEM efforts are concentrated on providing students, parents, and teachers with substantial involvement with STEM professionals and the work they do. With APL since 2003, Carr has held successive technical positions as an electrical engineer, lead engineer, and project manager. Before joining APL, he was instrumental in establishing a manufacturing laboratory for the Gene Logic Genomics Corporation and served as a research fellow for the National Institutes of Health. Carr holds a doctorate degree in education and a

master’s degree in electrical and computer engineering, both from The Johns Hopkins University, and received his undergraduate degree in biology from Howard University, where he was a member of the National Golden Key Honor Society and the Beta Kappa Chi Honor Society.

KEYNOTE SPEAKER

Dr. Kathleen Deloughery

“The Why Public Perception Matters”



Dr. Kathleen Deloughery is the Deputy for the Enduring Sciences Branch in the Technology Center Division at the DHS Science & Technology Directorate. In this role, she is responsible for overseeing a set of interrelated research activities across the Social Sciences Technology Center and the Hazard Awareness and Characterization Technology Center. These Technology Centers provide subject matter expertise and foundational research in the life, physical, and social sciences to support and strengthen preparedness and prevention of communities for current, future, and emerging disasters, threats, risks, or incidents, and improve their capabilities for effective mitigation, response, and recovery from such events. Dr. Deloughery analyzes and manages the personnel and funding resources of these Technology Centers and will

identify and resolve unique issues related to those needs. Dr. Deloughery also serves as a subject matter expert on research efforts related to terrorism prevention, evaluation, and technology adoption.

AWARDS CEREMONY

H. ROBERT (BOB) SCHROEDER BEST PAPER AWARD

Bob Schroeder, a life-long resident of the Trenton, NJ area, was a founding member of the Princeton / Central Jersey Chapter of the IEEE Education Society, serving as its inaugural chair. He retired as the communications and warning officer for the New Jersey Office of Emergency Management, New Jersey State Police, and led a technology consulting company, Adro!t. The Best Paper Award is given in his memory to honor his devotion to and expertise in technical writing and engineering education as well as his service to the conference.

DAVID SOLL AWARD

David Soll, a member and a leader in many different positions of the Princeton / Central Jersey Section. His engagement in the memberships by reaching out to the schools and universities in the section to support their programs and provide guidance in the technology. Dave had ideas to improve the section and then went about working to make the changes happen. He was a patient leader who helped to train the new volunteers on how to get the best out themselves in their chapter or society.

2023 BEST PAPER AWARD – FULL PAPER

1st Place

“Adapting Cybersecurity Teacher Training Camp to Virtual Learning”

Joshua Maddy, Eric M Dillon and Husnu S Narman (Marshall University, USA)

2nd Place

“An Immersive Curriculum to Develop Computational Science and Research Skills in a Cohort-Based Internship Program”

Erik Johnson, Marisel Villafaña-Delgado, Danilo Symonette, Katherine-Ann Carr, Marisa Hughes, Julie Burroughs, Sydney Floryanzia and Martha Cervantes (JHU/APL, USA); William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)

3rd Place

“Multi-Lingual DALL-E Storytime”

Noga Mudrik (Johns Hopkins University, USA); Adam Charles (The Johns Hopkins University, USA)

2023 BEST PAPER AWARD WINNER – WORKING IN PROGRESS

1st Place

“Adjustable Platform for Exploring Soft Robotic Gripper Design”

Janelle P Clark (University of Massachusetts Lowell, USA); Emily LaBelle and Domenic Carrillo (UMass Lowell, USA); Holly Yanco (University of Massachusetts Lowell, USA)

2nd Place

“Developing Mini VR Game Engines as an Engaging Learning Method for Digital Arts & Science”

Angelos Barmpoutis, Wenbin Guo and Ines Said (University of Florida, USA)

3rd Place

“Competencies assessment: indicators for a covariance structural model for STEM”

Leopoldo Julian Lechuga Lopez (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico); Olga Lopez (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico)

Honorable Mention

“A3Sat: Using CubeSat Emulators to Broaden Advanced Participation in STEM Education”

John D Moore (Institute for Earth Observations, USA & NASA GLOBE Mission Earth, USA); Maxwell Friedman and Sriram Elango (Institute for Earth Observations, USA); Jin Kang (United States Naval Academy, USA); Christine Maceo (USNA, USA)

2022 David Soll Memorial Award – SPONSOR POSTER

“Using Social Media to Predict Stock Market Prices”

Samuel T. Ghezze (JHU APL, USA); Alexdru Cara (JHU APL, USA); Nicholas P. Farber (JHU APL, USA)

2022 BEST PAPER AWARD WINNER – FULL PAPER

1st Place

“An Interdisciplinary Approach to High School Curriculum Development: Swarming Powered by Neuroscience”

Elise Buckley (Johns Hopkins University Applied Physics Laboratory, USA); Joseph D. Monaco (Johns Hopkins University School of Medicine, USA); Kechen Zhang (Johns Hopkins University, USA); Kevin Schultz (JHU/APL, USA); Robert W. Chalmers and Armin Hadzic (Johns Hopkins University Applied Physics Laboratory, USA); Grace M. Hwang (Johns Hopkins Applied Physics Laboratory & National Science Foundation, USA); M. Dwight Carr (Johns Hopkins University Applied Physics Laboratory, USA)

2nd Place

“Adapting a STEM Robotics Program to the Covid-19 Pandemic - a Validation of the Proposal Presented at ISEC in 2021”

Neville E. Jacobs (IEEE Baltimore Section, USA); Eric V Sudano (Eric V. Sudano System Solutions LLC, USA)

2nd Place

“Developing Surveillance Applications with Raspberry Pi, Django, and Cloud Services”

Ravi Rao (Fairleigh Dickinson University)

3rd Place

“Integrating Animation and Game-making in Teaching JavaScript”

Shuting Xu, Shuhua Lai and Lissa Pollacia (Georgia Gwinnett College, USA)

2022 BEST PAPER AWARD WINNER – WORKING IN PROGRESS

1st Place

“Towards the Effective Selection of Guest Speakers within an Introductory Electrical and Computer Engineering Course”

Henry Griffith (University of Texas at San Antonio, USA); Jonathan Flores and Ashley Larweck (The University of Texas at San Antonio, USA)

2nd Place

“Physical Meaning of Digital Signal Processing: What Students May Think and What They Really Should Know”

Konstantin A. Grebenyuk (Saratov State University, Russia)

3rd Place

“Engineering Project Activities Designed to Promote STEM Engagement”

Zachary Dickinson, Tyler Seelnacht and Ramakrishnan Sundaram (Gannon University, USA)

2022 POSTER MENTION

EDIS #	Title	Authors with affiliation and country
Advanced, College Level		
1570789867	Using Machine Learning to Identify Gender Bias in Screenplays	Faith Comising, Hanna E Wosenu, Jason H Kang and Irene Shijo (Johns Hopkins University Applied Physics Laboratory, USA)
1570789212	Data Science and Analytics for Esports	Arjun Agrawal (Peddie School, USA)
1570789105	Facial Recognition for Deepfake Detection	Firaol Desta (JHU/APL Intern, USA); Emily J Brown (& Johns Hopkins Applied Physics Lab, USA)
1570789855	Using Social Media to Predict Stock Market Prices	Samuel T. Ghezae (& Johns Hopkins Applied Physics Laboratory, USA); Alexandru Cara (& John Hopkins Applied Physics Laboratory, USA); Nicholas P Farber (& Johns Hopkins Applied Physics Laboratory, USA)
1570790897	Dynamic Fused Deposition Modeling for Rapid Development of Aerial Swarms	Ryan A Ellis (Johns Hopkins Applied Physics Laboratory, USA)
1570788905	Detecting Anomalies in IoT Device Communication Based on MUD Profiles With Zeek and Python	Rohan Nunugonda (Peddie School & Carnegie Mellon University CyLab, USA); Vyas Sekar (Carnegie Mellon University, USA)
1570787929	Determining a Correlation Between Common Skin Conditions and Anxiety	Janice Chao (High Technology High School, USA); Ching-yu Huang (Kean University, USA)
1570787241	Fueling the Future: A Study of Nuclear Fusion Reactors and Their Modern Capabilities	Suzanne Keilson (Loyola University Maryland, USA); Dahlia Shafiq (River Hill High School, USA)
1570788910	Project NARWHAL (Nautical Autonomous Robot for Wire Hunting through Analysis and Localization) Poster Abstract	Thomas Edwards (Johns Hopkins University Applied Physics Laboratory, USA)
1570787662	A Quantum Optimization Algorithm for Single Machine Total Weighted Tardiness Minimization	Youhao S. Wang (Union County Magnet High School, USA); Julian Cheng (University of British Columbia, Canada)

2022 POSTER MENTION CONTINUE

EDIS #	Title	Authors with affiliation and country
Biology		
1570787567	Using Computational Methods to Identify Small Molecules for Cancer Immunotherapy	Nicole Liang (USA)
1570787904	Analyzing the environmental effect of Chlorophyta using Convolutional Neural Network	Heyu Li (PRISMS, USA)
1570788206	Visualizing Territorial Overlap of New Jersey Grapevines and Spotted Lanternflies using GIS	Sreya Jonnalagadda (Princeton International School of Mathematics and Science, USA)
1570788547	Creating an app using AI to analyze eye movements to screen for Neurological Disorders	Srihithaa Vaidya (USA)
1570789165	Darwin's Finches Population - Will it Thrive or Dwindle under Climate Change?	Kavin S Sankar (Enloe High School, USA)
Chemistry		
1570787930	Reducing Plastic Consumption with Molecular Gastronomy	Shreya Dutt (MCVTS, USA)
Computer Science		
1570787658	Tactic classification of broadcast soccer videos by using AI	Jioh In (Princeton International School of Mathematics and Science)
1570787671	Coding Classical Logic Gates on the D-Wave Quantum Annealer	Naren K Sathishkumar (American High School, USA)

2022 POSTER MENTION CONTINUE

EDIS #	Title	Authors with affiliation and country
Engineering		
1570788847	Automatic Clothes Finder for the Colorblind	Bao T To (Peddie School, USA)
1570788946	ATmega328P-Based Portable Heartrate Monitoring System That Can Transmit SMS Messages in Case of a Cardiac Arrest	Eugene John (Korea (South)); Joseph Matthew Y. Espinas and Ramon Carmelo Y. Calimbahin (Philippines); Randy O. Zebroff (Canada)
1570790704	Developing a Noise Canceling Device for Ranged Sound Suppression	Jason J Lai and Joseph Townsend (Gwinnett School of Math, Science, and Technology, USA)
Math		
1570789490	Non-existence of the Algorithm that can Obtain the Optimal Solution for a Few Given Options of Investment in Constructive Mathematics	Jiahong Toby Sun (USA)
Physics		
1570789192	Modeling Historical Devices Using Computer Aided Design (CAD)	Vanisha S Nagali (Allentown High School, USA); Rohan Deb (Hillsborough High School, USA)
Science, Middle School, Elementary School Level		
1570788942	Minimizing Weight in High Performing Gaming Mice	Judah Lerman (Community Park Elementary School, Princeton NJ, USA)

2022 POSTER MENTION CONTINUE

DAVID SOLL MEMORIAL AWARD

EDIS #	Title	Authors with affiliation and country
1570789855	Using Social Media to Predict Stock Market Prices	Samuel T. Ghezze (& Johns Hopkins Applied Physics Laboratory, USA); Alexandru Cara (& John Hopkins Applied Physics Laboratory, USA); Nicholas P Farber (& Johns Hopkins Applied Physics Laboratory, USA)
1570787241	Fueling the Future: A Study of Nuclear Fusion Reactors and Their Modern Capabilities	Suzanne Keilson (Loyola University Maryland, USA); Dahlia Shafiq (River Hill High School, USA)
1570789867	Using Machine Learning to Identify Gender Bias in Screenplays	Faith Comising, Hanna E Wosenu, Jason H Kang and Irene Shijo (Johns Hopkins University Applied Physics Laboratory, USA)
1570788905	Detecting Anomalies in IoT Device Communication Based on MUD Profiles With Zeek and Python	Rohan Nunugonda (Peddie School & Carnegie Mellon University CyLab, USA); Vyas Sekar (Carnegie Mellon University, USA)
1570788910	Project NARWHAL (Nautical Autonomous Robot for Wire Hunting through Analysis and Localization) Poster Abstract	Thomas Edwards (Johns Hopkins University Applied Physics Laboratory, USA)
1570787929	Determining a Correlation Between Common Skin Conditions and Anxiety	Janice Chao (High Technology High School, USA); Ching-yu Huang (Kean University, USA)
1570789212	Data Science and Analytics for Esports	Arjun Agrawal (Peddie School, USA)
1570790897	Dynamic Fused Deposition Modeling for Rapid Development of Aerial Swarms	Ryan A Ellis (Johns Hopkins Applied Physics Laboratory, USA)
1570789105	Facial Recognition for Deepfake Detection	Firaol Desta (JHU/APL Intern, USA); Emily J Brown (& Johns Hopkins Applied Physics Lab, USA)
1570787662	A Quantum Optimization Algorithm for Single Machine Total Weighted Tardiness Minimization	Youhao S. Wang (Union County Magnet High School, USA); Julian Cheng (University of British Columbia, Canada)

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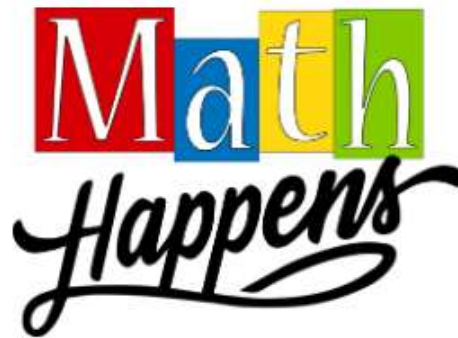
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Ralph Tillinghast	US Army & CCDC Armaments Center
James Whitehair	Laing Middle School of Science and Technology
Wei-Hsing Wang	Princeton International School of Mathematics and Science

EDIS #: 1570873028	Title: Engineering Simulations through a Language Lens
Author(s) with affiliation and country: Lauren Mauel (UW System, USA); Cody Steuck (Wausau Coated Products, USA)	
Abstract: This workshop will explain ways for schools and teachers to provide engineering education to students through the lens of language. In K12 schools, many English Language Learners lose out on opportunities to learn to engineer. Since there are 5.1 million English Language Learners in the United States, and this number is projected to grow, we hope that schools find use in our immersive workshop experience. Integrated STEM (I-STEM) opportunities should be equitable, but in today's world, the doors to I-STEM opportunities quickly close for children who perform below their grade level in mathematics and science. This curriculum aims to provide teachers with entry points and lessons for all students to experience engineering. I-STEM should not be available for only a select few within our school systems; the opportunity to benefit from an integrative experience must be accessible to all students. With accessibility comes the chance to improve academic and employment success. Even if students require language intervention, academic support, or behavioral assistance, there is room for every student in the I-STEM arena. By focusing on culture, we strive to create more dynamic and equitable paths for student engagement within I-STEM. According to research, African American and Latino populations are attracted to STEM when the work's main purpose is to enhance the common good. Without a focus on creating a better world, African American and Latino populations could lose interest in STEM activities. At the same time, research shows that STEM careers are viable and lucrative options for disadvantaged students (Rozek et al., 2019, p. 1553). According to the US News and World Report, STEM careers exceed non-STEM careers by \$8.50 per hour (Hansen, 2017). For many students, however, a bigger paycheck and increased job security may not be appealing enough. Students require a higher purpose to drive their interest in technical STEM fields. RESEARCH QUESTIONS 1) What experiences inspire students to pursue STEM careers? 2) How do students "see themselves" as engineers through the art of simulation? We will discuss how schools can use the K 12 Engineering simulation for many CCSS applications, including Writing and Geometry Standards. This was written through the lens of an Engineer.	
EDIS #: 1570877902	Title: Digital Ethics in a Global Learning Society
Author(s) with affiliation and country: Donna Schaeffer (Marymount University, USA)	
Abstract: This facilitated discussion session focuses on enabling students to present learning accomplishments through e-portfolios navigating through a three-way intersection of what is morally acceptable, legal, and within social mores that comprise "Digital Ethics." The intersection of morals, law, and society is made even complex when it is located in a global context. As many pundits envision a future of work and life for our students that is global, we must prepare them to work in a digital ethical manner. For example, in an e-portfolio about a study abroad class, it is possible to include photos of street vendors taken with one's mobile phone. It is likely legal to take photos in a public place. But wouldn't it be impressive if the photos were accompanied by a sentence or two where the student explains "I was at the XYZ street market in City 1, and I asked Vendor abc if I could share his/her photo with my classmates and teacher in my e-portfolio about this trip. He/she agreed."? This brief example covers the technology, legal, and social aspects of digital ethics. In today's global digital society, ethical behavior is paramount. After a short presentation on digital ethics and international laws regarding materials that students may place in e-portfolios, the session will move to a co-operative attempt at brainstorming best practices for designing clear requirements for what may be included in e-portfolios and identifying resources to help students make good decisions. A goal includes creating a compliance checklist for instructors and students. A compliance checklist can be a subject of future research on its efficacy	

EDIS #: 1570877903	Title: Digital Ethics and e-Portfolios
Author(s) with affiliation and country: Donna Schaeffer (Marymount University, USA); Patrick Olson (National University, USA)	
Abstract: This facilitated discussion session focuses on enabling students to present learning accomplishments through e-portfolios navigating through a three-way intersection of what is morally acceptable, legal, and within social mores that comprise "Digital Ethics." The intersection of morals, law, and society is made even complex when it is located in a global context. As many pundits envision a future of work and life for our students that is global, we must prepare them to work in a digital ethical manner. For example, in an e-portfolio about a study abroad class, it is possible to include photos of street vendors taken with one's mobile phone. It is likely legal to take photos in a public place. But wouldn't it be impressive if the photos were accompanied by a sentence or two where the student explains "I was at the XYZ street market in City 1, and I asked Vendor abc if I could share his/her photo with my classmates and teacher in my e-portfolio about this trip. He/she agreed."? This brief example covers the technology, legal, and social aspects of digital ethics. In today's global digital society, ethical behavior is paramount. After a short presentation on digital ethics and international laws regarding materials that students may place in e-portfolios, the session will move to a co-operative attempt at brainstorming best practices for designing clear requirements for what may be included in e-portfolios and identifying resources to help students make good decisions. A goal includes creating a compliance checklist for instructors and students. A compliance checklist can be a subject of future research on its efficacy	
EDIS #: 1570878819	Title: Design and Testing of Dielectric Barrier Discharge Torches for Wound Healing and Sterilization
Author(s) with affiliation and country: Krishnaveni Parvataneni (BASIS Independent Silicon Valley, USA)	
Abstract: Due to their low temperatures, non-thermal dielectric barrier discharge (DBD) plasma jets are frequently used for medical applications. One prominent application involves rapid wound healing/sterilization that is achieved by exposing the wound surface to an impinging DBD plasma jet. Research efforts at San Jose State University involve the design and testing of such DBD plasma jet devices including single-electrode, multi-electrode, and variable electrode torches, multi-facet plasma torches, and DBD plasma sheet torches. All these torches were designed, tested, and characterized with the applied voltages (10-20 kV, 10-50 kHz) with helium, argon, or nitrogen as working the working gas. Experimental results have been widely published in various conferences (International Conference on Plasma Medicine 2022, 2021, IEEE, Bay Area Biomedical conference, NCUR, SCCUR). The research was focused on characterizing the plasma jets (Measurements of plasma jet lengths, plasma input power, plasma jet temperatures - gas, vibrational, rotational, and electronic) by using spectroscopy, SpecAir, and simple k-type thermocouples. The impact of adding oxygen and nitrogen in the main gas (helium or argon) on various oxygen and nitrogen (ORS and NRS) radicals were also investigated by applying spectroscopy at different operating conditions. It is widely accepted that ORS and NRS play a vital role in the wound-healing process. For this purpose, additional experiments (TALIF) were performed in Princeton labs to estimate the relative concentration of atomic oxygen at various operating conditions. Over time, a wealth of practical knowledge has been accumulated on various aspects of plasma torch design, characterization, and applications in mitigating bacteria (I have been working as a research intern on this project since 2021). The proposed workshop will present this research experience by educating new students who intend to join the plasma community later on in their research carrier. The workshop will include the following: Introduction to plasma and types of plasmas Nonthermal DBD plasma jets and their applications in the medical field Design of DBD plasma torches Characterization of plasma jets (Plasma input power, plasma gas temperatures)	

Spectroscopy to identify various plasma species at various operating conditions.
 Spectroscopy and SPECAIR to estimate rotational, vibrational, and excitation temperatures
 Protocol to grow E-Coli bacteria
 Bacteria mitigation results
 The workshop will include the following:
 Visual inspection of various kinds of DBD plasma torches (will be brought for this workshop)
 Multiple PowerPoint presentations describing gas temperature measurements, Spectroscopy, power measurements, SPECAIR based information on vibrational, rotational, and excitation temperatures
 Movies for plasma jet operations (on blood drop and Patri E-Coli dishes)
 References
 Prerequisites:
 Preliminary Physics Knowledge
 No previous plasma knowledge is required
 Work Collaboration and Research Venue
 This research work was carried out at IntelliScience Training Institute, San Jose. This was a collaborative project between San Jose State University and IntelliScience Research Institute. The project was fully funded by IntelliScience Research Institute.
 Mentor
 Bhavya Bellannagari
 Department of Computer Science, Columbia University, New York, NY
 Dr. Sohail H. Zaidi
 Department of Mechanical Engineering, San Jose State University, San Jose, CA

EDIS #: 1570883058	Title: STEM approach for Human Rights activism based on Wireless Technologies - Including an analysis of Diversity and Inclusion - from the 1940s predicting the future in 2030
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Author(s) with affiliation and country:
 Paulo Sergio Rufino Henrique (SAS Spideo, France)

Abstract:
 *** Objectives:
 The proposed workshop aims to demonstrate the importance of wireless communications to foster STEM studies through the lenses of Diversity, and Inclusion, Gender Equality, and other Sustainable Development Goals set by the United Nations. During the proposed workshop, the presenter will slice through history the technologies underpinned the wireless communication systems from the development of Spread Spectrum Technology by the actress Heidy Lamarr in 1940, passing thru the contributions to the pivotal role of the black female engineer Gladys West. Additionally, the presenter will slide the main components of mobile generations from 2G to 5G that foster human rights based on education, participation in the economy, and human activism like fighting social mobilization. The final objective is to promote the studies of STEM to foster the next generation of engineering in the future wireless technology, the 6G.
 ***Here is the proposed Workshop Description:
 - Wireless Technologies Milestones (From analog to Digital)
 - Cellular Networks first generation.
 - From 2G to 5G (Key Network Architecture)
 - Human Rights activism based on Wireless Technologies
 - The Network Society
 - From consumers to prosumers
 - Mobile Economy
 - SDGs
 - Health and Education
 - World COVID Impact - An outlook based on Mobile Broadband perspective

<ul style="list-style-type: none"> - Social Mobilization via Mobile Handsets - Fighting Disinformation and the AI world - The next generation of the mobile communication system (6G) - High-profile fields of STEM studies <p>Target. Audience: All students above 12 years old. The teachings will offer videos and photos embedded in the PowerPoint presentations.</p> <p>Additional notes: The workshop will be a storytelling presentation to captivate the student's pedagogical interest in STEM.</p> <p>*** Expertise Lead Presenter:</p> <p>Paulo Henrique is an electrical engineer based in Paris, France. Paulo has more than 20 years of working in the telecom industry, from his early years at Unisys to British Telecom and Vodafone UK. Most recently, he has been the Head of Operations and Delivery at Spideo in Paris. He is also a postgraduate in Wireless Communication Systems at Brunel University in London/UK, co-author of the book: 6G The road to the future wireless technology 2030, Ph.D. Candidate at Aarhus University in Denmark under the supervision of Professor Ramjee Prasad and keynote speaker. Paulo Henrique also supports diversity and Inclusion initiatives for the black communities in Brazil, such as art and film exhibitions.</p>	
EDIS #: 1570886764	Title: Toward Scalably Empowering Trailblazing Students through Inclusive and Supportive Mentoring, Systematized Training, and Data-Driven Assessment
Author(s) with affiliation and country: William Gray-Roncal (Johns Hopkins University, USA)	
<p>Abstract:</p> <p>Speakers:</p> <p>William Gray-Roncal, PhD: Electrical Engineer and CIRCUIT Program Lead, focused on program vision and unique elements required to support trailblazing students.</p> <p>Martha Cervantes: Mechanical Engineer and CIRCUIT Project Manager, focused on program implementation and scalability.</p> <p>Katy-Ann Carr: Mechanical Engineer and CIRCUIT Training Staff, focused on sensor-based human performance and assessment.</p> <p>Danilo Symonette: Computer Scientist and PhD student, focused on next-generation assessment and XR methods to encourage and support students.</p> <p>Aishwarya Jayabharathi: Education Masters Student, focused on qualitatively and quantitatively understanding Imposter Syndrome and Self-Efficacy in diverse populations.</p> <p>Erik C. Johnson, PhD: Electrical Engineer and CIRCUIT Training Lead, focused on project-based learning and assessment.</p> <p>Learning Objectives: (1) To provide generalized insight into how to combine engineering expertise with outreach programs to provide a more robust approach to learning; (2) to better understand systemic barriers faced by underresourced and underrepresented students in becoming leaders in STEM; (3) to discuss scalable, assessment-based solutions to overcome intervention limitations.</p> <p>Target Audience: Educators, Engineers and Scientists, and Students (especially college, but high school also welcome).</p> <p>Workshop Overview: Our team has developed the CIRCUIT program over the past 7 years to serve diverse, passionate, highly capable trailblazing students who have had limited opportunities to convert their potential to kinetic energy. We have developed eight pillars including: holistic recruiting, mission-driven research, targeted technical training, leadership development, high-resolution assessment, diverse mentorship, academic partnerships, and career empowerment. In this workshop, we will explain our program vision and the key elements that inspire and allow us to successfully achieve our program goals. We will discuss how to identify and help students to overcome structural barriers, and leverage engineering and assessment methods to create a high-quality and scalable approach. We hope that attendees can meet new collaborators and learn principles that can be distilled and leveraged in their own work with students, whether on an individual or program level.</p>	

EDIS #: 1570866505	Title: Research Platform to Promote the Evolution of STEM Project Experiences
Author(s) with affiliation and country: Ramakrishnan Sundaram (Gannon University, USA)	
Abstract: This paper discusses the setup of the research platform to engage middle and high school students, undergraduate and graduate engineering students in STEM project experiences which evolve from the basic to the advanced according to the STEM preparation of the student in each category. The research platform comprises wireless sensor nodes which are configured to record radio frequency signals within a grid or network of nodes. Radio frequency signals are used to perform non-invasive and device-free target localization of objects or entities in space. Radio tomographic imaging uses wireless sensor networks to form images from the attenuation of the radio frequency signals. The system is comprised of three subsystems the wireless sensor network, the command and data collection platform, and the user interface. STEM project activities are identified on the proposed research platform at different levels of complexity, specific to the category of students assigned to work on the platform.	
EDIS #: 1570874799	Title: Brief overview of embedded systems for Industry 4.0 Applications and Networks
Author(s) with affiliation and country: Ian Hernandez Morales (Universidad Galileo, Guatemala)	
Abstract: This paper contains a brief survey of technologies used to develop embedded system designs and implementations as a work in progress, including microcontrollers, microprocessors, reconfigurable hardware, and recent developments in heterogeneous hardware. These components are classified by the complexity of the application and hardware implementation capabilities, using real-life examples compiled from literature to exploit their capabilities in industrial applications. This work aims to provide the best functionality to achieve the recommendations for Industry 4.0 and its integration with industrial networks under protocols and as accomplished in today's manufacturing process requirements. There are mentioned some related and extensive surveys that study the capabilities of embedded systems, their implementation in some industrial Internet of Things capabilities, and some development tools that are used for embedded systems for real-time applications in industrial environments. It compiles some standardization and good practices recommendations that provide well-established steps, criteria, and guides for their implementation. Also, it shows four different examples of industrial networks developed using a variety of protocols and commercial hardware currently available for wired connections, wireless connections, long-distance situations, and multi-protocol implementations. This work wants to be a literature resource for students, professors, and professionals who wish to have an overview of the different capabilities and advantages that embedded systems offer in industrial and academic environments.	
EDIS #: 1570874893	Title: Energy consumption and future forecast of IoT devices in networks
Author(s) with affiliation and country: Kevin A Echeverria (University Galileo & Galileo, Guatemala)	
Abstract: Electricity plays an important part in everyday life and it is estimated that in the next decade it will open more than 40 billion intelligent objects connected to the IoT. Reducing energy consumption in wireless communications has attracted increasing attention, such as renewable energy and energy optimization. Considering the energy consumption in the development of such applications, as well as the consumption of data produced by IoT devices, this remains a huge challenge. There is the absence of knowledge about what are the best practices for developing green IoT applications, and for that it is necessary to understand the energy use of various communication technologies. In this paper, it aims to increase the awareness of understanding and helping application and device designs to better utilize energy in communication. We will analyze the IoT structure in the network layer. To itself talk about the different types of connections and how is the performance in the energy in each of them, evaluating the energy consumption of different communication technologies in IoT (ZigBee, WiFi, LoRA, NB-IoT) and analyzed to see which performs best with low energy consumption. Achieving a strategy to minimize the volume of data that can be transmitted through the IoT environment.	

EDIS #: 1570875135	Title: WiP: A wearable system for detecting falls using a sound sensor
Author(s) with affiliation and country: Fabián A Hernández (Universidad Galileo, Guatemala); Oscar Rodas (Universidad Galileo & Tesla Lab, Guatemala); Erick Petersen (Universidad Galileo, Guatemala)	
Abstract: In the elderly, the accidents that are most likely to happen are falls and the consequences can be very serious, from hip and femur fractures to death. Along with this, the time to care for a person after this type of incident is essential so that the consequences are minor. Given all this, this paper presents a fall detection system through a portable device that implements an accelerometer and a sound sensor, which together work with a microcontroller capable of processing the information and with a machine learning algorithm. The previously mentioned algorithm will oversee the processing of the accelerometer data together with the sound sensor data to detect a fall.	
EDIS #: 1570878360	Title: Developing Mini VR Game Engines as an Engaging Learning Method for Digital Arts & Sciences
Author(s) with affiliation and country: Angelos Barmpoutis, Wenbin Guo and Ines Said (University of Florida, USA)	
Abstract: Digital Arts and Sciences curricula have been known for combining topics of emerging technologies and artistic creativity for the professional preparation of future technical artists and other creative media professionals. One of the key challenges in such an interdisciplinary curriculum is the instruction of complex technical concepts to an audience that lacks prior computer science background. This paper discusses how the process of developing small custom game engines for virtual and augmented reality can become an effective and engaging method for teaching various fundamental technical topics from Digital Arts and Sciences curricula. Based on empirical evidence we demonstrate examples that integrate concepts from geometry, linear algebra, and computer programming to 3D modeling, animation, and procedural art. The paper also introduces an open-source framework for implementing such curriculum in Quest VR headsets, and we provide examples of small-scale focused exercises and learning activities.	
EDIS #: 1570879734	Title: WIP: Interdisciplinary Teaching via Hands-on Practice in Cybersecurity
Author(s) with affiliation and country: Qiaoyan Yu (University of New Hampshire, USA); Dean Sullivan (UNH, USA); Diliang Chen, Dongpeng Xu, Karen H. Jin and Joshua Calzadillas (University of New Hampshire, USA)	
Abstract: Interdisciplinary teaching is challenging but it is also highly demanded, especially in the era of internet-of-everything. This work-in-progress paper introduces the effort that promotes interdisciplinary teaching across discipline boundaries of electrical and electronic engineering, information theory, semiconductors, telecommunication engineering, robotics, computer science, and control. Two approaches are proposed to enhance interdisciplinary teaching: student-driven skill sharing fosters more knowledge exchange across multiple disciplines and curriculum changes advance active learning and competency learning. The proposed teaching approaches are implemented in the hands-on projects conducted in a new educational laboratory and outside-of-classroom activities, such as skill-sharing workshops, IEEE club nights, and Cybersecurity Day.	

EDIS #: 1570879755	Title: Fostering Computer Science Education through Expert Interviews
Author(s) with affiliation and country: Victor I Robila (Hunter College High School, USA)	
Abstract: Computer Science Chats (CSChats) was developed as a platform that promotes career awareness and readiness for students' computer science careers. Through CSChats, a series of publicly available video interviews with expert professionals was created. This paper details a content analysis of the interviews, identifies themes related to motivation for pursuing computing careers, recommendations for pursuing such careers and the future of computing. Motivations for pursuing a career in computing included the novelty of the domain, the creativity in performing the work, the drive to contribute to solving complex problems and being exposed to it. The recommendations for preparing for CS careers included taking advantage of accessibility of opportunities to experience computing, developing a mathematical and communications foundation and considering computing's applicability in the broader context. Cybersecurity, privacy, and artificial intelligence from the point of view of explainability, societal acceptance, and ethics were identified as key aspects of CS' future.	
EDIS #: 1570880542	Title: Question Assessment Recommendation System Based on Personalization using Collaborative Filtering and Long-Short Term Memory
Author(s) with affiliation and country: Hartawan Bahari Mulyadi (University of Jember, Indonesia); Saiful Bukhori (Universitas Jember, Indonesia); Gayatri Dwi Santika (Jember University, Indonesia)	
Abstract: The use of e-learning has the potential to change the way students learn, and it can be further improved by utilizing stored digital data to provide an engaging and interactive learning experience. The Collaborative Filtering approach is applied to increase student learning interest by providing personalized questions that are tailored to each student's needs and abilities. This feature is used to solve teacher issues and the need to create assessments that be time-consuming and not accustomed to digitalizing questions. During creating an assessment, the system will provide the teacher with recommendation questions; therefore teacher is able to adjust it based on every curriculum. Another application of machine learning is using Long Short-Term Memory helps the teacher by being able to forecast student scores and is used as an early detection tool for identifying students who may be struggling or losing interest in learning. The data source obtained from e-learning to implement both machine learning algorithms is limited to data on students' assessment scores and data on questions with mathematics subjects. This work is intended to assist primary school mathematics teachers in making personalized assessments for each student with the aim of presenting interactive learning media as well as being a medium for monitoring student performance.	
EDIS #: 1570880740	Title: Adjustable Platform for Exploring Soft Robotic Gripper Design
Author(s) with affiliation and country: Janelle P Clark (University of Massachusetts Lowell, USA); Emily LaBelle and Domenic Carrillo (UMass Lowell, USA); Holly Yanco (University of Massachusetts Lowell, USA)	
Abstract: The growing importance of STEM careers and the imbalance of the demographics of people who pursue them have resulted in a myriad of outreach activities and platforms to expose students to key concepts in fun and interactive ways. Robotics is one of the primary themes of these outreach activities due to the combination of disciplines (e.g., mechanical and electrical engineering, computer science). Specifically, soft robotics, an emerging field, has become a popular topic as it is outside the expectations and experiences of most students, making it more universally accessible. In this work, we present a tendon-driven, soft-robotic gripper platform with multiple adjustable design features in order to emphasize the iterative nature of design. Students can choose the number of fingers, their distance apart, and their length and number of joints. After designing and molding the fingers themselves, threading the tendon and installing them on the base, they have the opportunity to test and iterate their design. Eleven high school girls and their teachers participated in a pilot activity, filling out a survey on the design of the platform. The	

surveys indicated the students found the activity a fun, interesting, and valuable learning experience, one they would recommend to their friends.	
EDIS #: 1570880799	Title: Hours of Work, Minutes of Code: An Investigation Into Software Development Applications and Computer Science Education for Engineers and Scientists
Author(s) with affiliation and country: Ana Zoe Rasking (Johns Hopkins University Applied Physics Laboratory, USA)	
Abstract: The need for programming skills is becoming increasingly ubiquitous within the fields of science and engineering. However, new professionals entering their respective fields, in addition to practicing professionals with years of experience, lack the education and exposure necessary to effectively apply software development to their work. In order to promote the increased use of software development within scientific and engineering fields, this research project primarily seeks to survey, characterize and categorize applications of software development. Additionally, it aims to understand how students interested in science and engineering might best be motivated to learn programming. An initial review of literature will be supplemented with original data collection through interviews and a questionnaire in order to reach research objectives. Data collection will allow for a comprehensive review of the current uses of software development for personal or intra-institutional use, as opposed to commercially produced software packages, and will shed light on the state of computer science education among students pursuing non-computer science majors. This review of practical applications, in addition to research-founded recommendations, will aid educators and professionals in advocating for increased participation in computer science curricula, and thus contribute to a more thorough and grounded preparation of the next generation of engineers and scientists entering the workforce.	
EDIS #: 1570882106	Title: Extracting occupancy information from sensor data using machine learning: LU-PRISM Program
Author(s) with affiliation and country: Sanish Rai (Longwood University, USA)	
Abstract: Two undergraduate students will work with the faculty to implement machine learning models on extracting meaningful information from building sensor data. As a part of the LU-PRISM (Longwood University Perspectives on Research in Science and Mathematics) program, the students will learn research methodology and also implement in their field of study. Under the mentorship of the faculty, the students will collect data from building spaces, and apply steps of data analysis and machine learning to estimate the occupancy status of the environment. The students will report their finding to faculty and also present their work in peer reviewed medium. In this paper, we briefly provide information about the PRISM program and the discuss the research and the plan for the project.	
EDIS #: 1570882133	Title: An Innovative Scheme for College Ranking: A Socialization Perspective
Author(s) with affiliation and country: Binxi Xie (Emory University, USA)	
Abstract: Using the U.S. News college rankings as an example, this scheme highlighted the concerns and obstacles existing commercial college ranking lists confront, including data fabrication and data credibility. As we have anchored contemporary thought in education, the college rankings nowadays are irrational and contrary to the spirit of education. Instead, we utilized socialization as a valid objective of education and examined how the socialization of students is a core ranking indicator congruent with education's raison d'être. Therefore, we proposed a new Bayesian statistical ranking method based on colleges' impact on students' socialization. This new approach to college ranking provides a more accurate and fair representation of the quality of institutions and is more in line with the true purpose of education. This paper aims to contribute to the ongoing conversation about the importance of socialization in education and the need for a more equitable and meaningful way of evaluating educational institutions.	

EDIS #: 1570882382	Title: A Framework for Evaluating Parental Controls for Streaming Services
Author(s) with affiliation and country: Amanda Moctezuma and Stefan Robila (Montclair State University, USA)	
Abstract: The paper describes the development of an evaluation framework for parental controls as a mechanism for managing children's access to video content and discusses how educational practices can be employed for better design. The evaluation framework has two components. First, the differences, effectiveness, and the user's perception of various parental control software systems were investigated through surveys that evaluated both general aspects of controls as well as through usability questionnaires focused on individual applications. Results indicate that while control mechanisms are seen as needed, their usage continues to be low. Factors that limit their adoption include a limited understanding of their functionality, significant differences in the interface between various services, and a lack of hardened security. Second, the security and usability features placed into the parental controls of different streaming platforms were analyzed through an evaluation toolkit grounded in previous literature as well as on user feedback. The toolkit is formed of a set of evaluation criteria that include user experience, security, and alignment with the content rating system for which scores are generated. The toolkit was used to evaluate the largest streaming services (in terms of the number of users). The results show that parental controls continue to be quite diverse in implementation across various platforms, leading to non-uniform experiences and limited usage, a concerning aspect given the continuous growth and diversification of the content streaming industry.	
EDIS #: 1570882456	Title: Low-cost hearing aid using Mobile App and Bluetooth headset
Author(s) with affiliation and country: Mohana Bhuvanagiri (Acton-Boxborough Regional High School, USA); Srikar Bhuvanagiri (RJ Grey Junior High School, USA)	
Abstract: As humans age, one of the major problems that many face is loss of hearing. Good hearing aids in the market are expensive, ranging from hundreds to thousands of dollars, making them inaccessible to most people. To make hearing aids more affordable, we are using a mobile app and a Bluetooth headset to perform the functions of a hearing aid. The Microphone in the mobile phone picks up audio, analyzes it, and converts it into frequency bands. It will apply the gain of the frequency bands based on the user's audiometry graph. The gain in each frequency band is adjusted to avoid saturation. The resultant frequencies are synthesized and played back on the Bluetooth Headset of the user. The user of the app is given control to increase the volume based on their ambient noise. The entire process should happen within 40 milliseconds to avoid losing lip synchronization.	
EDIS #: 1570882833	Title: Microcontroller Based Platforms For STEM Education
Author(s) with affiliation and country: Kam C Sum (Alquanta Ltd., Singapore); Kei-Hin Ng, Wang-Kong Lam and Ho-Yin Chui (Alphotonics Limited, Hong Kong); Chiu F Li (Cognitio College Kowloon, Hong Kong)	
Abstract: Use of microcontroller in electronic kits has been popular in STEM education. Students around the age of 14 to 15 years old learn coding skills and basic electronic principles from practical projects, raising their interests to become future scientists or engineers. In this paper, we present our past IoT project working with a school with the theme of smart campus. Students received demonstration and gained hands-on experience with IoT devices in less than a total of five hours of lessons within a month-long period. We also introduce a microcontroller based platform offering multiple features on an Enhanced Shield. Key advantage of this new platform lies in a single serial bus structure facilitating easy addition of accessories such as motors and sensors in a daisy chain fashion. Each accessory is software defined for control purposes. The new platform will be implemented in an upcoming robotic car project. Students will be taught skills of motor control and artificial intelligence feature of color recognition.	

EDIS #: 1570883238	Title: Survey of K-8 Teachers: Intersecting Computer Science Education, Diversity, and Inclusion
Author(s) with affiliation and country: Sumi Hagiwara (Montclair State University, USA); Katherine Herbert (1 Normal Ave & Montclair State University, USA); Minsun Shin, Vaibhav Anu, Rebecca Goldstein, Patricia Virella and Gerald Wang (Montclair State University, USA)	
Abstract: The national call to teach computer science (CS) in elementary school is widely adopted, but how prepared are elementary teachers to deliver CS instruction? Researchers explore this question through a pre-/post-CS attitudinal survey, based on teachers participation in a series of CS professional development (PD) workshops for teachers. Researchers developed the PD training that aims to develop teacher's professional knowledge and skills. The PD includes content related to surveying the current context of CS education, the landscape of CS as a field, and understanding the CS student learning standards. PD training also included interdisciplinary approaches to CS education and examined diversity and inclusive practices to meet the needs of students from diverse background and learning styles. The attitudinal survey is based on an existing computer science attitudinal instrument with additional items on diversity and inclusion. Attitudinal constructs included six subscales: 1) Confidence in learning computer science and programming, 2) Attitude toward success in computer science, 3) Computer science as a male domain, 4) Usefulness of computer science and programming, 5) Effective motivation in computer science and programming, and 6) Perceptions of diversity and equity in a CS classroom. Descriptive statistical analysis from 32 participant responses interpret attitudes towards computer science, diversity and inclusion before and after the PD. Teachers' attitudes towards CS increased when exposed to professional development that intersects content with practical applications. Overall, teachers' responses indicate a positive change in their Confidence in learning computer science and programming, attitude toward success in computer science, recognizing of the utility and ubiquity of computer science and programming and motivating factors for efficacy in computer science and programming.	
EDIS #: 1570883755	Title: Data-driven Analysis of Elementary School Students' Computational Thinking through Scratch Projects
Author(s) with affiliation and country: Guang Yang, Daisuke Saito, Hironori Washizaki and Yoshiaki Fukazawa (Waseda University, Japan)	
Abstract: The development of computer science has led to an increase in programming education for younger people. Many countries have begun programming education in elementary schools. As is a relatively new subject in elementary education, the course design and textbooks for programming education remain under development. The growth trend in computational thinking (CT) is helpful for educators to teach suitable programming concepts to students. Scratch, which is mostly used as an introductory programming language for elementary school students, can be evaluated to reflect students' CT. In this work-in-progress research, we conducted a data-driven analysis on fourth-grade students' CT growth in their first 3 years of programming learning by evaluating their Scratch projects. A preliminary result shows that CT grows rapidly in the first 2 years and tends to be stable in the third year. The reasons for the difference in growth of specific CT concepts are discussed.	
EDIS #: 1570884119	Title: Facilitating Students' Abstract and Computational Thinking Skills Using Virtual Reality
Author(s) with affiliation and country: Xinze Wang, Daisuke Saito, Hironori Washizaki and Yoshiaki Fukazawa (Waseda University, Japan)	
Abstract: As Virtual reality (VR) devices become more widespread, they are being recognized as efficient teaching tools for many subjects. In the 21st century, learners are expected to master important skills, which are difficult to teach in conventional lectures, such as computational thinking, critical thinking, creativity, and abstract reasoning. [1] Therefore, computer science or information technology courses often limit the discussion of recursion to calculating a factorial or a Fibonacci number, even though recursion is presented as an academic-type oddity in most cases. [2] To elucidate how VR can improve students' computational thinking skills and abstract thinking associated with solving problems that require recursive algorithms, this paper examines the use of VR in computer science education to teach	

the abstract concept of recursion. The results of learners using VR Tower of Hanoi software are compared to those using the conventional Hanoi puzzle. Most learners show an improved understanding after experiencing the gameplay in the VR software, and some demonstrate a better understanding of recursion. In the post-survey, most participants acknowledge that the immersive environment is helpful when learning abstract subjects.

EDIS #: 1570884135 | **Title:** Competencies assessment: indicators for a covariance structural model for STEM

Author(s) with affiliation and country:

Leopoldo Julian Lechuga Lopez (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico); Olga Lopez (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico)

Abstract:

During the last two decades, formal studies focused on explaining the gender gap in science, technology, engineering, and mathematics careers have increased exponentially. In parallel, the efforts and strategies of universities, international organizations e.g., the United Nations Agency for Education, Science and Culture, the European Union, and the World Economic Forum, and women's associations have emphasized the under representation of females in science and engineering professions. However, the efforts to reduce the gender gap remain insufficient, and increasing female underrepresentation in STEM careers continues to be a big challenge. Information technology careers present a much more dramatic gender gap when considering the availability of professionals for the jobs that will be required in the future for this industry. This paper is an evolving work which aims to propose more effective strategies that can positively impact women's recruitment in STEM intensive careers in the medium and long term. As a first approach, we have collected data from a group of young women who chose an engineering major, and we measured their level of proficiency in 10 competencies at the beginning of their undergraduate studies and two years later, after they have followed STEM courses. Using traditional statistical methods such as correlations, cluster analysis, and parametric hypothesis testing, we found that their competencies evolved and clustered following trends and could serve as indicators that measure latent variables of a structural model of covariance. Our goal is to generate enough data to build such a model that explains why a woman might choose or avoid STEM careers.

EDIS #: 1570884176 | **Title:** Quantum Sensing for Anti-Submarine Warfare

Author(s) with affiliation and country:

Benjamin E Nathan (Johns Hopkins University - Applied Physics Laboratory, USA)

Abstract:

Quantum Sensors are highly sensitive detectors that have the potential to improve our sensing capabilities for Anti-Submarine Warfare. There are three different types of sensors (Nitrogen Vacancy Diamonds, Silicone Carbide Magnetometers, and Superconducting Quantum Interference Devices (SQUIDS)) that are the best candidates for Anti-Submarine Warfare. Throughout this paper, I review these three sensors and their capabilities. Based on this, I eventually conclude which of the three sensors I believe would be most optimal for quantum sensing. This paper is based on published reports as well as my meetings with experts at JHU/APL and representatives from companies that produce quantum sensors.

EDIS #: 1570884274 | **Title:** Developing Efficient Bayesian Estimation of IRT Models for Integrated STEM Education

Author(s) with affiliation and country:

Yanyan Sheng (University of Chicago, USA); William S Welling (Texas A & M University, USA); Michelle M. Zhu (Montclair State University, USA)

Abstract:

Item response theory (IRT) is a popular approach used for addressing psychometric problems in educational and psychological measurement. Its use in large-scale assessments typically involves a calibration stage where a large and representative sample is needed to ensure the accuracy in estimating item parameters. This is, however, difficult to achieve in small-scale or classroom settings, especially when immediate feedback is desired. The problem can be resolved by combining existing and newly collected item response data to simultaneously estimate both item parameters and person abilities, which require a complex estimation procedure and an efficient algorithm. The complex estimation of IRT models via fully Bayesian approach is usually computationally expensive due to the large number of iterations, and a large amount of memory to store massive amount of data. This limits the use of the

<p>procedure in small-scale time sensitive or large-scale applications using traditional CPU architecture. In an effort to overcome such restrictions, previous studies focused on utilizing high performance computing using either distributed memory based message passing interface (MPI) or massive threads compute unified device architecture (CUDA) to achieve certain speedups with a simple IRT model where one latent trait is assumed. This study focuses on such models and aims at demonstrating the scalability of parallel algorithms integrating CUDA into MPI computing paradigm. Results of this study further shed light on applications of IRT in integrated STEM education.</p>	
EDIS #: 1570884381	Title: An Expression-Oriented Approach to Programming Education
Author(s) with affiliation and country:	
Enzo Alda (Lakebolt Research, USA); Jorge Baralt-Torrijos (Simón Bolívar University, Venezuela)	
Abstract:	
Learning programming language syntax is considered an obstacle in programming education. However, we believe it is an overlooked opportunity to exploit obvious synergies with Math. As evidenced around the world, middle and high school students know the syntax required to compute simple expressions, without previous exposure to programming languages. We make the case for an "expressions first" approach to facilitate the development of computational thinking. Our approach has the benefit of integrating directly with Math, which in turn reinforces the teaching of other STEM subjects as well as non-STEM ones. We report early results of an ongoing trial using a visual computing environment that supports this approach.	
EDIS #: 1570884570	Title: Chinese Urban Subculture of Misinformation: Ideology Formation of the Sanhe gods
Author(s) with affiliation and country:	
Tiffany Huang (Britannica International School of Shanghai, USA)	
Abstract:	
When coming across the topic of "misinformation," the direct linkage with misinformation was that it could cause the forming of an information cocoon. Nowadays, information cocoon shows up significantly through online social media to match groups of cocoons that share the same interests. This study chose to examine the life of the Sanhe gods in Shenzhen, China. A group of the population is the direct victim of an information cocoon. The inherent lack of interest in vulnerable groups will lead to their more effortless and faster formation of information cocoons. As the research method, many programs containing an overall view of the whole population ignore many personal feelings and characteristic colors at some levels. This research employed the method of microhistory in a Bayesian manner to study how the Sanhe youth stepped into their serious information cocoon due to misinformation in contemporary society. The microhistory method needs to be more significant to represent generalizability better. Quantitative data from online social media to evaluate the whole situation of the reason and forming of an information cocoon was interpreted as reasonable expectation representing a state of knowledge. Finally, the paper concluded that many factors triggered their information cocoon. However, the most significant cause was the lack of adequate education for vulnerable groups leading them to be trapped by misinformation, thus forming their own solidified information cocoon.	
EDIS #: 1570885090	Title: A3Sat: Using CubeSat Emulators to Broaden Advanced Participation in STEM Education
Author(s) with affiliation and country:	
John D Moore (Institute for Earth Observations, USA & NASA GLOBE Mission Earth, USA); Maxwell Friedman and Sriram Elango (Institute for Earth Observations, USA); Jin Kang (United States Naval Academy, USA); Christine Maceo (USNA, USA)	
Abstract:	
As CubeSats have expanded in usage and development within research and industry, capable of being applied for various mission purposes, their potential for educational impact has grown correspondingly. A culmination of several fields and dimensions of STEM, CubeSats possess the ability for in-depth and comprehensive technical education. The A3Sat Emulator V 2.0 is a 1U CubeSat-class satellite that is designed to be used for education in a classroom setting. It was devised to authentically replicate building a Tier 1 CubeSat for pre-college students. The current V 2.0 A3Sat fosters a more technically accurate and parallel experience compared to V 1.0, incorporating aspects such as radio communication and GPS, maintaining an emphasis on the operational mechanics of CubeSats. The A3Sat Emulator	

<p>Enterprise will introduce teachers and students to this emerging disruptive space technology, i.e. CubeSats, and seeks to train and develop a new pre-college SmallSat community. As part of the design, there are sensors that will collect/transmit data and provide operational feedback to a GroundStation. A3Sat was developed, constructed, and designed to both strengthen existing curriculum taught in class, as well as incorporate topics commonly missed. Within construction alone, the A3Sat retains lessons in computer science, aerospace/mechanical engineering, material science, and electrical engineering, fostering an intellectual environment for students to explore their STEM interests. The data and/or imagery provide a wide range of innovative and transformative opportunities to develop proficiencies, gain experience, and explore career pathways that are not readily available to the pre-college community, thus broadening participation in STEM careers.</p>	
EDIS #: 1570886727	Title: Middle School Teachers' Instructional Practices to Maximize Learning Using integrated STEM
Author(s) with affiliation and country: Paul Asunda, Fatima Perwaiz and Hillary O Omoze (Purdue University, USA)	
Abstract: While STEM fields contribute significantly to the United States' leadership position in the world, the current STEM pipeline problem poses a serious challenge to it. Considering integrated STEM (iSTEM) as an effective way to overcome the declining number of STEM graduates, this study explored middle school teachers' conceptualization of and instructional practices around iSTEM in classrooms. As participants, 4 teachers from 3 schools in a mid-west state took part in the study. An instrumental case study design, utilizing a phenomenographic lens, was used to explore the research questions under consideration. Data were collected through classroom observations, photo documentation, and teacher interviews and later analyzed using Kurkartz's six steps. There were 5 core themes that emerged: conceptual learning, reflection, teacher engagement, student engagement, and context set-up. The findings revealed that while teachers conceptualize iSTEM as the integration of interdisciplinary concepts and knowledge to situate problems in the real-world context, students are more inclined to learn STEM concepts by actively engaging in hands-on iSTEM activities.	
EDIS #: 1570886733	Title: Getting K-12 STEM Students to Interact with and Learn About Autonomous Vehicles
Author(s) with affiliation and country: William E Husen (University of Wisconsin, USA); Mehdi Roopaei (University of Wisconsin - Platteville, USA)	
Abstract: Exposing kids to modern technologies gives them an edge in today's world. Fostering cognitive development and enhancing problem solving skills are just some of the benefits that kids can acquire when they are exposed to modern technology during their early stage of development. The widespread adoption of autonomous vehicle will fundamentally change the society with we inhabit. If children are to inherit this changed society, they will need a base understanding of how these self-driving cars function. The way children are exposed to this new knowledge is important. It is essential to make sure they can interact with these technologies in a safe environment, could repeat it as much as they want, and enjoy the learning experience. In this work-in-progress paper, we try to make a driverless car in a game environment where the students control the status of this vehicle using AI. The students visualize how a driverless car is being controlled within a simple Scratch environment and how AI could be involved to help them to control their designed car. The proposed project also opens a new window for STEM programs to let the kids apply AI ideas in real life applications without any knowledge about programming.	
EDIS #: 1570886750	Title: An In-Situ Behavior Measurement Approach using Organic Text Communication Toward Monitoring Student Success
Author(s) with affiliation and country: Maya Albayrak (The Johns Hopkins University Applied Physics Laboratory & Carnegie Mellon University, USA); William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)	
Abstract: Precision education can aid students in fulfilling their academic potential. The first step in establishing a precision education approach is pinpointing behaviors that help students to succeed. Through this research, we explored the	

<p>use of Natural Language Processing (NLP) techniques on student text messages, through the Slack messaging service, as a tool for understanding student behaviors. We hope that this approach can be used in a Human-Computer Interaction (HCI) framework to build assessments and visualizations that will help communicate student behaviors to mentors to better support emergent needs. We already see that this analysis has a plethora of data that can provide unique insights into real-time communication and progress of program members. We work closely with trailblazing students, who have high capability, but often limited previous opportunities to work in a research environment. Therefore, it is critical to rapidly identify areas of strong or limited performance to provide enrichment and guardrails.</p>	
EDIS #: 1570886763	Title: Integrating Cyber Physical System Security Concepts in Computer System Security Curriculum
Author(s) with affiliation and country: Heena Rathore (Texas State University, USA)	
Abstract: Cyber physical systems (CPS) are becoming increasingly prevalent in our daily lives, from connected vehicles and medical devices to critical infrastructure systems. As there is growing emphasis both in industry and academia in security aspects of CPS, the students should have sufficient foundational knowledge about these topics as they transition into their professional careers. This manuscript describes the integration of modern CPS security concepts into the traditional required Computer System Security undergraduate course at Texas State University. Content is introduced through a group course project, where students reviewed and replicated results from a recent relevant CPS security paper. Papers were self-selected by groups based upon ten recommendations covering content from emerging CPS security topics, such as connected vehicle security and industrial IoT. Based upon the success of this initial implementation, future efforts to expand the scope of CPS coverage in future course iterations are proposed.	
EDIS #: 1570886768	Title: Enhancing a Multi-Disciplinary Introduction to Engineering Course Through Course-Based Undergraduate Research
Author(s) with affiliation and country: Henry Griffith, Christopher Saldivar and Michelle Baland (San Antonio College, USA)	
Abstract: This work-in-progress manuscript describes the redesign of a multi-disciplinary introduction to engineering course at San Antonio College, a two-year Hispanic Serving Institution located in San Antonio, Texas. This course redesign was intended to enhance students' persistence to transfer through the integration of multiple high impact practices, including a course-based undergraduate research experience (CURE) developed in partnership with a corporate partner. In addition to the CURE, students were also introduced to research computing skills to enhance their competitiveness for summer internship and research opportunities. Guest speakers were also utilized to enhance students' resource awareness and self-efficacy. Details regarding the initial implementation of the redesigned course during the fall 2022 semester are provided herein, along with lessons learned for improving the course in future offerings.	
EDIS #: 1570886773	Title: Toward a More Equitable and Effective Process for Student-Mentor Cohort Assignment (Paper)
Author(s) with affiliation and country: Carah Katz (JHU Applied Physics Laboratory, USA); Martha Cervantes (Johns Hopkins University Applied Physics Laboratory, USA); William Gray-Roncal (Johns Hopkins University, USA)	
Abstract: We host an internship program for trailblazing undergraduate students through intensive mentoring and the unique opportunity to participate in cutting-edge research while building skills to make future significant contributions to science. This program stands out for its focus on individuals from first generation or low-income backgrounds; those with limited research experience; and those facing systemic barriers. Through the adoption of a cohort-based model, students are able to gain scientific knowledge and critical professional skills in a hands-on, collaborative, and fun environment. Because of our student population, many of our interns have a strong passion and capability for their projects, but lack the necessary expertise at the beginning of the program. Mentors are excited to support students	

and leverage their enthusiasm, but are constrained by the need to achieve their promised research results. Finally, because this program is cohort-based, when considering the assignment between projects (and their mentors) and student subgroups, the relationships and shared capabilities within a cohort are much more important than the capability and match of a single student.

This paper presents possible solutions to enhance current matching algorithms to complete a task that current matching algorithms do not; current algorithms often match independent stability (as "skill" and "interest" in problems like Hospital Residency (HR) are supposedly equal) while we are attempting to match in accordance to group stability (including the dynamics between independents in a given situation). This requires an approach that considers different weights for attributes such as skill and interest, as well as tuning capabilities to reflect the needs of a particular program instantiation."

EDIS #: 1570887059 | **Title:** Legal Protection to Avoid Plagiarism Behavior Among Students

Author(s) with affiliation and country:
Muhammad Haitsam (Telkom University, Indonesia)

Abstract:
Plagiarism often occurs in the academic world and it is an offense to take someone else's work and admit it as its own. plagiarism must be prevented. Plagiarism activities make students turn off creative and critical thinking patterns so that they will tend to look for convenience which will result in stupidity for the nation's next generation. This study aims to review the plagiarism of existing legal regulations in Indonesia. This research uses the normative writing method, the approach used in this writing is the statutory approach (Statute Approach). This research also presents steps to reduce plagiarism, such as avoiding "intellectual theft", doing good writing (citation and paraphrasing).

EDIS #: 1570887107 | **Title:** Specific Absorption Rate Lessening Through A Combined EBG-Cells

Author(s) with affiliation and country:
Mohammad El Ghabzouri (Mohammed First University, Faculty of Sciences, Oujda, Morocco); Abdenacer ES-salhi (Université Mohamed 1er, Morocco); Paulo Mendes (University of Minho, Portugal)

Abstract:
This work investigates the specific absorption rate (SAR) reduction of the energy generated by handsets, either on the holding hand (when using WiFi, WiMax or WLAN), or on the human head when making voice calls over 4G or 5G mobile networks. In this paper, we investigate the efficiency of reducing SAR at 3.2 and 3.5 GHz throughout a combined electromagnetic band gap (EBG) cells instead of the diverse used methods in most recent years. Recently, with the beginning of the 5G era, the debate arose again about the possible health effects of electromagnetic (EM) radiation exposure on humans. Hence, as a consequence of this, it is evident that providing new SAR reduction approach is very demanding, especially when it involves characteristics improvement, miniaturization, and low-cost materials like EBG structures, which can allow its broad use for low SAR mobile phones or base stations antennas requiring high power radiation in rural areas. The obtained SAR levels are mostly very satisfying, which make these EBG structures a competitive solution to allow the commercialization of some high-performance antennas which are not below the SAR restriction limits specified by international standards.

EDIS #: 1570872300	Title: The trends of Research in STEM education in high scholarly journals
Author(s) with affiliation and country: Hisham Barakat Hussein (King Saud University, Saudi Arabia)	
Abstract: This Article aimed to Identify the trends of Research in STEM education, the Article conducted an analysis for the articles which published indexed in web of Science journals in 2020- 2021. The sample was 467 Articles have STEM in the Titles. 243 of them were published in 2020, and 224 were published in 2021. The Articles published in 110 High scholarly Journals which indexed in web of Sciences index -SSCI. The analysis reviews the type of sample, educational Stage, type of methodology Research, research topic, and Keywords. The result revealed that the students have the most articles. In the educational stage, the Secondary school have the most articles. In the type of methodology, the empirical and quantiles methodology Research have the most articles. In the Research Topic as Cultural and Social context -Gender inequity, Racial inequalities, and Social and cultural indicators-, Learner Characteristics (Self-efficacy, Attitudes, and Belief-, and Curriculum and activities -Design, Learning, and Practice- have the most articles. In the Keywords the STEM education, STEM learning, STEM students, STEM Teachers, and STEM schools have the most articles. In the light of the analysis result, the Article suggest a road map for the future research in STEM Education. Suggestions and recommendations were presented. Keywords Trends of Research, STEM Education, high scholarly journals, in web of Science journals, future research.	
EDIS #: 1570874590	Title: Developing a Lab Experiment for Demonstrating the Performance of an Off-Grid Solar Array
Author(s) with affiliation and country: Paul Cornean (BCIT, Canada); Pooya Taheri (BCIT & SFU, Canada)	
Abstract: The proliferation of photovoltaic (PV) systems in the last decade demands skilled technologists familiar with the theoretical and practical aspects of solar system technology. Hands-on experiments play a key role in the development of students' creativity and instinctive understanding of concepts. In this paper, we explain the process of developing a lab manual to introduce diploma-level undergraduate students to power-electronics aspects of a solar system. Experimental test setup and different equipment used for data acquisition purposes are detailed first. We then briefly explain theoretical concepts such as solar panel modeling, maximum power point tracking (MPPT), total harmonic distortion (THD), pulse width modulation (PWM), and filter design. MATLAB/SIMULINK is used as the simulation platform for virtual experiments due to its user friendliness and capabilities. Hands-on and simulation-based experiments and the results are explained and analyzed. This steppingstone project serves to solidify students' learning of practical aspects of solar energy harvesting through experimental learning.	
EDIS #: 1570877786	Title: A Sustainable Development Goal for a Campus: LED Vertical Illumination for a Classroom
Author(s) with affiliation and country: Enrique C Pajardo, Antony Kinyua and Dong H Kang (Morgan State University, USA)	
Abstract: Despite the vast research in Sustainable Development (SD), very little is known about providing "sustainable Light Emitting Diode (LED) lighting" for a campus. The overall image that emerges from advertisements is upgrading to LED's will last a long time. This is a simplistic view of understanding a Sustainable Development Goal (SDG). This misunderstanding is the motivation for this study is to help new graduate students build knowledge about sustainable lighting. Establishing sustainable LED lighting can increase students' well-being, which is a gap in most past research [14]. The primary objective of this study was proven after evaluating the lighting in two classrooms for; (1) economic growth, (2) environmental benefits, (3) and improving students' well-being. A LEED-certified classroom met all objectives with the lighting levels, mood, and reduced cost. Whereas the non-LEED-certified classroom did not meet any objectives or compliance. The larger implications of the findings are that sustainable LED lighting can benefit any size campus.	

EDIS #: 1570879017	Title: MATLAB Image Processing for Plasma-Wound Interaction to Accelerate Healing and Sterilization
Author(s) with affiliation and country: Akhil Agarwal (IntelliScience Institute & Research Intern at San Jose State University, USA); Aahan R Patel (IntelliScience Institute, USA)	
Abstract: Plasma healing has been found to be a very powerful technique to accelerate wound healing. Through this research conducted at San Jose State University, this process was automated in an attempt to make plasma healing more efficient in material usage and cost while allowing widespread usage by reducing the need for specialists. The plasma torch was held by a 2D-traversing arm system, which used two stepper motors, each attached to a set of linear slides, for movement. Motor drivers and a Raspberry Pi microcontroller were used to control the stepper motors. The Raspberry Pi was also connected to a USB Logitech camera module, which would take pictures of the wound. In this work, a pictorial version of the wound was provided to the camera to take images and process them accordingly. A MATLAB program was used to control the arm system. The MATLAB program wirelessly received the image from the Raspberry Pi and detected the wound by scanning for the most-red area of the image. It identified the most efficient way for the arm to move by placing the tightest possible bounding box around the wound. The MATLAB program then moved the arm around this bounding box, pausing at approximately 1.5 cm intervals for around 30 seconds generally required for wound exposure. The hardware and software systems are discussed further in the following sections.	
EDIS #: 1570879408	Title: The Impact of Credits on Student Performance: A Case Study of Sri Lanka
Author(s) with affiliation and country: Jagodage Dulangi Kanchana Rathnapala (University of Moratuwa & NONE, Sri Lanka); Amal Perera (University of Moratuwa, Sri Lanka); Vishaka Nanayakkara (Chalmers University of Technology, Sweden); Gayashan Amarasinghe (University of Moratuwa, Sri Lanka)	
Abstract: A proper curriculum is needed to enable students to have a healthy academic life either in school, college, or university, which helps to balance their academic work and their extracurricular activities. This research was conducted using data of university students from the department of computer science to study the influence of credit on semester-wise student academic performance. After performing feature engineering on the data, different machine learning algorithms such as decision trees, random forest, and support vector machines were applied to the data, with the inclusion and exclusion of credit load per semester, to identify the effect of the credits on the students' academic performance (semester end Grade Point Average). From this study, the relationship between credit and semester-wise student performance is found to be a weak correlation. This may be due to the fact that students get adapted to the heavy academic load from schooling. This study needs to be conducted using school students' data. It is further recommended to balance out the academic work load so that there is little or no difference in the number of credits registered per semester, so students can get sufficient time to engage in other activities.	
EDIS #: 1570879850	Title: Development and Implementation of Natural Language Processing and 3D Virtualization-Based Technologies in Educational Applications
Author(s) with affiliation and country: Saurabh Sanjay Saindhane (Indian Institute of Information Technology, Tiruchirappalli (IIIT), India & Indian Institute of Technology Indore, India); Venkanna U (Teacher, India); Debanjan Das (IIIT Naya Raipur, India)	
Abstract: The introduction of automated speech recognition (ASR) and 3D Virtualization has the potential to revolutionize education, particularly for underprivileged children in rural India. This research project aims to develop an affordable and accessible artificial educational system, called Response Learning App, which presents students with real-life situations that require them to apply their acquired theoretical knowledge. By doing so, this system helps students enhance their capacities that are often underdeveloped or nonexistent. As technology continues to advance, it is essential to provide a supportable and strategic academic platform for children in rural India. To achieve this goal, this research explores the adoption of Automatic Speech Recognition (ASR), Natural Language Processing (NLP), and 3D	

technology in an effective and affordable way. The study examines the use of technology, engrossment, educational attainment, and its effectiveness on the users through various interrogations. The project formulates a variety of teaching methods, designs and implements interactive artificial intelligence, and verbally communicates with students as if they were someone else. To assess the effectiveness of this approach, a survey was conducted, and the respondents (N = 47 participants) expressed their views on artificial intelligence technologies and their adoption in education. This paper concludes by highlighting the possibilities of using virtual technologies and natural language processing to increase students' degree of attention, engagement, and create captivating environments for encouraging students to become high-spirited pupils. This research project aims to provide a more equitable and accessible education system for underprivileged children in rural India.

EDIS #: 1570880073 | **Title:** A Collaborative Learning and Support System for STEM Education and Learning Analytics

Author(s) with affiliation and country:

Qizhi Xu and Beijia Zhang (University of Science and Technology of China, China); Jing Wang (Anhui Xiyue Educational Technology Co. Ltd., China); Xiang Liu (Educational Testing Service, USA); Mengxiao Zhu (University of Science and Technology of China, China)

Abstract:

STEM education encourages students to collaborate in learning. With the rapid progress of information technology, computer-supported collaborative learning becomes a powerful method to facilitate STEM education with promising learning outcomes. However, researchers and teachers lack an integrated CSCL system able to meet the following needs: (1) an integrated and ready-to-use instant messenger that can support a large number of users stably, (2) a secured and robust framework that allow embedding third-party learning tasks, (3) support for researchers to design research plans and for teachers to manage classes, (4) power mechanisms to capture, store and export learning process data. To address these requirements. This paper presents a powerful collaborative learning and support system (called CLASS) specifically designed to support learning, teaching, and research in collaborative learning. The CLASS system is web-based, and is compatible with third-party HTML5 applications, which can be embedded safely and smoothly into the system, communicate with the server, and interact with other interface elements. It has also integrated an instant messaging service that can support millions of users simultaneously with text, audio, and video conversations. Assessment data and learning process data are automatically recorded at the server, and can be easily exported for learning analytics research. Internationalizing functions are also employed for users with different language preferences.

EDIS #: 1570880119 | **Title:** Flexible Submission Policy and Its Impact on Student Learning

Author(s) with affiliation and country:

Wenbing Zhao and Xiongyi Liu (Cleveland State University, USA)

Abstract:

In STEM higher education, the practice of setting hard deadlines for assignments without the possibility of late submission or with harsh penalties for late submissions is mainstream and rarely challenged. In this paper, we present arguments in favor of implementing a flexible late submission policy, and share our experiences in implementing a no-late-submission-penalty policy in two courses. Students are overwhelmingly supportive of the policy. In addition to presenting the anecdotal evidence, we analyze theoretical foundation for the submission policy. It appears that the traditional hard deadline submission policy is influenced by behaviorism in which the learner is modeled as a passive entity that is molded by operand conditioning. However, newer learning theories, including cognitivism, constructivism, and humanism, are treating the learner as an active agent that is influenced not just by external stimulus and conditioning, but also by the individual's affection, motivation, culture, as well as past knowledge and experiences. As such, assignment submission policy must be designed accordingly so that it is conducive for learning.

EDIS #: 1570880147	Title: Design and Implementation of a Time Management Self-Help Mobile App for College Students
Author(s) with affiliation and country: Wenbing Zhao (Cleveland State University, USA); Hanna Harb (Garfield Heights High School, USA)	
Abstract: College students, particularly students in the STEM disciplines, are facing huge challenges in time management, juggling between classes, part-time or full-time jobs, extracurricular activities, and social activities. Evidence has shown that academic success in college students is directly associated with their time management skills. Furthermore, a significant fraction of students suffer from procrastination issues. Unfortunately, such students are not receiving adequate help despite the fact that virtually every college in the US provides a suite of student-centered services such as counseling services. In this paper, we review studies related to academic procrastination, identify primary factors associated with academic procrastination, and major interventions towards reducing academic procrastination. Furthermore, we describe the design and implementation of a time management self-help mobile app to help college students manage their time and overcome issues that lead to procrastination. The self-help app facilitates a student to set goals on time allocation, organize tasks, enter progress made, review history of performance, and get help (such as available student services) via a local chatbot. The app incorporates several well-known mechanisms for reducing academic procrastination.	
EDIS #: 1570880317	Title: Integrating Multi-Professional Principles and Practices into the Medical Education Curriculum
Author(s) with affiliation and country: Milan Toma, Faiz Syed and Lise McCoy (New York Institute of Technology College of Osteopathic Medicine, USA)	
Abstract: Purpose: Due to the advances in healthcare technology, it has become increasingly obvious that engineering is becoming more integral to the process of providing care to people. For engineering and medical students to be able to take electives related to healthcare technology within an interdisciplinary context, the engineering and medical programs must work closely together. Through the implementation of these innovative projects, the students are exposed to new ways of co-designing and interacting with each other. Methods: Medical students were required to collaborate with engineers, architects, and artists as part of a program that was offered to them to create new assistive medical devices. It was asked of participants during the ideation phase of their project to complete a questionnaire in order to assess compassion satisfaction and burnout metrics. Results: On average, the combined compassion satisfaction score was high for both medical students (42/50) and non-medical students (43/50). In terms of burnout, 77% of medical students and 81% of non-medical students reported low burnout; the average burnout score for medical students was 19/50, and for non-medical students 17/50. Only one statement produced a statistically significant difference between groups. For the statement, "I am a caring person", only 31% of medical students self-described as being a very caring person 'very often' as opposed to 62% of non-medical students. Conclusion: A critical component of this innovative curriculum was determining whether students had a high degree of compassion satisfaction and if they were at risk of burnout as a result of it. The service-learning experience through prototyping allowed students to bridge the gap between science and practice in health care, which in turn contributed to student development, pride, and well-being.	
EDIS #: 1570880409	Title: Teaching Scientific Experiments through Online Video Lectures: An Eye-Tracking Research
Author(s) with affiliation and country: Qizhi Xu, Nuo Chen and Juanjuan Tu (University of Science and Technology of China, China); Xiang Liu (Educational Testing Service, USA); Mengxiao Zhu (University of Science and Technology of China, China)	
Abstract: Online video lectures have been promoted by technological advances as a beneficial tool for learning scientific experiments and were proved valuable in the COVID-19 pandemic numerous times when millions of students were forced to be home-schooled. Therefore, the urgency of studying the effects and various factors influencing online	

scientific experiment teaching is highlighted to enhance students' learning outcomes. This research aims to explore how online video lectures influence procedural and declarative knowledge and to determine whether instructor presence and other visual elements have specific effects on students' learning. In this study, seventy-eight students were randomly assigned to two groups for the controlled experiment. Students' eye movement data were collected to analyze visual attention distributions. Data analysis shows that (1) online video lectures significantly impact the retention of knowledge but have little effect on knowledge transfer; (2) instructor presence has no significant effect on students' learning performance; and (3) complex visual elements such as instructor appearance, tags, and dynamic images compete for students' exogenous attention and significantly affect learning. These findings uncover various factors influencing learning in online video lectures and suggest solutions for proper video design to facilitate students' learning.

EDIS #: 1570880486	Title: Problem Based Gamification to Enhance Quantum Literacy within Computational Thinking 2.0 Framework
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Author(s) with affiliation and country:

Apostolos Xenakis, Maria Sabani, Maria Avramouli, Ilias K. Savvas, Costas Chaikalis and Kalliopi Theodoropoulou (University of Thessaly, Greece)

Abstract:

Quantum mechanics is a fundamental, axiom-based physical theory that describes and explains phenomena that Classical Mechanics and Electrodynamics are unable to describe. It is considered a cross - disciplinary STEM field, advancing the philosophy of Quantum Literacy (QL), which focuses on nature's real complex problems. QL addresses the challenges of computing skills acquisition, through problem-based activities to offer powerful knowledge to a wide group of learners. Therefore, quantum technology knowledge should be accessible to students and teachers, in a more interactive way. In this paper, we propose contemporary and Problem based scenarios, in which students may acquire stronger mathematical, computational and modelling skills, working as real researchers. Thus, they acquire all necessary knowledge related to quantum principles, such as superposition, teleportation, entanglement, quantum gates and quantum information. The serious games we propose, relate to strategic games, within the computational thinking 2.0 framework. Certain Python libraries and packages are used and the didactic approach is based on game - based inquiry learning.

EDIS #: 1570880490	Title: A Sustainable Development Goal: A SMART Sustainable Electrical System for an Urban Community
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Author(s) with affiliation and country:

Enrique C Pajardo and Dong H Kang (Morgan State University, USA)

Abstract:

Despite the vast research in Sustainable Development (SD), very little is known about having a sustainable electrical system for an urban community. The overall image that emerges from past literature is that obtaining a new electrical system, such as installing a new circuit breaker panel is safer and more convenient than replacing fuses. This is a very a simplistic view of achieving a Sustainable Development Goal (SDG). The motivation for this study is to develop the concept of a sustainable electrical goal for an urban community. Establishing an SDG can increase an urban community wellbeing, which is a gap in most past research. The primary objective of this paper is to provide an electrical system that addresses economic, environmental, and social elements of sustainable development for any urban community. A task was completed to develop a basic sustainable "Self-Monitoring, Analysis and Reporting Technology" (SMART) electrical system. This study evaluated the community of Edmondson Village electrical systems for three reasons: (1) promote economic growth, (2) environmental benefits, (3) and improve communities well-being. The study was conducted at Morgan State University (MSU) in Baltimore, Maryland. The existing electrical systems in Edmondson Village were observed from site visits, local zoning permit office, and "Google Earth Pro" for Baltimore city. After an intense quantitative and qualitative analysis, it revealed majority of community's electrical system were deemed missing, unsustainable, inadequate, and unsafe. An application of the three elements of the "Nested Development" provided the foundation for a sustainable electrical system. This system was developed to be installed for any residential and local business in an urban community. The larger implications of the findings were

that an SDG can benefit any size urban community. However, other lower budget communities interested in initiating sustainable goals might benefit from undertaking low-cost educational strategies and techniques.

EDIS #: 1570880609	Title: Discussion on the Mathematics Behind Extinctions: A Detailed Statistical Assay on the Population Density of Northern White Rhinoceros
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Author(s) with affiliation and country:

Manan Roy Choudhury (Maulana Abul Kalam Azad University of Technology, West Bengal & Government College of Engineering and Textile Technology, Serampore, India); Ishan Banerjee (Chennai Mathematical Institute, India)

Abstract:

Species extinctions have been a significant part in disturbing the biodiversity. This creates an importance in trying to simulate the populations of the species of interest to get an idea when its population looks threateningly low. We will try to get an idea regarding the mathematics working behind the prediction of the extinction time of a creature. We will briefly overview the associated ideas and how the predictions work mathematically. We will also take a real - life example to understand the idea better. A detailed statistical assay is being carried out using deterministic and non-deterministic approaches to study the Northern White Rhinoceros population curve. Probability heuristics is used along with its terminologies to analyze the extinction of Northern White Rhinoceros. Several fitting tests have been performed on the population dataset of the Northern White Rhinoceros to determine which statistical distribution fits well for the dataset. After testing it is observed that Weibull distribution fits well and it is to represent the demography of Northern White Rhinoceros year-wise from 1960 to 2022. Finally, a TreeMap has been used to represent the hierarchical population demography of Northern White Rhinoceros.

EDIS #: 1570880637	Title: Successful Model for a Course-based Undergraduate Research Experience (CURE) in Mathematics and STEM during the First Two Years of College
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Author(s) with affiliation and country:

Guillermo Alvarez Pardo (Cuesta College, San Luis Obispo, California, USA)

Abstract:

The importance of undergraduate research experiences (UREs) has been increasingly defended and documented in the last decades. As a consequence of its popularity, internships, summer camps and other types of UREs have become more competitive and harder for students to access, and, in the last years, colleges, universities and educative centers have developed an interest in offering their own opportunities in the form of Course-based Undergraduate Research Experiences (CUREs). This paper introduces a model for an accessible, low-cost, high-efficiency CURE in Mathematics with the involvement of collateral STEM disciplines like Statistics, Data Science or Business. The model is a work-in-progress that has been offered and tested for two academic years (2021-22 and 2022-23), with the course delivered in the fall and its fruits coming throughout the whole year. This paper presents a justification of the CURE and its design and a description of the methodology used, the challenges surpassed and the results obtained during those first two editions or iterations, including sample deliverables, publications, exposure in national conferences and other success data. It emphasizes the key aspects that make the course simple and exportable, so the reader acquires the know-how and can easily instrument the course at their own institution. The CURE was developed at a two-year college as part of a larger NSF-awarded project, and has established connections with four-year institutions, high schools, national and international professional associations, journals and conferences, employers, private investors and government agencies.

EDIS #: 1570880658	Title: On enabling remote hands-on Computer Networking Education: the NITOS testbed approach
Author(s) with affiliation and country: Nikos Makris and Virgilios Passas (University of Thessaly & CERTH, Greece); Apostolos Apostolaras (University of Thessaly & The Centre for Research & Technology Hellas, CERTH, Greece); Theodoros Tsourdinis (University of Thessaly, Greece & Sorbonne University, France); Ilias Chatzistefanidis and Thanasis Korakis (University of Thessaly, Greece)	
Abstract: Education in recent years has slowly transitioned to an online model, allowing massive access to online courses virtually from anywhere. The adoption of such educational models was boosted by the global pandemic in 2020, with universities and other degree programs quickly transitioning to such schemes. Although such a model is apt for lecture-based courses, hands-on training remains a puzzle on how it can transition to remote learning. In this work, we describe and evaluate our scheme for integrating testbed resources in online-taught networking-related courses in University of Thessaly, Greece. The framework is based on Kubernetes and is able to deliver hands-on labs related to networking as micro-services over the testbed architecture with minimal overhead on the lab setup from the instructor. The proposed approach has been applied in the networking-related courses of the curriculum during the 2020-2021 and 2021-2022 academic years, educating more than 800 students on computer networking concepts in practice. The paper describes the framework and a benchmarking evaluation, which proves the capacity of the framework to serve up to 5 times higher numbers of students, compared to prior methodologies and practices, without any infrastructure upgrades.	
EDIS #: 1570880761	Title: Active Learning on Neural Networks through Interactive Generation of Digit Patterns and Visual Representation
Author(s) with affiliation and country: Dong Jeong (University of the District of Columbia, USA); Jin-Hee Cho (Virginia Tech, USA); Feng Chen (University of Texas at Dallas, USA); Audun Jøsang (University of Oslo, Norway); Soo-Yeon Ji (Bowie State University, USA)	
Abstract: Artificial neural networks (ANNs) have been broadly utilized to analyze various data and solve different domain problems. However, neural networks (NNs) have been considered a black box operation for years because their underlying computation and meaning are hidden. Due to this nature, users often face difficulties in interpreting the underlying mechanism of the NNs and the benefits of using them. In this paper, to improve users' learning and understanding of NNs, an interactive learning system is designed to create digit patterns and recognize them in real time. To help users clearly understand the visual differences of digit patterns (i.e., 0 ~ 9) and their results with an NN, integrating visualization is considered to present all digit patterns in a two-dimensional display space with supporting multiple user interactions. An evaluation with multiple datasets is conducted to determine its usability for active learning. In addition, informal user testing is managed during a summer workshop by asking the workshop participants to use the system.	
EDIS #: 1570880789	Title: Review of Integrated STEM+C e-Learning Platforms to Support Underrepresented Students
Author(s) with affiliation and country: Ella Neading, Teresa M. Ober and Paul R Brenner (University of Notre Dame, USA)	
Abstract: Despite initiatives to promote broader participation within the workforce, the science, technology, engineering, mathematics, and computer science (STEM+C) fields still lack diversity. The underrepresentation of historically marginalized students in STEM+C fields may be caused by several factors. Such factors may include but are not limited to, a lack of exposure in their early childhood education, lack of confidence, and gender stereotypes that are perpetuated by society. While a systemic issue, the availability of e-learning platforms has the potential to provide low-stakes opportunities for historically marginalized students in STEM+C to explore subject areas and develop an interest. There is also the added benefit that such platforms are highly scalable. This paper offers a review and	

synthesis of the effectiveness of current e-learning platforms for promoting historically marginalized students' participation in STEM+C focusing specifically on female students' participation and e-learning platforms that teach STEM+C content. The benefits of such platforms, along with the limitations (e.g., cost, learner motivation, lack of social interaction and technical skills, etc.) are taken into consideration. However, based on the findings described in this review paper, such limitations ultimately do not undermine the benefits e-learning platforms may have in supporting students' interest in pursuing STEM+C and promoting broader participation.

EDIS #: 1570880815	Title: Examining the impact of experiment-centric pedagogy on students' critical thinking, test anxiety, and motivation while using hands-on technology through pre- and post-activity questionnaires
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Author(s) with affiliation and country:

Frank Efe (Morgan State University, Baltimore, MD, USA.); Antony Kinyua, Ezana Negusse, Krishna. Bista, Gaulee Uttam, Oludare Owolabi, Pelumi Abiodun, Adebayo Olude, Opeyemi Adeniran, Neda Bazyar Shourabi and Chukwuemeka Duru (Morgan State University, USA)

Abstract:

This study aims to summarize the positive effects of Experiment-Centric Pedagogy (ECP) hands-on tools on students' ability to think critically, test anxiety, and motivation rate. Using survey-monkey and IBM SPSS, data was gathered, examined, and cleaned. Both remote and classroom lab experiments were used in this study. Thirty undergraduate physics students served as the subjects. The results include analyzed data, photographs, and feedback from students gathered through observation and oral defense of their reports. The study demonstrated that the introduction of the ECP hands-on device changed the learning environment, resulting in (1) an increase in the positive impact of the survey constructs of critical learning and test anxiety, (2) an enhancement of learning enthusiasm, and (3) an increase in motivation rate that enhances their academic performance. There was a significant difference in the pre- and post-test scores of critical thinking and test anxiety ($p < 0.05$). All these observations account for the high impact of ECP on students' critical thinking, test anxiety, and motivation via hands-on devices.

EDIS #: 1570881617	Title: Best State Estimate for the Phase Angles of Busbars in Power Systems via Circuit Modeled with DC Load Flow
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Author(s) with affiliation and country:

Ronak Ali (University of Kentucky USA, USA); Shujaat Ali (Tianjin University, China); Tariq Pirzada (Nazeer Hussain University, Pakistan); Syed Hadi Hussain Shah (Muhammad Ali Jinnah University Karachi, Pakistan); Madad Shah (IBA Sukkur, Pakistan); Saeed Ahmed Khan (Sukkur IBA University, Pakistan)

Abstract:

State estimate is a digital processing method that gives many of the central control and dispatch operations in a power system a real-time data basis. It is essential to do state estimates to get rid of probable errors and boost system reliability. State variables, which are utilized to further calculate other power system characteristics, are necessary to determine the state of a system. Based on measurements, or input, such as active power, reactive power, voltage, and current magnitude collected from the system, these state variables are given a value. Voltage and phase angle are often utilized as state variables. The method used for state estimation will, however, affect the choice of state variables. In addition to input parameters, network data such as topology and impedances are also necessary. The measurements are made with a meter that has a predetermined full-scale reading that can be used as a starting point for calculations. When estimating the state, there may be errors that cause the reading from a meter to differ from the genuine value. Error in measurement is taken good care of here. Where measurement error, measurement and estimated value for the meter reading is considered. The best approximation of the voltage angles and power flow is obtained using it. The Weighted Least Squares Method is a widely used method for estimating system state.

EDIS #: 1570882072	Title: Challenges and Applications of AI in Healthcare: A Review
Author(s) with affiliation and country: Arav Kumar (Monroe Township High School 200 Schoolhouse Rd Monroe Township NJ 08831, USA); Savya Vats (Bergenfield High School 80 S Prospect Ave Bergenfield NJ 07621, USA); Anvi Kumar (Monroe Township High School 200 Schoolhouse Rd Monroe Township NJ 08831, USA); Avimanyou K Vatsa (Fairleigh Dickinson University, Teaneck, USA)	
Abstract: In this fast-paced automated digital world, people's feelings about Artificial Intelligence (AI) applications in healthcare depend on the diverse attitudes of the patients. It also depends on reliable sources and anxiety about healthcare and AI. However, healthcare faces many challenges in trying to achieve its goals. The four main goals of healthcare are to improve population health, patients' experience, and caregiver experience and to reduce the rising cost of care. Although people are getting a better understanding of healthcare situations and are encouraged to broaden their thoughts on the potential computerized technologies, people are still concerned about the effect of AI in the medical domain. Therefore, applying technology and AI in healthcare can help hospitals, especially when viruses like COVID reduce the workforce. As a result, if AI is successfully implemented, we could see a rapid change in the hospital experience, reduce the amount of work needed in the hospital, protect healthcare professionals from life-threatening viruses or infections, and diagnosis would be efficient, effective, fast, and accurate.	
EDIS #: 1570882078	Title: Enumeration of Birds using Video Segmentation for a Better Understanding of Bird Behaviors
Author(s) with affiliation and country: Avimanyou K Vatsa (Fairleigh Dickinson University, Teaneck, USA); Dohyun Lee, Benen Sullivan, Daniel Hogan and Amishi Mittal (Bergen County Academies 200 Hackensack Ave Hackensack NJ 07601, USA); Elise Morton and Harald Parzer (Fairleigh Dickinson University, USA)	
Abstract: The State of the World's Birds 2022 report estimated a decline in 30% of the world's birds since 1970, largely attributed to habitat loss, climate change, and other anthropogenic factors [1, 3]. Chimney swifts are aerial insectivores that forage during the day and commonly roost in large colonies inside hollow vertical human-made structures such as chimneys. Signaled by sunset, large groups of this species, sometimes comprised of thousands of individuals, exhibit an impressive display of coordinated entry into their roosting sites. Despite this striking behavior and close relationship with humans, the factors influencing this collective behavior are poorly understood. To understand how anthropogenic and environmental factors influence the population health of this (and other species), reliable methods for counting individuals are required. The purpose of this study is to develop an automated method to accurately count the number of birds over a given period at the roosting site. To understand the behavior of colonially roosting species such as the Chimney swift, we proposed a methodology in which we collect and analyze videos of birds at roosting sites to understand their behaviors. The proposed approach consists of two steps: physically gathering the video with cameras perched at optimal locations [2] and utilizing video segmentation algorithms to count the number of birds at roosting sites over time. The final goal of this research is to build useful data for ecologists that can be utilized to fill critical gaps in knowledge. To achieve this, the number of birds counted over time will be analyzed with ambient weather datasets at different geographical locations. Therefore, in this paper, we use four video segmentation algorithms to detect and track the movement of birds, count the number of birds at certain intervals, and then compare the performance of the algorithms.	

EDIS #: 1570882775	Title: Local Energy Marketplace Agents-based Analysis
Author(s) with affiliation and country: Ameni Boumaiza (ALRAYYAN & QEERI, Qatar)	
Abstract: A new role known as an energy prosumer is created when distributed energy generation is established through home and commercial PV applications. This eliminates the conventional distinction between energy producers and consumers. Blockchain technology automates direct energy transactions within a distributed database architecture based on cryptographic hashing and consensus-based verification, consumers, prosumers, offering energy, and utilities with a unique, affordable, and safe energy-trading solution. The goal of this study is to deploy a general ABM simulation framework for electricity exchange and illustrate the predicted households' power profiles as well as the functionality of any blockchain process (see Figure. 1). For a Transactive Energy (TE) type Distributed Energy Resources (DER) within the ECCH microgrid that is dependent on blockchain engineering, an original version of a robust multi-agent structure was built and simulated. Recent blockchain-based LEM proposals use auction systems to balance supply and demand in the future. As a result, these blockchain-based LEMs depend on precise short-term projections of the energy output and consumption of specific households. Such precise estimates are frequently just taken for granted. This assumption was put to the test in the current study by first assessing the forecast accuracy that can be achieved for specific households using cutting-edge energy forecasting techniques, and then by analyzing the impact of prediction errors on market outcomes in three different supply scenarios. Although an LSTM model can produce reasonably low forecasting errors, the evaluation revealed. The prediction procedure will be adjusted to the configuration of an LEM built on a blockchain. Therefore, the current research stands out significantly from earlier experiments that make a complete attempt to estimate the time sequence of smart meters in general .	
EDIS #: 1570883097	Title: Representation of Distribution Network for Teaching Power Flow Analysis- A Case Study of an Academic Campus
Author(s) with affiliation and country: Suresh H Jangamshetti (Basaveshwar Engineering College (Autonomous), India); Sangamesh Goudappanavar (Basaveshwar Engineering College, Bagalkot India, India)	
Abstract: This paper presents representation and analysis of 11 kV, 15-bus electrical distribution network of an academic campus for effective teaching of network topology and power flow analysis. Distribution network of Basaveshwar Engineering College, Bagalkote, Karnataka India is considered for the case study. It has dual path radial distribution network which is spread over 92 acres with overhead transmission length of 0.89 km. Seven 11 kV/440 V distribution transformers are connected using ACSR rabbit type overhead lines. The transformers are located close to load centres, viz different departments. The real-time data of campus distribution network helped students to draw single line diagram, obtain line data, bus data and formation of admittance matrix. The resultant data of topology is employed to perform load flow analysis using MiPower simulation software. The proposed scheme is included in undergraduate curriculum of academic years 2017-18 and 2018-19. The outcome clearly showed improvement in understanding the practical concepts of power flow analysis. The proposed topology is further used for short circuit and stability studies. The study can be extended for campus energy management, distribution network analysis and integration of renewable energy sources.	
EDIS #: 1570883271	Title: Evaluating the Effectiveness of Equitable K-12 Professional Learning Access in Computer Science
Author(s) with affiliation and country: Jean Chu, Yulia Kumar, Daehan Kwak, James Novotny, Pankati Patel and Patricia Morreale (Kean University, USA)	
Abstract: Computer science professional learning, widely available to 9-12 educators, has increased the number of AP CS courses offered in the U.S. and the number of students taking those courses. However, access to all CS classes remains unequal, dependent on the state, district, counselors, and teachers providing a pathway for K-12 students into the CS classrooms. A 15-month project was undertaken to provide professional learning for K-12 educators to	

provide broader access for more students. The goal was to increase the knowledge and preparation of teachers in a wide range of school districts, as defined by socioeconomic status (SES), to meet state CS standards. Objectives included increasing the number of educators to teach CS, expanding equitable access to high-quality CS education, and providing resources to school districts to support CS education across the K-12 curriculum. Research questions include determining the most effective professional learning strategy for K-12 educators by grade band and identifying best practices to build a community of educators to support students in CS equitably. Strategies included physical and virtual events, single and multi-day workshops, individual study and out-of-class learning. Results show that 70% of the participants (n=175) came from districts with low SES factors. Short events and peer support enticed educators new to CS. In contrast, experienced CS educators wanted to meet nationally recognized norms, such as the Praxis CS examination, or learn advanced topics. These results can be used to provide more K-12 educators with CS professional learning.

EDIS #: 1570884157	Title: Teaching an Introductory Programming Course with Project Based Collaborative Learning in a Virtual Learning Environment
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Author(s) with affiliation and country:

Mahmudur Rahman and Roshan Paudel (Morgan State University, USA)

Abstract:

Computer programming is one of the most challenging subjects in the computer science curriculum, particularly for the freshmen without any programming background. This work presents our experience and approaches of teaching an introductory computer programming class virtually using Python programming in Fall 2020. Without reinventing the wheel and without missing out the benefits of hands-on learning, project based collaborative learning was infused and assessed with well-defined rubrics to create a dynamic remote classroom environment. To keep the structure of the session much like an in person learning experience, the synchronous session included whole group instruction in Zoom led by the instructor and small group (breakout room) based lab work in Repl.it amongst the learners. Both interactive and collaborative learning are infused in pedagogy effectively so that students can learn using interactive platforms, tools, technologies, systems, and services as available to them and collaborate within and among groups. To evaluate the impact of the infusion, a pre- and post- performance survey were conducted on a student cohort of 4 sections taught by 3 different instructors. In addition, final project scores and final grades for Fall'2020 semester and enrollment number and final grade distributions from Fall'2017 to Fall'2020 were also available for analysis. The initial evaluation of the survey results and student's performances based on quality point scores show evidence to conclude that the proposed pedagogical approach increased student motivation and engagement and facilitated learning to entry-level computer science students.

EDIS #: 1570884178	Title: System Dynamics Modeling Optimization of STEM Education and Outreach Career Pipelines for Students in Underrepresented Communities
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Author(s) with affiliation and country:

Daniel C Appel (US Air Force Research Laboratory, Kirtland AFB, NM & Aegis Technologies Group Inc., USA); Mo Mansouri (Stevens Institute of Technology & University of South-Eastern Norway, USA)

Abstract:

Academic and career achievement in science, technology, engineering, and mathematics, (STEM) for K-12 students remains a key area to advance equity and achievement across society. Developing and exploring system dynamics models of the STEM education and outreach ecosystem to understand phenomena related to pipeline leakage observed in underrepresented demographics provides opportunities to explore and optimize intervention strategies. Correlating outputs of system dynamics modeling and simulation to real-world survey data enabled extensive sensitivity analysis of the feedback-driven model elements to be performed. Modeling the complete outreach-catalyzed education to workforce ecosystem enables testing and optimization of intervention strategies, tailored for underrepresented demographics. Strategies such as prioritizing near-peer and other mentorship initiatives, involving families in activities such as 'family STEM nights', using field trips to expose students to the diversity of work opportunities, and tailored curriculum including the accomplishments of prominent contributors in STEM fields from diverse backgrounds emerged as key heuristics for closing the representation gap in these fields. The massive

improvements and positive feedback mechanisms that reinforce beneficial changes across the ecosystem can benefit all students with their STEM education and career aspirations.	
EDIS #: 1570884244	Title: Environmental Education Through Activities: Teacher Practices of Including Students' Lived Experiences
Author(s) with affiliation and country: Tanaya Vyas and Girish Dalvi (Indian Institute of Technology Bombay, India)	
Abstract: This paper examines teachers' use of students' lived experiences in primary Environmental Studies (EVS) classrooms of government schools in suburban Mumbai. Data was collected through ethnographic field notes and semi-structured interviews across four schools and fifteen teachers teaching Grades 3 to 5. Environmental Education (EE) is a crucial aspect of the integrated STEM field, for advancing sustainability in a rapidly changing world. EE in primary grades in India is introduced through the subject 'Environmental Studies' (EVS). EVS integrates the concepts and issues of science (physical, chemical and biological), social studies (history, geography, civics, society, culture) and environment education (protection and conservation). Under efforts to generate quality education, several activities have been introduced to link theoretical concepts and students' real-world scenarios. While the effectiveness of curricular activities and resources for EVS in promoting student learning is often investigated, teachers' implementation of these materials have received less attention. Students bring different lived experiences into the classroom, and we examine what those mean to the teachers. We examine teachers' approaches towards inviting these experiences as part of their process of adapting textbook activities. Episodes of teacher practice illustrate the wide variety in their use of timing and reasons for introducing and sustaining discussions with students. The study also describes how the teachers integrate their own life experiences with those of the students to support meaningful dialogue. Finally, teacher views on limitations and possibilities of using students' lived experiences are discussed.	
EDIS #: 1570884297	Title: CPS-TR: An Online Training Platform to Address Fourth Industrial Revolution Workforce Needs
Author(s) with affiliation and country: Pratik Satam, Carter Philipp, Sicong Shao and Soheil Salehi (University of Arizona, USA)	
Abstract: The widespread deployment of 'Smart' Infrastructure, which uses networked computing systems to manage physical processes, has brought the onset of the fourth Industrial Revolution (4IR). The 4IR relies on network interconnectivity, sensing, automation, robotics, and artificial intelligence to improve the productivity of modern manufacturing environments while reducing their workforce needs. Although beneficial, this growing adoption of 4IR has increased the complexity of Industrial Control Systems (ICS), creating a huge workforce skills gap and causing 2.1 million manufacturing jobs to go unfulfilled by 2030. In the context of these challenges, this paper presents Cyber-Physical Systems Training Range (CPS-TR), a cloud-based scalable student training platform to address 4IR needs, especially cybersecurity. The CPS-TR, built on Amazon Web Services (AWS), allows instructors to create experimental scenarios using virtual machines in AWS' Elastic Cloud (EC2), connected via AWS Virtual Private Cloud (VPC) based subnet providing an isolated communication environment. The CPS-TR front-end provides a web application-based interface for students and instructors to design new material and perform experiments. This paper evaluates the performance and efficiency of the CPS-TR environment while showcasing an experiment teaching trainees about the safe use of the MQTT protocol from 4IR infrastructure software updates. The experimental evaluation shows that a trainee's network traffic volume while using the CPS-TR peaks at 2000 packets in a second; the network bandwidth requirements of a basic network connection suited for usage with mobile and tablet devices. The experimental evaluation also shows the VPC subnet communication peaks at eight packets in a second, with a cumulative packet count of fewer than 70 packets. This low VPC subnet utilization is in combination with EC2 T2.Micro VMs allows the CPS-TR operation costs to stay low.	

EDIS #: 1570884373	Title: Realistic Examples of Mathematical Physics at the Civil Engineering Program
Author(s) with affiliation and country: Huber Nieto-Chaupis (Peru & Universidad Autónoma del Perú, Peru)	
Abstract: As commonly known, a first course of physics at the civil engineering program is planned to expose classical mechanics with applications to concrete examples of real life. The lack of a sustainable mathematical level emerges a first obstruction to go through a deeply treatment of cases that might be an important motivation to enrich the theoretical component of program towards a solid professional formation as well as in the territory of research. This paper tries to present some methodologies from the Mathematical Physics with concrete examples in the manner as seismic waves can affect large buildings. The case of shear stress and the possible solutions by employing novel versions of Internet are presented as a sequence of topics. The Bessel polynomials are introduced to model the generated S-wave that are released after a random shear stress. These prospects of topics might be included in a modern curricula of civil engineering program with a view in next decade.	
EDIS #: 1570884387	Title: Virtual Reality Museum Application for the Arts
Author(s) with affiliation and country: Joshua Maddy and Husnu S Narman (Marshall University, USA)	
Abstract: Most students are monetarily or physically inhibited from visiting private or public institutions. The Metaphysical Exhibit project goal is to give all ages a modern, technological take on the museum experience by providing a Virtual Reality alternative. By lowering the barrier of entry to a one-time purchase for the hardware and free software, any classroom or consumer can experience masterworks in an immersive environment. A rich collection of art pieces across the eras can be displayed under one roof by compiling public information on historical works. By utilizing Virtual Reality, the museum is easily distributed and portable. In this paper, we aim to develop a virtual museum with artworks and observe its effects on users. The developed application is capable of running on modern headsets, specifically the Meta Quest 2. To analyze the viability of the application in a classroom and personal setting, we especially find answers to the following questions: (i) Does experiencing the museum in this format feel analogous to prior exhibit experiences? (ii) What is the level of interest in exploratory, self-guided Virtual Reality content used in education from a student and teacher perspective? (iii) How can the experience be improved? The results show that the project was received positively by students and teachers as an introductory experience for the arts.	
EDIS #: 1570884409	Title: An Immersive Curriculum to Develop Computational Science and Research Skills in a Cohort-Based Internship Program
Author(s) with affiliation and country: Erik Johnson, Marisel Villafañe-Delgado, Danilo Symonette, Katherine-Ann Carr, Marisa Hughes, Julie Burroughs, Sydney Floryanzia and Martha Cervantes (Johns Hopkins University Applied Physics Laboratory, USA); William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)	
Abstract: Workforce education is a key challenge as computational science, including data science and machine learning, increasingly influences critical application spaces such as public health and medicine, space exploration, national security, autonomous systems and cybersecurity. Developing core software development, analysis, and machine learning skills will enable workers to have impact across a range of spaces. These skills are in high demand in industrial research and development, but we do not believe that traditional recruiting and training models in industry (e.g., internships, continuing education) are serving the needs of the diverse populations of students who will be required to revolutionize these fields. To accelerate workforce development in these key areas, we have designed and executed a machine learning and research skills training curriculum for our cohort-based research internship program, the Cohort-based Integrated Research Community for Undergraduate Innovation and Trailblazing (CIRCUIT). The program targets trailblazing, high-achieving students who face barriers in achieving their goals and the training program is aimed at accelerating their growth as leaders in data science, machine learning, and artificial intelligence research. The training curricula and support structure is designed to be flexible to student and research project needs	

during a research internship. Utilizing both existing online material and custom workshops, this model consists of a compressed data science and machine learning curriculum, a series of professional development training workshops, and team-based challenges. Strategies allow for customization of these training efforts for individual students and projects. Over four cohorts, this training curricula has helped students achieve mastery of data science and machine learning concepts, produce key demonstrations and work products in their cohort research projects, and progress to further internships, graduate school, and employment.

EDIS #: 1570884432 | **Title:** Adapting Cybersecurity Teacher Training Camp to Virtual Learning

Author(s) with affiliation and country:

Joshua Maddy, Eric M Dillon and Husnu S Narman (Marshall University, USA)

Abstract:

Over the past couple of years, many summer camps have found it necessary to transition their face-to-face programs into online experiences. When adapting it, it is critical to consider how to best ensure an educational experience similar to preceding programs. This raises two primary questions: what pedagogical tools and methods are supported in an online format that replicate the teachings in a face-to-face experience; and second, how to best maintain the efficacy of the program. We define efficacy as a combination of two measures: first, whether the camp matches the sponsor, GenCyber's, mission of promoting the education of cybersecurity to K-12 students and teachers; and second, whether the camp maintains a high level of participation and reported interest. We evaluated our efficacy by analyzing the report provided by the official GenCyber team as well as by recording hours of participant activity, polling participants on a daily basis, and following up after the program with an additional questionnaire. We determined that the camp was effective due to near-unanimous daily approval, strong interest in repeating the camp, and a significant amount of real-world student exposure to cybersecurity topics. Approximately 65% of the twenty teachers who participated in the camp immediately implemented cybersecurity principles in their respective fields, ranging from subjects in science and mathematics to career education and ROTC. Our result shows that 950 K-12 students exposure to cybersecurity subjects within their course subjects in the first semester after the camp and 800 of those are not in the computer science course subjects.

EDIS #: 1570884535 | **Title:** A Predictive Analysis of Imposter Phenomenon in STEM Education

Author(s) with affiliation and country:

Katherine-Ann Carr (Johns Hopkins University Applied Physics Laboratory, USA); Aishwarya Jayabharathi (Johns Hopkins University, USA); Jacalynn Sharp (Johns Hopkins Applied Physics Laboratory, USA); Julie Burroughs (Johns Hopkins University Applied Physics Laboratory, USA); Jorge Rivera (Johns Hopkins University, Applied Physics Laboratory, USA); William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)

Abstract:

Technology companies across the country have used hackathons to showcase ideas, talents, and collaboration in a time-bound, prompt-driven framework. These hackathons also often act as an informal learning space. We recently implemented an intern hackathon as a tool for engaging students through innovation, technical work, and further exposure to our work culture. We expanded beyond these goals to develop an inclusive and diverse talent identification platform. When considering STEM fields and inclusivity, the concept of imposter phenomenon is often discussed as a barrier through feelings of self-doubt. This topic is based on research that began with particular populations and often did not include the diversity needed to generalize appropriately. Exploring the diverse identities within the intern population during a hackathon, our research seeks to explore the connection between imposter phenomenon and different identifiers. In addition to analyzing these connections, we hope to see whether machine learning approaches may be used to identify these barriers earlier and the effects the environment had on the study results. In this study, we developed a reproducible framework; identified correlations using machine learning; and critically found that many of the demographic correlations expected in a STEM environment were not observed, suggesting that our inclusive environment may limit these negative emotions.

EDIS #: 1570884543	Title: Multi-Lingual DALL-E Storytime
Author(s) with affiliation and country: Noga Mudrik (Johns Hopkins University, USA); Adam Charles (The Johns Hopkins University, USA)	
Abstract: Visualizations are a vital tool in the process of education, playing a critical role in helping individuals comprehend and retain information. With the recent advancements in artificial intelligence and automatic visualization tools, such as OpenAI's DALL-E, the ability to generate images based on text prompts has been greatly improved. However, these advancements present a significant challenge for populations with limited English proficiency, exacerbating the educational divide between children from different backgrounds and limiting their access to new technology. Here, we introduce a DALL-E storytelling framework designed to facilitate the fast and coherent visualization of non-English songs, stories, and biblical texts. Our framework extends the original DALL-E model to handle non-English input and allows users to specify constraints on story elements, such as a specific location or context. The key advantage of our framework over manual editing of DALL-E images is that it offers a more seamless and intuitive experience for the user, as well as automates the process, thus eliminating the time-consuming and technical-expertise-requiring manual editing process. The visualization masks are automatically adjusted to form a coherent story, ensuring that the figures and objects in each frame are consistent and maintain their meaning throughout the visualization, allowing for a much smoother experience for the viewer. Our results demonstrate that our framework is capable of effectively and quickly visualizing stories in a coherent way, conveying changes in the plot over time, and creating a narrative with a consistent style throughout the visualization. By enabling the visualization of non-English texts, our framework helps bridge the gap between populations and promotes equal access to technology and education, particularly for children and individuals who struggle with understanding complex narrative texts, such as fast-paced songs and biblical stories. This holds the potential to greatly enhance literacy and foster a deeper understanding of these important texts.	
EDIS #: 1570884565	Title: Strategies for Enhancing Retention of Information Technology Students
Author(s) with affiliation and country: Tacksoo Im, Hyesung Park, Wei Jin, Sonal Dekhane, Sebastien Siva and Rahaf Barakat (Georgia Gwinnett College, USA)	
Abstract: In this paper, we describe the challenge of retaining students enrolled in an Information Technology undergraduate degree program and the various interventions initiated to improve the result. The success of students in information technology programs can be measured by their graduation rates and outcomes. However, a major challenge for some students is often the first programming course. In this study, we evaluate the effectiveness of our efforts to address this challenge and discuss plans for future improvement. We broadly define our interventions into two categories: curricular and student engagement related. Efforts to decrease the cost of textbooks, POGIL inspired instruction, media-based instruction and a non-majors course are examples of curricular interventions that were adopted. Student engagement strategies such as programming boot camps and peer led instruction are also discussed. Retention data is also presented which indicates that the preparedness of student is not indicative of student retention and that other factors may be influencing retention.	
EDIS #: 1570884590	Title: Retrocomputing in Contemporary Integrative STEM Education
Author(s) with affiliation and country: Zheming Zhang (Rensselaer Polytechnic Institute, USA)	
Abstract: In a world of exponentially growing demand for computing power running into chip technology challenges, it takes both software and hardware backgrounds to design and constructs an optimal system. The existing computer system engineering curricula have drawbacks as they cannot reach the equilibrium between the simplicity of theory and complicated real-world practical systems. This article proposes an initiative to introduce retrocomputing to bridge the gap between hardware and software curricula. The core idea is to bring simple yet practical computer systems into the classroom, specifically consumer market microcomputers built upon microprocessor technology in the 1980s. The retrocomputing activities can be summarized into a three-stage collect-restore-build pathway with progressively	

demanding knowledge and problem-solving skill requirements for different levels, from middle school to college. In addition to hands-on experience, introducing retrocomputing as a hobby has several benefits, including developing self-motivated students, lifetime learning habits, and sustainability awareness. Challenges such as class organization and insufficient teaching resources exist, but there are workarounds.	
EDIS #: 1570884594	Title: An Inclusive Approach to Hands-on STEM programs in Underserved Secondary Schools: An Epistemological STEAM Model
Author(s) with affiliation and country: Martha Omoekpen Alade (Ambrose Alli University Ekpoma & Women in Technology in Nigeria, Nigeria)	
Abstract: Underserved schools globally do not often have sufficient resources and requisite models to run inclusive and sustainable hands-on STEM programs. This mixed and longitudinal study proposes an inclusive framework to address this inequity in STEM comprising seven hypothesized critical concepts after inductive analysis of empirical observations over a decade. A survey of 148 participants comprising 32 teachers and 116 students was carried out and analysed using simple statistical method to tests our framework. The research reveals Underserved schools globally do not often have sufficient resources and requisite models to run inclusive and sustainable hands-on STEM programs. This mixed and longitudinal study proposes an inclusive framework to address this inequity in STEM comprising seven hypothesized critical concepts after inductive analysis of empirical observations over a decade. A survey of 148 participants comprising 32 teachers and 116 students was carried out and analysed using simple statistical method to tests our framework. The research reveals	
EDIS #: 1570885237	Title: A meta-analysis on the effect of internal communication
Author(s) with affiliation and country: Jieqi Wang (Nanyang Technological University, Singapore)	
Abstract: Internal communication is a necessary factor within any organization in the workplace. It can partly affect the efficiency of how an institution works as well as an organization's achievements and developments. However, how internal communication contributes to the three vital factors - employee satisfaction, employee performance, and employee engagement, is poorly understood. The majority of previous studies only concluded the possible influences of internal communication on one of the factors (i.e. employee satisfaction, employee performance, or employee engagement) or in a single industry (e.g. healthcare). Thus, a meta-analysis was conducted in this research to examine the general influence of internal communication on all these three employee outcomes without the limitation of industries. By using the findings from 33 studies, this research summarized the effect and the most influential characteristics of internal communication on employee performance, employee engagement, and employee satisfaction. The results from the current meta-analysis have theoretical and practical implications for internal communication related research and management within companies, and highlight new directions for future studies.	
EDIS #: 1570885580	Title: Detecting encrypted traffic activities and patterns in ZigBee network Data
Author(s) with affiliation and country: Jeffrey S Chavis (Johns Hopkins University Applied Physics Laboratory, USA); Joy Falaye (JHUAPL & Morgan State University, USA); Kevin Kornegay (Morgan State University, USA); Daniel H Simon (Johns Hopkins Applied Physics Lab, USA); Khir Henderson (JHUAPL & Morgan State University, USA)	
Abstract: With the increase in data transmissions and network traffic over the years, there has been an increase in concerns about protecting network data and information from snooping. With this concern, encryptions are incorporated into network protocols. From wireless protocols to web and phone applications, systems that handle the going and coming of data on the network have applied different kinds of encryptions to protect the confidentiality and integrity of their data transfers. The addition of encryptions poses a new question. What will be observed from encrypted traffic data? This work in progress research delivers an in-depth overview of the ZigBee protocol and analyzes encrypted ZigBee traffic on the ZigBee network. From our analysis, we developed possible strategies for ZigBee traffic analysis. Adopting the proposed strategy makes it possible to detect encrypted traffic activities and patterns of use on the ZigBee	

network. To the best of our knowledge, this is the first work that tries to understand encrypted ZigBee traffic. By understanding what can be gained from encrypted traffic, this work will benefit the security and privacy of the ZigBee protocol.	
EDIS #: 1570885674	Title: Design and Development of a Sustainability-focused Hybrid Course for Undergraduates Based on Open Educational Resources
Author(s) with affiliation and country: Mohammad U. Mahfuz (University of Wisconsin-Green Bay, USA); Agachai Sumalee (Chulalongkorn University, Thailand)	
Abstract: In this paper, a complete design of a sustainability-focused hybrid course has been presented for undergraduate curricula. The three remarkable features of this course are the following. Firstly, this is a sustainability-focused course suitable for undergraduate students of any discipline. The course particularly focusses on smart and connected cities and how they can help the vision of smart cities. Secondly, this course is based on hybrid modality, meaning that the course has both face-to-face and virtual lectures and other contents that can be balanced with careful attention to program needs. Thirdly, this course is entirely based upon open educational resources (OER) meaning that students do not have to purchase textbooks but rather rely on open-access (OA) scholarly articles for this course. The course is designed and developed by the first author in his sabbatical leave at Chulalongkorn University in Thailand and has been offered for the first time to the undergraduate students of the School of Integrated Innovation (ScII) at Chulalongkorn University in Thailand.	
EDIS #: 1570886587	Title: Comparing the Performance of Classification Algorithms for Melanoma Skin Cancer
Author(s) with affiliation and country: Avimanyou K Vatsa (Fairleigh Dickinson University, Teaneck, USA); Arav Kumar (Monroe Township High School 200 Schoolhouse Rd Monroe Township NJ 08831, USA); Savya Vats (Bergenfield High School 80 S Prospect Ave Bergenfield NJ 07621, USA); Anvi Kumar (Monroe Township High School 200 Schoolhouse Rd Monroe Township NJ 08831, USA)	
Abstract: Computer vision plays a beautiful role in the early identification of Melanoma skin cancer. Images are used to classify malignant and benign phenotypes. Also, Dermatologists claim that Melanoma may be diagnosed and cured if it is identified in the early stage. However, selecting an appropriate classification algorithm is essential in early and accurate melanoma detection. Therefore, inspired and motivated by our previous study outcome, we know that early detection and prediction of melanoma skin cancer may be cured (malignant and benign images are classified using CNN, RNN, and XG-Boost methods) [10, 11, 22, 23, 24, 25]. In this experiment, we compared the performance of supervised learning methods like Linear Regression, Light Gradient Boosting Regression, Random Forest Regression, Logistic Regression, Support Vector Machine (SVM), K-Nearest Neighbor (KNN) Classifier, Decision Tree, Passive Aggressive, Multinomial Naïve Bayes, and Bernoulli Naïve Bayes. Moreover, a better and more accurate performing algorithm is used in early melanoma skin cancer detection.	
EDIS #: 1570886646	Title: Gamification FrAmework for promoting Computational Thinking (GFACT)
Author(s) with affiliation and country: Yuri M Bermudez (Universidad del Valle, Colombia); Maria Trujillo (Univerdad del Valle, Colombia); Juan Francisco Díaz Frias (Universidad del Valle, Colombia)	
Abstract: Computational Thinking is a skill that has become relevant and necessary to be more competitive in the twenty-first century. Primary and secondary school students are challenged to develop it for solving problems. However, there are two issues to consider. Although, there are proposed methods for teaching Computational Thinking, there is no standardization of the dimensions or aspects that compose Computational Thinking. The lack of standardization makes harder to provide methodological guidance to promote and develop those competences in educational environments. On the other hand, new metaphors are needed for facilitating student's computational thinking learning process. In this paper, we propose a Gamification FrAmework for promoting Computational Thinking,	

addressing these two issues. Our Framework is composed of a conceptual definition of Computational Thinking along with a gamification strategy for motivating learning Computational Thinking. Our conceptual definition is based on associating learning outcomes to abstraction, decomposition, and algorithmic thinking, as the three core competences of Computational Thinking. The gamification strategy incorporates game elements using learning styles and player types. It can be used by students as a tool for achieving problem solving skills in any context and area of knowledge using Computational Thinking.

EDIS #: 1570886680	Title: Integrating Real-Life Examples into Software Engineering Instruction: A Case Study of Software Product Families
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Author(s) with affiliation and country:
Swapna S. Gokhale (University of Connecticut, USA)

Abstract:
Many instructors indicate that integrating practical activities that can balance between teaching theoretical concepts and their application to real-life systems is a significant impediment in teaching software engineering courses. This paper presents an active learning approach that can mitigate this problem. In this approach, students are challenged to search from their experiences, examples of software systems that exemplify a particular concept discussed in the classroom. This approach was applied to elucidate the idea of software product lines or product families. Students crafted examples from many computing systems including smartphones, operating systems, productivity suites, gaming, music, media and communications software. Members from these families were compared along the obvious, what-meets-the-eye type of features to unobvious, niche functions. The breadth and depth of product families and their comparative analysis highlighted the willingness of the students to reorient their daily engagement with software systems within the context of software engineering principles. A subsequent assignment demonstrated that students indeed inculcated the key concept underlying product families, which is the reuse of abstract functions across systems in diverse, sometimes even unrelated domains. This suggests that our approach could be promising to build an appreciation for concepts such as software product families, which may otherwise be difficult to relate to, especially for inexperienced students.

EDIS #: 1570886740	Title: Basic Mathematical Methodologies as Tool to Interpret Pandemic Data on the Sight of Freshman Engineering Students
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Author(s) with affiliation and country:
Huber Nieto-Chaupis (Peru & Universidad Autónoma del Perú, Peru)

Abstract:
Along these last years (2020-2022) a lot attention has been paid on all types of information concerning to the pandemic of Corona virus 2019 and recently Monkeypox-2022. Mainly the information about the evolution of pandemics has been resumed in terms of infections and projections from a statistical analysis of world-wide data. However, one can wonder: Which material (or academical topics) and methodology might be of interest to engineering students in order that them can extract their own view and perspective on the pandemic and how it can be valuable for local public health operators? This paper tries to answer this question from the fact that freshman students have taken first courses of mathematics as well as computing. Under the guidance of Professor and Instructor, students can build their basic methodology that can help them to understand data of global pandemic. Some toys models are presented and are interpreted in terms of infections.

EDIS #: 1570886775	Title: Integrating Scrum Project Management in Information Technology Capstone Course
Author(s) with affiliation and country: Shuting Xu, Shuhua Lai and Lissa Pollacia (Georgia Gwinnett College, USA)	
Abstract: Agile project management has replaced the traditional Waterfall as the main project management method in IT industry. Scrum is the most popular Agile framework, which may greatly improve productivity. In this paper, we introduce the pedagogical methods applied in teaching Scrum project management in an IT capstone course. We integrate the Waterfall and the Scrum methods in the capstone project procedure, to combine the planning of Waterfall and the agility of Scrum. The hybrid method enables students to experience the benefits and differences of these methods while working on the project. We conducted a pre-survey and a post-survey to assess the outcome of the applied pedagogical methods. Survey results show that using Scrum in students' capstone projects is an efficient way for them to learn Scrum project management, and, in addition, using Scrum is helpful in the implementation of students' projects. The surveys indicate that most students recommend using Scrum project management in this and later IT Project courses.	
EDIS #: 1570887218	Title: Disparities in Digital Access at the Intersectionality of Race and Sexual Orientation
Author(s) with affiliation and country: Jeffrey B Chavis (University of South Carolina & Johns Hopkins University Applied Physics Lab, USA)	
Abstract: Healthcare and health services research when it pertains to racial or sexual minorities has identified many different factors that lead to a minority group being discriminated against or facing disparities in their care individually. However, there is very little research that examines the intersectionality of race and sexual orientation together. This study seeks to examine the relationship between the two and find if their access to the internet, and then healthcare by proxy, is equal to their racial or sexual orientation counterparts. The hypothesis is that areas with high Lesbian, Gay, Bisexual, Transgender, and Queer (LGBTQ+) and People of Color (POC) populations will have less access to the internet. This is a quantitative study that examines the internet access of the 3225 counties of the United States. Factors such as county, region, race, sexual orientation, age, median income, and population were examined. The results showed that there is a direct correlation between a counties level of LGBTQ+ people and the level of POC residents. A liner regression was done and showed a Multiple R value of 78%, an R squared value of 60.8%, and a P of 1.03712E-91. It was concluded that based on this data, there is not a direct correlation between race and sexual orientation and digital access. However, race and sex orientation showed to be closely tied to each other	
EDIS #: 1570887223	Title: A Pragmatic Approach To Training The Next Generation Cyber-Physical Workforce
Author(s) with affiliation and country: Jeffrey S Chavis, Daniel P Syed, Prathista Annapareddi and Ian Chu (Johns Hopkins University Applied Physics Laboratory, USA); Khir Henderson (JHUAPL & Morgan State University, USA)	
Abstract: Training the next generation Cyber-Physical workforce takes a novel and pragmatic approach to offer the necessary skills and experiences needed for up incoming candidates to be successful in the workplace. During the summer of 2022, the Cyber-Physical Systems Development and Cyber Capabilities Development groups at the Johns Hopkins University Applied Physics Laboratory (APL) implemented a pilot project combining educational opportunities for university students and mentoring opportunities for early career staff to develop necessary Cyber-Physical skill sets. The pilot centered on a cohort of ten college interns from a sponsoring organization on a short term rotation at APL; they were supported by a number of additional college-level interns from within the CIRCUIT. The internship experience centered around building relevant IoT and Cyber-Physical capability. Its goals were to provide the cohort with hands-on experience and guidance working with cyber-physical systems and to introduce them to working with an unstructured problem as a team. This paper describes the pilot program and its outcomes.	

EDIS #: 1570875419	Title: Drone-Aided Sensor Networks for Soil Contamination Monitoring
Author(s) with affiliation and country: Lizbeth He (USA)	
Abstract: On my drive to school each morning, I pass by acres and acres of local farms. My mom often buys fresh produce from these farms as well. However, I see them spraying pesticides and fertilizers from machinery during each growing season. The excessive usage of Nitrogen-based fertilizers and chemical pesticides concerns me, as toxic effects can contaminate the soil and reside directly in our agricultural products. Soil contamination has negatively impacted the growth of crops and harmed the health of consumers for centuries. A study conducted in 2015 concluded that pollution was responsible for 268 million disability-adjusted life years (DALYs). The majority of these were caused by soil pollution alone. Additionally, a recent study concluded that 64% of global agricultural land (or about 24.5 million km ²) is in danger of pesticide pollution. With this newfound research, it is critical to accurately monitor soil contamination in farmlands before implementing any pollution treatments. This research project applies recent advancements in chemical sensors and computer networks. It implements drone-aided sensor networks to tackle this issue. A group of sensors can be deployed as a sensor network to cover a particular area. Data collected by each sensor are transmitted to a central node for storage, analysis, and further processing. The proposed method includes two types of components in the network: chemical sensors and drones. The drone first deploys the available chemical sensors into farmland in a formation to maximize the coverage. The sensors will detect factors such as but not limited to the amount of heavy metals, petroleum hydrocarbons, and polychlorinated biphenyls (PCB). The drone then functions as the central node to collect data from each sensor later on. After data collection for a pre-scheduled duration, the drone will fly out to receive the data from each sensor. Scientists and agricultural professionals can use the collected data for analysis. To evaluate performance of the drone-aided sensor network, a mathematical model is further proposed. It aims to use the least amount of resources while still providing enough monitoring readouts. Parameters in this model include sensor amount, sensor monitoring range, sensor battery life, detection power of the drone, distance of the drone flying above the ground, monitoring interval, as well as the required readout amount. They describe different characteristics of the sensor network. Typical values from sample cases are implemented to evaluate scenarios. Results show this proposal offers feasible guidelines of conducting soil contamination monitoring.	
EDIS #: 1570878728	Title: Detection of <i>Lycorma delicatula</i> using Thermal Imagery and UAVs
Author(s) with affiliation and country: Joseph E Miller (PRISMS, USA)	
Abstract: The Spotted Lanternfly, <i>Lycorma delicatula</i> , is an invasive insect species that is causing damage throughout the Mid-Atlantic region. Large quantities of lanternflies have recently been infesting states including Pennsylvania, New Jersey, New York, and Connecticut. They harm native wildlife and crops by feeding on them, blocking sunlight, and excreting honeydew. Spotted Lanternfly often live on the trunks of trees and it has been difficult to estimate the complete population distribution through conventional means because of inaccessible locations and high elevations. This project describes a method to detect Spotted Lanternfly populations by using an Unmanned Aerial Vehicle equipped with a FLIR Vue Pro thermal camera to record heat signatures. Likely as a result of the Spotted Lanternfly's natural metabolism, body heat of adult Spotted Lanternfly can be detected using thermal infrared imagery if the difference between the lanternfly and background is significant enough, which occurs at an ambient temperature of approximately 50°F. The resulting footage is processed using object detection machine learning to provide an accurate estimation of colony size, location, and spread. The data produced by this study will be used to create a density map of the Spotted Lanternflies over a given area. This will provide an easy way to count Spotted Lanternfly for observational studies and future research.	

EDIS #: 1570879496	Title: A Biomedical Device for Separating Fluids from Tissues - FluidXtractor
Author(s) with affiliation and country: Arthur Yang (Marriotts Ridge High School, USA); Feng Ouyang (Johns Hopkins University / Applied Physics Lab, USA)	
Abstract: Biopsies are commonly used for molecule study in the laboratory. However, because tissue fluids, which are taken with the tissue specimen, flow between cells and blood capillaries in a tissue, are similar to plasma, it is necessary to separate tissue fluid from the tissue so that they can be studied respectively. Currently, there are no efficient tissue isolation methods that can separate blood or tissue fluid from the tissue itself during molecule characterization. In this study, a biomedical device was designed that can separate tissue fluid or blood from the tissue using a vacuum-assisted filtration method. The device has two chambers, one chamber for collecting the extracted tissue fluids and the other chamber for holding the remaining tissue. Two different devices were produced, one with a lower-power vacuum pump while the other with a higher-power vacuum pump. The devices were tested on multiple tissue samples purchased at a grocery store, including pork liver, pork tenderloin, and beef sirloin. Each sample was tested in set conditions, where samples were tested for the same amount of time in the same place. The samples were also weighed before and after each test. Afterwards, samples were frozen and sent for glycan analysis. Tissues were then characterized by their glycan profiles before and after vacuum-assisted filtration. The results demonstrated that the biomedical device could remove tissue fluids and facilitate the analysis of tissue-specific molecules while minimizing tissue fluid contamination. The results also showed that the power of the vacuum pump did not significantly affect tissue fluid removal, with a difference of less than 5% between samples using a stronger vacuum pump and those using a weaker one.	
EDIS #: 1570880366	Title: SOS.net: A Robust System Harnessing the Power of AI to Expedite Search and Rescue Missions
Author(s) with affiliation and country: Nesara Shree (Portland State University, USA)	
Abstract: According to the National Missing and Unidentified Persons System, over 600,000 people go missing around the US wilderness every year, and there are at least 1,600 people currently missing- these only being the ones that were officially reported. Current, drone-and-human-vision dependent systems in place are not only incredibly inefficient, but also tiresome for drone pilot operators, who carry out over 60 Search and Rescue (SAR) missions a year. Alternatively, thermal detection drones used are inaccurate and far too generalizing, picking up on unrelated, inanimate objects that radiate heat. This is where I saw Artificial Intelligence (AI), Machine Learning (ML), and their powerful Computer Vision (CV) capabilities coming into play. What is needed is a reliable system that can accurately locate and signal by recognizing visual indicators of human presence or distress, and AI's application is a crucial first step in being able to expedite SAR missions, relieving the strain on our SAR teams, and saving lives. The goal is to make human search missions much more refined and efficient by implementing RCNN's Resnet50 ML model methodologies. By open-sourcing SOS.net, meaning that all of the code, procedures, a snapshot of the trained model, and the option to access the entire dataset is available to the general public on Github to download and/or contribute towards its further improvement, enables SOS.net to be a dynamic, yet robust, AI system that has high potential for actual implementation and continued refinement as a tool.	
EDIS #: 1570880526	Title: Design Calculations of a Biochair for Patients Requiring Leg Rehabilitation
Author(s) with affiliation and country: Pranav R Bellannagari (IntelliScience Institute & San Jose State University, USA)	
Abstract: The biochair is a rehabilitation chair designed specifically for patients with leg injuries or disabilities. The chair is equipped with two flexible leg-holding support plates, which are activated by a control panel to move the legs up and down in an automated fashion to conduct rehabilitation exercises. The control system employs an Arduino microcontroller processor, as well as motor drivers, which connect to stepper motors that enable the system to	

operate. The control system requires a software program that dictates the required movements of the leg supporting plates. The design of the biochair also includes the conversion of the motors' rotary motion into the translational motion of the linear actuator, which was mounted on a ballscrew and was connected to the leg resting plate giving it the required angular displacement. Two Nema-23 H2045 motors (1.8 degrees/step) were used in this project. Assuming the human leg with a mass of about 7.0 kg, the required torque was calculated for the ballscrew (diameter = 16 mm and Pitch/Lead Distance= 3 mm) by estimating the Mechanical Advantage (~25.15 N) and the required force of effect (~25.15 N). Calculations showed that a torque of about 0.2 Nm will be required for moving the mass along the ball screw. The step rate was calculated at around 100 steps per second which were within the pull-in error rate with the required torque. Rotary sensors were attached to the chair's moving support plates to give out angular readings for the leg position during the exercise. The calculations for the produced force as a function of the angular displacement of the leg supporting plates were performed. The maximum force (~1000 N) was calculated around 39 degrees from the vertical position of the plates. The leg rest plates' velocities were also calculated as a function of the linear actuator's linear velocity. A linear relationship was found. In this system, two mechanisms for activating the system have been used. In the first, a push button was used to initiate the central control system to activate the chair's leg supporting plate movements. The other option included the use of EMG sensors (mounted on the subject's leg muscles) signals that were provided to the central control system to activate the operation. The EMG signals, in general, are noisy and need some processing to increase the signal-to-noise ratio and also need amplification before they can be used to activate the system. The work presented in this poster will include detailed signal processing for the EMG sensors. Bio chair performance testing is under progress and new results will be added in the final presentation. Overall, the biochair provides a cutting-edge solution for patients undergoing leg rehabilitation and especially for patients who need extra assistance to move their legs for various rehab exercises. A disclosure has been submitted on the chair design and a patent application is under review.

EDIS #: 1570880547 | **Title:** Design and Testing of A Multifaceted DBD Plasma Torch

Author(s) with affiliation and country:

Karthik Hari (Santa Teresa High School & San Jose State University, USA); Krishnaveni Parvataneni (BASIS Independent Silicon Valley, USA)

Abstract:

Low-temperature plasma generated by dielectric barrier discharge (DBD) is used for fast wound healing and sterilization. The temperature and radicals of the plasma play an important role in the healing process. Recent research efforts at the San Jose State University (SJSU) are focussing on various DBD torch designs and their characterization. In earlier designs, the plasma was created in a single thin dielectric tube where the plasma properties could not be adjusted without altering the input power or gas flow rates. It was not convenient during the operation of the torch. In a revised design, a variable outer electrode was used to control the plasma jet characteristics [S.H. Zaidi, US Patent US 9,433,071 B2]. This design was further improved at SJSU by employing a multi-electrode plasma torch, which utilized multiple fixed outer electrodes that eliminated the variable electrode. It was shown that the choice of the outer electrode can impact the plasma radicals and the plasma rotational, vibrational, and electronic temperatures. The control of the plasma characteristics is important to find optimum plasma operating conditions that can be used to mitigate bacteria and enhance the wound healing process. In the current research, a single jet plasma torch is further improved by a new design where a multifacet plasma torch with the option of multiple plasma jets ejecting simultaneously from the plasma torch. Due to its smaller size (~ 2-3 mm diameter), a single jet plasma torch may take a long time to scan the large wound surfaces. This problem is solved by designing a multifacet plasma torch that, due to its four plasma jets, can cover larger wound areas in a shorter period of time. The current design is being operated at 5-10 kV (20-40 kHz) with argon as the working gas (10-20 slpm). The plasma jets are about 3 -5 cm long. The plasma gas temperatures were measured along the plasma jet showing a significant change in the gas temperatures. The highest gas temperatures (~50 C) were found near the jet exit whereas the temperatures at the plasma jet tips were about 30-35 degrees Celsius. An OceanOptics UV-IR Optical fiber-based spectrometer was used to capture the spectral features of the emitted light from the plasma. In the spectrum, various emission lines for different radicals were identified. SpecAir software was used to estimate the plasma vibrational,

<p>rotational, and electronic temperatures at various plasma operating conditions. The poster will include full details on the design of the multifacet torch along with its characterization results that will summarize the impact of various plasma operating conditions on the plasma radicals and plasma temperatures. It is anticipated that the understanding of both plasma radicals and plasma temperatures will help to understand the wound healing and wound sterilization process in an effective manner.</p>	
EDIS #: 1570880615	Title: Impact of Training/Testing data ratio on ML Model Accuracy in predicting Cardiac Patient's Mortality
Author(s) with affiliation and country:	
Siddhartha Shibi (Washington High School & Intelliscience Training Institute, USA); Vaishali Jha (Evergreen Valley High School, USA)	
Abstract:	
<p>Coronary Artery Disease (CAD), a common heart disease in the US, is the inability for a coronary artery to function, making it unable to pump blood, nutrients, and oxygen to the heart. It may be due to smoking, high blood pressure, high cholesterol, lack of regular exercise, diabetes, and thrombosis. A beforehand prediction of the disease outcome can save thousands of lives. The main objective of this research is to analyze the CAD patient data and develop statistical AI machine learning models to predict in-hospital outcomes (Discharge, DAMA/Discharge Against Medical Advice, Mortality) for such patients. For this purpose, the data released from a hospital (Punjab, India) was collected from Kaggle (open-source data collection) and was analyzed to develop a model that could predict patient outcomes. The data featured 6500+ patients with 52 recorded variables including Blood Pressure, Diabetes, Age, etc. For this project it was decided to use IBM's Automated AI services (Watson Studio). Various Machine Learning models were developed by using different algorithms including Snap Random Forest. The accuracy of the supervised models was further enhanced by incorporating various feature engineering techniques by Hyperparameter Optimization. Feature engineering (FE) manipulates raw data into different features that are used for supervised learning. It optimizes the transformations of data and the model's accuracy. Both HPO-1 and HPO-2 (Hyperparameter Optimization) evaluate the effectiveness of the presented accuracy through optimizations. In our modeling, the training data, subset of the original data, is used to train the machine learning model, whereas the rest of the data, the testing dataset, is used for evaluating the accuracy of the model. To see the impact of the split ratio on model accuracy, we have modulated three training datasets, with 90% training data and 10% testing data, 80% training data and 20% testing data, and 70% training data and 30% testing data respectively. In this case the results from SNAP Random Forest Algorithm are being presented. Results from three models are compared for accuracy and selection of various top contributing features for the model predictions. For instance, the accuracy of the model reduced from 88.7% to 87.3% as the data ratio was changed from 80-20 to 70-30 respectively. For 90-10 data, urea (100%), glucose (89%), eject_fraction (77%), leuk_count (68%) and creatinine (51%) were changed to platelets (100%), leuk_count (77%), bnp (72%), glucose (66%), and creatinine (54%). Our research shows that data splitting ratio (Train-Test) does have an impact on the selection of various features that play a prominent role in predicting the outcome of the model. The variation in the relative percentage importance of these features in predicting the outcome of the model cannot be ignored and needs more research to understand its full impact on the ML model accuracy. This poster will include discussion on various algorithms employed in this research along with the split ratio impact data on the outcome of the model.</p>	
EDIS #: 1570880632	Title: MATLAB Based Meta-Analysis Code Providing Common Perspective by Synthesizing Data from Various Sources
Author(s) with affiliation and country:	
Himani Jha (Intelliscience Research Institute, USA); Rina M Weaver (Intelliscience Institute & San Jose State University, USA); Ambika Palleti (Intelliscience Research Institute, USA)	
Abstract:	
<p>Due to unparalleled development in IT sector/computer technology, capability of generating medical data has grown exponentially. Now we require efficient tools for data analysis that may provide insight on many emerging health problems. This becomes particularly relevant when data on a particular medical issue is generated by multiple research groups. The tool that can analyze randomized, control trials data in an efficient manner comes from Meta</p>	

Analysis. Meta analysis has the capability to analyze data emerging from various places of the world from a common perspective so that overall conclusions can be drawn successfully. Meta analysis synthesis can be performed by incorporating both random and fixed effect models. We have developed open-source meta-analysis code that uses these models and analyze data that may be on continuous, binary, and correlation data that is borrowed from literature to evaluate our models. For conducting meta-analysis the source book used for the fixed effect and random effect models was from Borenstein et al. [2007]. The example data presented in Borenstein's book was used to develop our MATLAB models. For the continuous data, the fixed effect model, used the mean, standard deviation, and sample size to estimate the bias-corrected standardized mean difference (Hedges') that was then used as the effect size measure. The summary size effect was then calculated to predict the confidence interval, Z value and p-values along with the variance of the true standardized mean differences. In order to incorporate Fixed Effects model for the given binary data, the analysis starts with events and non-events in two independent groups under investigation and then uses either Odds Ratio or Risk Ratio as the effect size measure. This part of the meta-analysis code was first tested on the example data described by Bornstein's work and then was used on the targeted data collected for this study. It was found that our MATLAB-based code was robust enough to generate accurate results.

In the second part of the code, the concept of heterogeneity was addressed by identifying and quantifying it in effect sizes through the MATLAB models. As the observed variation in the estimated effect sizes include true variation and random error, there is a need to isolate true variance and then use it to create to identify various perspectives on the dispersion. To achieve this goal, the MATLAB model was further developed that determined the Q statistics (a measure of weighted square deviations), the results of a statistical based on Q (i.e., P), the between-studies variance (T²), the between-studies standard deviation (T), and the ratio of the true heterogeneity to total observed variation (I²). This analysis provides evidence of heterogeneity in the true effect size. The newly developed MATLAB code is open source and will be available for any user to process the data. Our poster will include details on the models adopted in the MATLAB code along with the examples results that were obtained by executing the code for the target data borrowed from literature.

EDIS #: 1570880641 | **Title:** Automating Conventional Intravenous Stands for Easier Hospital Infusion

Author(s) with affiliation and country:

Yihan Chen (PRISMS (School), USA)

Abstract:

Infusion errors have always been a tremendous danger that directly or indirectly resulted in over 50 percent of hospital accidents. However, since infusion looks minor, people rarely pay attention to solving this problem. As a kid, I often received infusions, so I deeply understand that there are many places for improvement in the infusion department.

The automated version of intravenous stands aims for a better infusion experience for both patients and medical staff. Furthermore, it should be easily adaptable to current hospitals.

I am trying to create a clip-on device for current intravenous stands. This device should enable the intravenous stands to free the patients' hands and help with their mobility to some extent, monitor the medicinal fluids, infusion frequency, and patients' status, and share all data of patients with medical staff.

The project is still in progress.

EDIS #: 1570880643 | **Title:** Building a Standing Mobility Device to Help Handicapped People

Author(s) with affiliation and country:

Yihan Chen (PRISMS (School), USA)

Abstract:

The current world is paying more and more attention to human equality, including creating a more friendly environment for disabled people. Convenient devices appear in the public now and then. However, people rarely focus on improving the mobility and convenience of the disabled themselves. In this paper, a Standing Mobility Device is presented.

The Standing Mobility Device mainly focuses on helping people with lower body disabilities. As suggested in its name, this device enables people to get up and go around on the same plane.

The goal of the Standing Mobility Device is to make disabled people in wheelchairs able to move around more freely and let them have a more independent life. The whole device looks like a small-sized car that people can sit on. In this case, a pushing device is used to push the person on the device into a standing position, while wheels are attached at the bottom to move both the person and the device as a whole around the flat plane. As for the pushing device, we mainly used an electric putter for the main force input. Arduino is used to controlling the two functions, and buttons and a rocker are designed to let the person control the device. The overall structure of the Standing Mobility Device is built with Aluminum bars and Aluminum plates. A few testing experiments done on the device prove its feasibility.

EDIS #: 1570880758 | **Title:** Using human body tracking technology to analyze the double axel in figure skating

Author(s) with affiliation and country:

Wanyun Qu (High School, USA)

Abstract:

Figure skating is becoming a very popular sport, and I'm a figure skater myself. But double axel (a jump) got in my way. I've been dealing with double axel for years. So I want to do research on the double axel, and use human body tracking technology to analyze the maximum parameter when doing double axel. Then through this research, the success rate may be increased. I would like to explore more about double axel using human body tracking technology. By measuring the height, speed, and other essential elements in jumps, I want to know how to increase the success rate and reduce injury. Furthermore, if possible, I want to improve/design a jump harness (the equipment that the assistant jumps on the ice) according to the result I found.

EDIS #: 1570881208 | **Title:** Instrumentation and Control of a Fluidic Muscle-Based Exoskeleton Device for Leg Rehabilitation

Author(s) with affiliation and country:

Rishit Agrawal (Evergreen Valley High School & IntelliScience Training Institute and San Jose State University, USA);
Sahana Chowlur (Silver Creek High School, USA & IntelliScience Institute, San Jose State University, USA)

Abstract:

This STEM-based project was initiated to design and develop an exoskeleton device for leg muscle rehabilitation at San Jose State University. This exoskeleton device is designed for patients who have lost their leg mobility due to a fatal illness and is intended to conduct rehabilitation exercises without any external human assistance. This device consists of two movable brackets designed to be mounted on the patient's leg. The initial design incorporated two fluidic muscles on the top and two on the bottom bracket. A few limitations were identified in characterizing that device, especially on the angular displacement of the brackets. In the current project, we have further improved the device design by using the top part of the bracket that utilizes five fluidic muscles, which require an air pressure of 30-60 PSI for its operation. The fluidic muscles, pressurizing, and depressurizing, mimic the leg muscle's movement as the patient moves their leg for rehabilitation exercises. The lower part of the bracket is designed to support the leg during its motion. The central control system is based on a microcontroller (Arduino Uno) which receives input signals from EMG sensors on the patient's leg. The EMG sensors are activated by the leg muscle's movement as soon as the patient intends to move his/her legs. These noisy signals needed further processing to achieve a high signal-to-noise ratio. The processed EMG signals were further amplified to activate the central control system. For proper functionality, a control box was strategically designed to house the Arduino circuit and various other components, such as relays, solenoids, actuators, and regulators. The system implemented a relay capable of electrically controlling the current flow to the actuators responsible for determining the airflow direction. Solenoids were placed within the control box to assist the actuators. Before characterizing the operation of the device, sensors were calibrated. That included the calibration of the MyoWare EMG sensors and the Cylewet KY-040 rotary encoder that was used to measure the angular displacement and the angular velocity of the device. The calibration of the rotary encoder mounted at the joint of the two brackets of the exoskeleton was obtained by comparing the predicted angles by the software to the measured angles using a protractor. The rotary encoders were also used to estimate the rotation velocity of the exoskeleton device by measuring the time of rotation. The EMG sensor's signals were optimized for the leg's mounting locations. The work included in this presentation will highlight the various control circuits and associated

design efforts to develop a control box for the operation of the exoskeleton device. In addition, sensor calibration programs and data linked with the performance characterization will be presented in greater detail.

EDIS #: 1570882059 | **Title:** Domestic Wind Power Apparatus

Author(s) with affiliation and country:

Man Kin Cheng (Bishop Hall Jubilee School & BHJS, Hong Kong); Andrew Wong and Shing Chan (Secondary School & Bishop Hall Jubilee School, Hong Kong); Christopher Tang (Bishop Hall Jubilee School, Hong Kong)

Abstract:

We found that problems with energy are prevalent worldwide. For instance, many European countries are facing a shortage of energy and need to face a ruthless winter. The energy crisis in Europe led to panic buying of stoves, which work by burning wood, to prevent power cuts. If it suffers from a shortage of energy, the world will be affected as Europe is the first five largest economies in the world. Hence, a domino effect occurs.

Furthermore, although there are vast non-renewable energy resources, our consumption speed of non-renewable energy is far greater than their formation, like petroleum. Therefore, we need to confront the energy crisis and develop renewable energy which is more stable.

Wind power is the largest source of renewable electricity generation in the US, providing 10.2% of the country's electricity, and growing. The advantages of wind power include occupying tiny land and having a minimal environmental impact.

We aim to provide a sustainable energy supply and reduce pollution produced by the consumption of non-renewable energy. We want to alleviate the energy crisis worldwide by creating a wind power generator.

We faced some difficulties during the making process of the device. For example, we need to lower the voltage to 5V, the common voltage for daily uses. Also, we may need to design the custom printed circuit board (PCB) because there is no suitable designed PCB for us to use in the market and we may only design it ourselves.

We first surfed the Internet on how to build a wind turbine model. Then, we started to design it with devices like Rectifiers Diodes on our own-designed PCB to stabilize the voltage, then with a capacitor to store the electricity. After that, a 5V3ADC-DC converter module is for converting all the voltages into 5V. Lastly, we test all the models we made.

When the wind speed in front of the blade is greater than the wind speed behind the blade, the blade starts to turn which generates power from the movement of the blade. Then the energy flows onto the PCB. First, energy enters rectifiers diodes to make its voltage stabilized. Then, the stabilized energy passes through the capacitor, 5V3ADC-DC converter module, and lastly the battery. We can consume energy by charging batteries and phones with a USB plug. The product meets the intended goals. The product can convert kinetic energy into electric energy for charging. It can generate electricity by wind power. If it were widely used, it would decrease the use of non-renewable energy. Our device cannot face strong winds. We hope we can use tougher materials to make a new stand to overcome it. In addition, if we can improve it, we may enlarge the wind turbine model and blades to have better efficiency and the ability to generate more energy.

We hope that each household could own our device and put it in their garden or balcony to generate electricity for personal use to save energy.

EDIS #: 1570882116 | **Title:** Muscle-Inspired Home Automation System

Author(s) with affiliation and country:

Andrew Yuting Lu (Oyster River Middle School, USA); Femi Olugbon (University of New Hampshire, USA)

Abstract:

Aging causes various health issues, such as muscle weakness, joint problems, and neurological (brain and nervous system) problems, which challenge seniors' mobility in their daily life. Extensive life care service often leads to a significant cost. To support an affordable smart home for senior people, we propose a home automation system that exploits muscle sensors to control smart devices. Since Internet-of-Things (IoT) technologies have been widely applied to household appliances, we can remotely manipulate those appliances via a message queueing telemetry transport (MQTT) server using existing cloud service (e.g., Amazon Web Service). In this project, we interpreted the signal from a muscle sensor into an instruction of light control and deployed MQTT clients over transmission control protocol in a pair of microcontroller units (MCUs) to create a remote-control channel. C++ was the primary language used in this

project. All codes were developed and debugged in the PlatformIO development environment using the Arduino framework. This two-week research project motivated a middle-school student to pursue future study in Science, Technology, Engineering, and Mathematics (STEM) and also enabled that student to practice his prior skills in coding and sensor utilization. The project outcome is encouraging. In future work, we will further advance the remote control technology in other bio-signal-inspired home automation systems.

EDIS #: 1570882310 | **Title:** Immersive Experiences in the Omniverse Channel

Author(s) with affiliation and country:

Adrik Ray (Huber Street Elementary School, USA)

Abstract:

The Metaverse and Omniverse represent a new frontier in human experiences, with the potential to transform the way we interact with technology. By incorporating augmented and virtual realities, these new channels offer the opportunity to create truly immersive experiences that can enhance our understanding of the world around us. One area in which this technology can be particularly transformative is leveraging weather forecasts in predicting and planning our experiences. By incorporating weather data into augmented and virtual realities, users can experience the impacts of weather in a way that is not possible with traditional methods of data delivery. This allows for a more intuitive and engaging way to understand and prepare for changing weather conditions and plan for the best possible experiences.

The possibilities for immersive experiences are not limited to weather forecasts. Other areas such as sports, education, and entertainment can all be transformed by incorporating augmented and virtual realities. This can result in a more personalized, engaging and collaborative experience for users, with the potential to revolutionize the way we learn, play, and interact with the world.

The potential impact of the Metaverse and Omniverse goes beyond the realm of individual experience. They have the potential to create new opportunities for businesses and commerce, as well as to facilitate communication and collaboration on a global scale.

While there are still many technical and ethical challenges to overcome in the development of these new channels, the potential benefits are enormous. As we continue to push the boundaries of technology and explore new frontiers in human experiences, the Metaverse and Omniverse offer the promise of a truly transformative future.

My paper focuses on combining weather forecasts and augmented reality to create an immersive experience for visualizing a location on a future day and time. Though I have used weather forecasts to create this future immersive experience, this is not limiting. This approach can be expanded to include other elements such as crowd density, surrounding environment, augmentations with avatars etc for added effects. These experiences can be rendered in Metaverse and Omniverse channels, as well as existing channels like Mobile. Such experiences can enable better decision making, planning and satisfaction.

EDIS #: 1570882334 | **Title:** Modulation and Noise Effects in a Free-Space Optical Communication System

Author(s) with affiliation and country:

Joseph M Bailor (Johns Hopkins University Applied Physics Laboratory, USA); Jeremy Chung (Johns Hopkins University Applied Physics Laboratory & Winston Churchill High School, USA); Jonathan C Moses (Mount Saint Joseph High School & Johns Hopkins University)

Abstract:

Free-space optical (FSO) communication provides an alternative to fiber optics and is a method of transmitting information that involves sending data over infrared lasers. Research into this field has shown that it has the potential to be a powerful alternative to cable-restricted fiber optics. There are some applications for which FSO outperforms both fiber optics and RF including extraterrestrial communications, solutions for telecommunications networks, and communication between vessels. However, disturbances, irregularities, and beam divergence attenuate the signal's power as it travels through the atmosphere, affecting the efficiency of data transfer. This project studies how the error rate of a signal changes as its signal-to-noise ratio (SNR) is adjusted. The process in which data is encoded onto a laser signal is known as modulation. The types of signal modulation formats used in our research included On-Off Keying (OOK), Return to Zero (RZ), and Non Return to Zero (NRZ). OOK splits an optical signal in two, and the phases of

these two waves are adjusted to either constructively interfere (1) or destructively interfere (0). RZ means that the signal's value automatically resets to zero after each individual bit of data is transferred. Unlike RZ, an NRZ signal's value does not automatically reset to zero after each individual bit of data is transferred. To begin our analysis of the correlation between SNR, modulation scheme, and BER, the laser first generated a signal at 1550 nm, which was then sent to a modulator that encoded data onto the signal. The signal was then sent to a variable optical attenuator (VOA), which simulated power loss over a distance due to beam divergence by reducing the signal's SNR. To maintain a stable noise floor, a second signal was added to the laser from an erbium-doped fiber amplifier (EDFA). The attenuated signal was received by two devices: the optical spectrum analyzer (OSA) and the customized bit error rate tester (CBERT). The OSA measured the SNR of our laser frequency, and the CBERT compared the received signal with the expected signal to determine how much data was lost (bit error rate, or BER). Because the computer could not communicate with the VOA or CBERT directly, a data acquisition device (DAQ) was used as an intermediary. Information from the OSA and CBERT was then sent back to the central computer, which recorded the information through a MATLAB program, which attenuated the signal and collected the SNR readings from the OSA. From this experiment, SNR plays a key role in the efficiency of data transfer in an optical link. NRZ-OOK requires the highest SNR, and 67% RZ-OOK can preserve an optimal BER at an SNR where the other modulation schemes lose data. Assuming beam divergence is the only factor affecting FSO communications, we would expect a 67% RZ-OOK signal with an initial SNR of 50dB to surpass the maximum allowable BER of 10⁻⁹ after 4km. Forward error correction (FEC) could extend this distance, allowing a maximum BER of 10⁻³, but our CBERT cannot measure this high of an error.

EDIS #: 1570882354	Title: Investigating the role of polyrhythmic music in attention-based neurological therapies using EEG Sensors
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Author(s) with affiliation and country:
Sumanth Mahalingam (Evergreen Valley High School, USA)

Abstract:
The neurological pathways involved in listening to complex rhythms pose multiple avenues in investigating the etiology and treatment of neurobiological disorders. In literature, many models regarding the brain's mechanism of rhythmic processing hypothesize the existence of neural oscillators to adapt to rhythmic patterns, thereby comparing rhythmic intervals using these oscillators and their relative temporal changes. In regards to interrelation between such processing and other cognitive processes, the most prominent avenue for understanding these models is the balance between top-down (predictive) and bottom-up (reactive) processing maintained in the brain. Similar balances are maintained in numerous cognitive processes, including selective attention and impulse control -- hence the disruption in top-down processing commonly noted in attentional disorders such as ADHD. Disruption of top-down and bottom-up processing can lead to difficulties in maintaining the balance of fulfillment and violation of cognitive expectations, often constituting the basic neuropathology for attention deficits. In this paper, the current author aimed to examine this balance in the context of the brain's processing of polyrhythmic music, in order to investigate the possibility for such music to be utilized in attention therapies. Polyrhythms involve the concurrence of two different rhythms simultaneously, such as a three-beat pattern superimposed on a four-beat pattern.

In theory, entrainment models involving oscillators would involve adaptation to multiple simultaneous rhythms, creating complexities in the rhythm that aid in restoring the balance between dopaminergic fulfillment and violation of cognitive expectations. Current authors carried out this study with the purpose of examining how polyrhythmic music's complexity would assist in creating a complex mode of reactive processing, thereby satisfying the attention-deficit brain's inclination towards complex changes in the environment and limiting related distractions. Using electroencephalography (EEG) to measure neural responses and activity in the frontal and parieto-temporal regions, participants in one experiment were played a continuous 4:3 polyrhythmic melody with variances in tonal patterns. As the music was played, participants were instructed to copy a passage from a book, as a means of measuring the extent of the music's effects on motor coordination and attention. In another experiment, the same participants were instructed to copy down a similar-length passage while listening to a non-polyrhythmic melody with similar minor-scale tonal patterns as the polyrhythmic melody. In the final experiment, the same participants merely copied down a similar-length passage without music, to contrast neural activity during a motor task with no musical stimulus. PSD

analysis of the EEG results showed comparative increases in pre-frontal beta waves and decreases in pre-frontal theta waves when listening to polyrhythmic music, indicating an increase in focus while polyrhythmic music was played. This demonstrates that polyrhythmic music may be a viable avenue in exploring the extents of neural entrainment, providing insights into attentional therapies.

EDIS #: 1570882416 | **Title:** Detecting a system of Binary Black Holes using the Einstein Toolkit

Author(s) with affiliation and country:

Agneya D Pooleery (USA)

Abstract:

Black Holes are strange, mysterious objects in space. They weigh millions to billions of solar masses (mass of the sun) and have such an immense gravitational pull that nothing -- not even light -- can escape from them. They are mainly formed from dying stars. As stars live their lives, they fuse elements in their core. Once the star's core fuses into iron, it marks the end of the star's life. Typically, the star will explode, creating a supernova. However, due to intense gravity, the core of the star may collapse on itself, forming a black hole.

Black holes can be identified by jets and swirling masses of matter around them. They have an event horizon, plasma disk and a singularity in the center. The singularity of a black hole is an infinitely small point at the center where all its mass is concentrated. If you were to go inside a black hole and touch the singularity, you would instantly become part of the black hole. A black hole's event horizon is its perilous edge. Once something crosses the black hole's event horizon, it will never return. Since light cannot escape it, one would need to travel faster than the speed of light to escape it, which is impossible. A black hole also has an accretion disk. This is a disk of plasma orbiting around the black hole. The plasma may have been part of a star. The black hole's gravity is what keeps the plasma disk in place, and it can reach a stunning temperature of over 1,000,000 degrees Celsius! Also, the plasma is slowly spiraling into the black hole, making it smaller by the second.

An interesting phenomenon that has been observed by astronomers in recent years is the merging of two black holes, often called a Binary Black Hole (BBH) system. For many years detection of BBH systems was hard because of the nature of the black holes themselves and limited detection facilities available. More recently, it has been found that when black holes spin close to one another they can emit massive amounts of energy in the form of gravitational waves. These waves are about ten trillion times smaller than human hair and are incredibly hard to detect - but, they have distinctive waveforms and can be calculated using general relativity. When a BBH system reaches very high velocities, the amplitudes of gravitational waves reach its peak allowing them to be easily detected by laser interferometers.

My project aims to study and use a software platform designed by the astrophysics community - the Einstein Toolkit - which can be used to simulate the merging of black holes and study the gravitational waves emitted from them.

EDIS #: 1570882425 | **Title:** An Artificial Intelligence Approach to Fetal Health Risk Prediction

Author(s) with affiliation and country:

Vighnesh U Nair and Devika Gopakumar (Dougherty Valley High School & IntelliScience Training Institute, USA);
Krishnaveni Parvataneni (BASIS Independent Silicon Valley, USA)

Abstract:

The use of artificial intelligence (AI) in obstetrics has the potential to improve the prediction and monitoring of fetal health, which in turn could help to reduce maternal and infant mortality rates. This study uses IBM Watson, a powerful cognitive computing platform, to predict fetal health by analyzing data from cardiotocography (a recording of the fetal heart rate, based on ultrasound). The data contains information on fetal movement and accelerations as well as the mother's uterine contractions. Fetal movement and uterine contractions are two important indicators of fetal well-being. However, monitoring these factors in a traditional manner can be subjective and may not provide a complete picture of fetal health. By using AI to analyze data from these sources, we aim to identify patterns and make more accurate predictions about the health of the fetus. To evaluate the effectiveness of using IBM Watson to predict fetal health, we conducted a prospective observational study. In this study the data was borrowed from the University of Porto, which consists of 2126 pregnant women whose fetal movement and uterine contractions have been monitored throughout their pregnancy using a combination of ultrasound and tocodynamometry. IBM Watson

platform was then used to analyze this data and make predictions about fetal health. The data contained about 2000 rows and 21 columns showing 20 features that include %_of_time_with_abnormal_long_term_variability, abnormal_short_term_variability, accelerations, mean_value_of_short_term_variability, histogram_variance, media, tendency, # of zeros, and # of peaks. The outcome column included three numbers 1,2 and 3 indicating if the fetal prediction with 1 showing healthy, 2 showing fetal with a possible disease, and 3 representing fetal with a definite disease. The IBM program read the data and split it in 90:10 ratio for the training and testing purposes. The choice of the algorithms was left on IBM machine to propose various models. In the current work, random forest classifier and decision tree classifier were used with and without enhancements. Without enhancements, the model based on random forest classifier gave a model with accuracy reaching to 93.3% where the corresponding value for decision tree classifier was 90.2%. The enhancements improved the accuracy for the decision tree classifier to 92.2%. Further analysis of results revealed percentages of various features in predicting the outcome of the model. Prominent features selected by both algorithms included %_of_time_with_abnormal_long_term_variability, histogram_mean, abnormal_short_term_variability, accelerations, histogram_median (100%, 99%, 75% 68% and 48% respectively for random forest classier). Similar selection with slight variation was observed for the decision tree classifier. In conclusion, this study aims to demonstrate the effectiveness of using IBM Watson to predict fetal health based on factors like fetal movement and uterine contractions. By identifying patterns in these data, we hope to make more accurate predictions about fetal health and ultimately help to reduce maternal and infant mortality rates. Final poster will include all the information related to our research methodology, and IBM models that were developed in this work.

EDIS #: 1570882476 | **Title:** Geometry and Origami

Author(s) with affiliation and country:

Rishi Balaji (RJGrey Junior High School, Stanford OHS, USA)

Abstract:

Origami is the ancient art of paper folding. Aside from being a popular form of art, origami is used in many fields of Science, Technology, Engineering, and Math (STEM). From an early age, I have been fascinated by origami and have folded many models, ranging in levels of difficulty. Another area of interest of mine is mathematics. I am very interested in the various properties and uses of math in real life.

In this case, math and origami meet, involving numerous geometric concepts. This poster paper will cover some proofs and explanations of different geometric techniques used in various origami models. For example, the folding of a square into any number of divisions using diagonals involves similar triangles, while folding a strip of paper to make equilateral triangles uses 30-60-90 triangles.

EDIS #: 1570882510 | **Title:** Plantis: Floating Greenhouse

Author(s) with affiliation and country:

Simeon Wan To Suen, Ka Lun Tang, Hoi Ching Leung and Zi You Jasmine Siaw (Bishop Hall Jubilee School, Hong Kong); Man Kin Cheng (Bishop Hall Jubilee School & BHJS, Hong Kong)

Abstract:

Nowadays, the impact of global warming becomes more and more significant. For example, sea level has been rising rapidly, causing many agricultural lands to be inundated. And extreme weather like hurricane has also appeared more and more frequently in US as well as worldwide.

On the other hand, the demand of crops around the globe is increasing with the rising population growth. Together with the disruption of supply chain and logistics, the food prices skyrocket recently. In addition, the situation is worsening with tightening of geopolitics such as Russo-Ukrainian War. Therefore, due to the inadequate supply of agricultural land, we have to explore new farmland with minimal transportation. Hence we propose the use Plantis, a floating greenhouse, to adapt to such change given in this era.

Plantis aims to make use of the inundated area to plant crops. The system will first absorb seawater through a cotton wick that's made from old clothes. And then, we can obtain fresh water from the sea simply by distillation that made use of the natural heat source, sun, and room temperature. Which does not require any additional artificial energy sources. Besides, we have applied new technology like the ESP32 camera, water level, humidity, and temperature

sensors, so as an electric valve. With the use of such IoT (Internet of Things), farmers can monitor their crops remotely and control the amount of water inflow, so that the crops will not be flooded. And these devices are all powered by the solar panel above to achieve zero carbon emission.

To observe the effectiveness of the system, we have monitored the growth of Dazzling Blue Kale and the seedlings of Lacinato Dinosaur Kale inside the greenhouse for 8 days. We can see that both species grow significantly. This means that the salinity of seawater does not affect the growth of vegetation. Instead, it seems that fresh water has been successfully obtained and supports their growth. In other words, Plantis succeeded in providing a suitable environment for the growth of plants.

EDIS #: 1570882531 | **Title:** The Importance of Experiential Learning

Author(s) with affiliation and country:

Yingyi Wei (China)

Abstract:

With the advancement of the world and the improvement of the economy, an increasing number of schools begin to advocate for experimental learning. The primary focus of this project is on how practice can supplement theoretical learning. I observed the students around me effectively picking up knowledge after having practiced when we were conducting physics experiments, which then made me intrigued to doing research on it. I want to emphasize the value of practice in the learning process. Finally, I'm seeking to understand how practices and everyday activities impact how the brain processes information.

EDIS #: 1570882568 | **Title:** Simulation of Basketball Shooting Process and Investigation of the Optimal Shooting Speed and Angle Using Mathematical Models

Author(s) with affiliation and country:

Enze Danny Zhang (Beijing 80 High School, China); Rui Wang and Haoran Zhang (China)

Abstract:

Basketball has been one of the most popular sports in the world. A lot of basketball amateurs have been practicing to improve their shooting precision. Shooting precision is determined by three major factors, i.e., body factors (such as body position, arm stiffness, and damping factors), shooting angle, and shooting speed. Existing research has been analyzing the optimal shooting angle given a random position. However, there's still a lack of effort that comprehensively considers the intertwined relationship between the three factors. Therefore, in this study, we developed a computer-vision-based mathematical model to simulate the shooting process and predict a successful shot. First, a dynamic model was developed to simulate the shooting process of an arm and analyze the influences of the body factors on the shooting speed and angle of the ball. Second, a kinematic model was developed to simulate the ball trajectory given the ball's initial speed and angle, thus deriving the optimal shooting speed and angle given the shooter's position. Finally, a computer vision model was developed to analyze the shooting process videos, and predict whether it is a successful shot based on the ball's initial speed, angle, and the releasing height and position of the shooter. The results indicate that the proposed model can effectively learn the influences of different body factors on a person's shooting speed and angle, and identifies the optimal solutions according to the height and distances from the basket of each player. Therefore, this model can be used to improve the shooting percentage of basketball players, and the authors aim to expand the study to model the whole-body shooting posture in the future.

EDIS #: 1570882742 | **Title:** Local Teachers' Satisfaction with and Perceptions of Voluntary Teaching Programs and Their Instructional Practices in Rural China

Author(s) with affiliation and country:

Siyu Liu (Shenzhen College of International Education, China)

Abstract:

Voluntary teaching programs are becoming increasingly popular in rural China in order to reduce the gap in educational resources between urban areas and backward areas in China. Most existing papers studied the impacts of voluntary teaching programs on local students, while local teachers' satisfaction and perceptions of these programs are always overlooked. On the one hand, volunteers bring fresh energy, innovative teaching materials, and modern teaching techniques to local education, and they help to reduce the teaching burden of local teachers and reach their

teaching targets. On the other hand, some studies found that some volunteers have poor class management skills and could mislead local students' view of right and wrong, which might leave a negative impression on local teachers. This paper aims to investigate local teachers' attitudes and perceptions of voluntary teaching programs and their instructional practices. The research questions are:

Do volunteer teaching programs affect local teachers' satisfaction with these programs?

How do local teachers perceive volunteer teachers' teaching quality (i.e., classroom management, teaching content)?

Do volunteer teaching programs affect local teachers' relationship with students (i.e., perception of students' closeness with volunteer teachers and local teachers)?

Do volunteer teaching programs affect local teachers' instructional practices (i.e., teaching schedule; class contents; effectiveness of communication)?

Online questionnaires were delivered to local teachers who have participated in voluntary teaching programs. Participants were reached by convenience sampling and were asked to respond to multiple choice questions, questions with rating scales, and open-ended questions. The data include demographic information of local teachers, their satisfaction with volunteers and programs, their perception on the relationship between local students and volunteers, as well as the degree of disruptions on their teaching schedules. I analyzed data descriptively using mean and standard deviations in Stata.

It was found that there were both positive and negative impacts of volunteer teaching programs on local teachers. Local teachers were generally satisfied with volunteers, their class management ability, and the voluntary teaching programs. Moreover, local teachers felt that their communication with volunteers was efficient. However, it was also reported that there should be more frequent communication between local teachers and volunteers, and local teachers' teaching schedules were disrupted, which brought inconvenience for their teaching progress.

Taken together, this study has the following policy implications. First, volunteers should contact local teachers before voluntary teaching programs, such as online meetings to have a better understanding of the real circumstances of local education and prepare for class contents. Second, frequent communication between local teachers and volunteers is needed before and during the voluntary teaching programs. Lastly, further research is needed to reach a larger sample size, increasing generalizability.

EDIS #: 1570882861 | **Title:** Performance Improvement of Table Tennis Server and Intelligent Training System

Author(s) with affiliation and country:

Lijia Shen (High School, China)

Abstract:

Recently, an increasing number of automatic table tennis serving machines are entering the market, which offers alternative options for table tennis players to train and improve their skills. However, it is still unclear whether these automatic serving machines are effective at improving players' skills. To better understand and quantify the effectiveness of existing table tennis serving machines, this research project conducted a market survey and four customer interviews to determine customers' preferences for existing products, as well as any gaps in product features. An improved design was then proposed to address the drawbacks of current products. Results of the market survey indicated that there are three main types of serving machines, portable, fixed, and table tennis serving robots. However, many customer pain points remain unresolved; the top three limitations include: 1) lack of variation in spin on the ball and path of the service, 2) difficult to operate, and 3) no feedback for users to improve. These results indicated that customers need a more "human-like" server that is easy to use and can also provide feedback for improvement. A new automated table tennis training system is thus prototyped. The system consists of an off-the-shelf automatic serving machine modified such that all of its motion axes were independently controlled via an embedded system of Arduino, and programmed with improved serving routines to achieve a more human-like serving. Future improvements to the system will include acoustic or visual sensors to detect the successful rate of users' return, and algorithms to adjust serving routines automatically based on sensor measurements.

EDIS #: 1570883042	Title: Robotic prosthetics
Author(s) with affiliation and country: Man Hin Cheung, Hoi Lam Wong, Ka Yip Li and Anson Ngan (Hong Kong); Man Kin Cheng (Bishop Hall Jubilee School & BHJS, Hong Kong)	
Abstract: We are working on a project, aiming to create cheap and accessible prosthetics using motors and strings to act as muscles in body parts. For the motors, we decided to use servo motors as they are light, and their degree of turning can be easily controlled and limited by coding. We are using an Arduino board for our prototype, but we may change this due to its size. In order to control movement, we tested buttons, microswitches, slide switches, and toggle switches. Slide switches are not favorable to us as it is hard to activate. They are not convenient to be used to control the servo motors. Moreover, we would like to let the servo motors have different degrees of movement. Hence, switches that can only send on-off signals are not favorable. Rotary Switches and rotary resistors seem like our only choice. However, they are bulky and we would like them to be portable. We are using different body parts to control the movement of servo motors. Since we read a few sci-fi books, we decided to control the movement of servos by less-used body parts such as the jaw, toes, and eye muscles. To fulfill our imagination, we used stress sensors on those body parts for signals to control the motors. However, our school does not have stress sensors, so we made our own to test them out. We tried using a pressure-sensitive conductor sheet (velostat) to create a pressure sensor, which worked very well. However, it is expensive and unstable as we ordered it from Taobao (the change of resistance differs greatly for each sensor). After knowing how velostat works (Wikipedia: Velostat, also known as Linqstat, is a packaging material made of a polymeric foil (polyolefins) impregnated with carbon black to make it electrically conductive.), we decided to try coating paper with carbon by pencil lead (12B which conducts electricity better than other pencils lead) and it also works well. We found a cheaper version of a homemade stress sensor. The stress sensor consists of two copper or foil strips and a pencil coated paper as the sensor is bent, the resistance of the strip will decrease and hence, we can use the change of resistance to control the movements. The board will read the change and hence, cause the servos to contact. We would also like to add a mini-game to let it play rock paper and scissors, pushing buttons to demonstrate its movements. In the future, we would also make a whole arm. We would like to improve the design and help more people as it's the aim of this project. We would also like to try using EMG to control it, but we have to conduct more research. We are unsure whether people born without arms can have those neuron motors.	
EDIS #: 1570883157	Title: Improving chess player skills with studying tactics comparison between chess Grandmaster and chess engines
Author(s) with affiliation and country: Jinshang Li (PRISMS High School, USA)	
Abstract: This study aims to investigate the effectiveness of studying tactics in improving chess player skills by comparing the tactics used by chess Grandmasters and AI-based chess engines. The study will involve a sample of chess players at various skill levels, who will be divided into groups and assigned different tactics and training methods. One group will study tactics used by Grandmasters, another group will study tactics used by chess engines, and a control group will not receive any tactics training. The study will measure the participants' chess skill levels before and after the training period, and compare the results between the groups. After all that is done, chess masters will offer interpretations of chess engines' moves to better their tactics. The findings of this study will provide valuable insights into the most effective tactics and training methods for chess players, and may also have implications for other domains where strategy and decision-making are important.	

EDIS #: 1570883162	Title: Effective Methods of Detection and Prevention of Falling Over by Using AI
Author(s) with affiliation and country: Qinuo He (PRISMS High School, USA)	
Abstract: Artificial intelligence and several sensors integrated into the belt and clothing detect changes in the human environment and movement to analyze whether a fall occurs. If this behavior is detected, the clothing and belt will take protective measures to avoid injury, the device will analyze physical signs and determine if the wearer needs assistance and rescue. The main objective of this research is to achieve as much accuracy and no misjudgment as possible through the simultaneous operation and monitoring of several sensors while improving and integrating the sensors to achieve the lowest cost and mass production. The main work of artificial intelligence in this research is data analysis and processing.	
EDIS #: 1570883190	Title: Designing a Sensor Embedded Tracksuit using Arduino MCUs and Accelerometers to Model Kinesiology of Athletes
Author(s) with affiliation and country: Shaunak M Marathe (JHU APL, USA)	
Abstract: Problem: Today, in modern times, every athlete yearns the opportunity to become a better and more stronger version of themselves with immediate hopes of improving their unprecedented skills and multitude of fitness levels. Many have the challenge of how or what they specifically have to improve on and because of this, they fail to understand their full potential by becoming figuratively frozen in the process. Not knowing how to improve and what areas they are stronger/weaker in can be a detrimental factor for every athlete. Whether it be in sports that require immense stamina, skills, or patience, perfecting the specified sport form and understanding the in-depth statistics will improve any athlete's performance and game confidence exponentially, making this one of the hardest problems in athletes today. Solution: With cutting edge, modern wearable technology, every athlete can benefit from information honed around improving their technique and physical movements in their designated sports area. In order to tackle the given problem, I decided to create a tracksuit model/prototype that would use sensors attached to a person's limbs (arms and legs) to imitate the physical motion and proper technique of designated exercise such as a workout routine, high endurance game, or just a simple walk.	
EDIS #: 1570883192	Title: Genomic Curation for Improved Marine Mammal eDNA Classification
Author(s) with affiliation and country: Christopher Li and Olive J Lara (Johns Hopkins University Applied Physics Laboratory, USA); William Joseph Ross III (John Hopkins Applied Physics Laboratory)	
Abstract: Environmental DNA (eDNA) is a promising tool for monitoring species abundance in the environment. However, there is still work to be done to improve the accuracy and reliability of this technology, which can be affected not only by the starting amount of DNA and wet lab processing, but also by the bioinformatics classification algorithms and reference databases chosen for taxonomic analysis. Additionally, certain taxa can prove more difficult to genomically classify than others due to a number of hurdles such as lack of assembled sequence references, repetitive regions, and high intraspecies diversity. For this reason, our team has focused on improving classification of species in the Delphinidae family (oceanic dolphins). Due to recent, radiative species divergence, as compared to other marine mammals, members of the dolphin family display high rates of intraspecies diversity, making classification based on single reference genomes per species difficult. To address this classification ambiguity, our team constructed a new marine mammal mitogenomic reference database which contains all publicly available mitochondrial genomic data for each species. Our team collaborated with The National Aquarium to procure positive control eDNA samples for sequencing, queried NCBI's GenBank for mitochondrial reference sequences, and employed the Kraken2 algorithm to build our database and classify our samples. We added 19,564 sequences to our custom Kraken 2 database and	

observed improved species-level classifications of Atlantic bottlenose dolphins (*Tursiops truncatus*) through use of the expanded database. Future work aims to continually assess methods to increase species-resolution classifications of marine mammals in eDNA samples.

EDIS #: 1570883292 | **Title:** Precision Medicine in Lung Cancer

Author(s) with affiliation and country:

Yuchen Ye (China)

Abstract:

Lung cancer is the second most common cancer with the lowest survival rate of 18% compared to other common cancers. There are 2.3 million new cases each year and a majority (85%) of them are non-small cell lung cancer (NSCLC). There are different molecular sub-types of NSCLC with different biomarkers. Although immune checkpoint inhibitors (ICIs) including monoclonal antibodies against programmed death-1 (PD-1) and programmed death ligand-1 (PD-L1), have significantly improved the survival and quality of life of a subset of NSCLC patients, the identification of patients who will obtain the best benefit from ICIs is still an unmet need and targeted therapies against various biomarkers are significantly wanted. Thus, precision medicine which aims to provide customized treatment strategies based on genetic testing, individual habit (like smoking), etc., could potentially select the suitable therapy regime with high efficacy and reduced side effects to patients. To identify the feasibility of using precision medicine on lung cancer treatment, this research is based on a comprehensive literature review and conducted a data analysis of different research results, articles and data. Firstly, through study of PD-L1 expression as a predictive biomarker, ICI efficacy may be evaluated. Immune checkpoints engage when proteins on the surface of immune cells called T cells recognize and bind to partner proteins on other cells, such as some tumor cells. These proteins are called immune checkpoint proteins. When the checkpoint and partner proteins bind together, they send an "off" signal to the T cells. This can prevent the immune system from destroying the cancer. Secondly, the discovery of novel biomarkers may further categorize patients and develop new targeted therapies. Lastly, patients who showed poor response to ICI may show better response with the combination of chemotherapy and ICI. With thorough information on immune profile, genome alteration as well as individual risk factors, precision medicine will dramatically improve and save a great many lives worldwide.

EDIS #: 1570883355 | **Title:** Flow of beads in a viscous film on vertical fibers

Author(s) with affiliation and country:

Leonardo Dobrinsky (USA)

Abstract:

People are usually fascinated by things that are unusual or different. In many cases, physics may be studied because it satisfies people's curiosity or because it is fun. For example, people studied static electricity to perform magic. Einstein studied physics because he wanted to better understand how the world works, not because he wanted to build a particular machine. I think learning about physics is exciting, fun, and somewhat educational. The goal of this presentation is to see how beads of a viscous fluid film flow down strings. In this presentation, I am going to show my experimental setup that includes a bucket, strings, and oil under a bright LED display. This setup highlights the interesting behavior of beads in a viscous film sliding down thin strings. The experiment shows that even a relatively simple system can exhibit complex behavior. For example, beads can slide in unexpected ways. By observing the experiment, I hope that you will find the joy and beauty in physics.

EDIS #: 1570883361 | **Title:** Academic Stress, Parental Expectations, and Sleep: A Daily Diary Study Among Adolescents

Author(s) with affiliation and country:

Melinda Yu (USA)

Abstract:

Introduction: Adequate sleep is essential for adolescents as it has been linked to various developmental outcomes (e.g., mental health, cognitive function, physical health). The current study aims to investigate factors that may contribute to adolescents' sleep. Specifically, academic stress has been negatively associated with sleep quality and length, yet less is known about how school and family intertwine to influence sleep. Parental expectations on

adolescents' academic performance may also have an impact on sleep. More importantly, parental expectation is also an indicator of family relationships and family support which are critical resources that may buffer the effect of academic stress on sleep. Furthermore, sleep fluctuations are often caused by poor sleep quality, and higher sleep fluctuations among a certain period may indicate poor adjustment ability and more disturbances in sleep. In sum, this study examines the association between academic stress, sleep, and sleep fluctuation, as well as the moderation effect of parental expectation on such associations.

Methods: Thirty high school students (aged between 15 and 17, 77% female) were asked to participate in a 3-day daily diary survey in which they reported their daily academic stress and sleep. Academic stress was measured by daily study time (in hours), number of school problems, whether participants had testing (yes/no), and overwhelmingness of workloads (1 (not at all) to 5 (extremely)). The current study calculated the average score of academic stress and sleep across the three days to indicate participants' experiences during the study period. The standard deviation of sleep quality was calculated to represent the fluctuations in sleep.

Results: On average, participants self-rated their sleep quality as 2.63 (possible range = 0-5), representing a relatively poor sleep quality. Their sleep length on average was 6.95 hours (range = 4.95-11.53 hours). Multiple regression showed that longer study time and a more overwhelming workload on a certain day were associated with poorer sleep quality. Facing more school problems was associated with shorter sleep. The study also found that higher parental expectation was associated with poorer sleep quality. Yet parental expectations did not moderate the effects of academic stress on sleep, meaning that academic stress has an adverse effect on sleep regardless of parental expectations. None of the academic stress indicators were associated with sleep fluctuations.

Discussion: The findings suggest that adolescents may face problems related to sleep quality and sleep length, especially when they perceive large academic stress and higher parental expectations on their developmental outcomes. Academic stress and parental expectations act dependently to influence sleep, such that adolescents with higher parental expectations also experienced more overwhelmed schoolwork. In short, the current study highlights the importance of both school and family environments on adolescents' daily activities and health, as well as provides implications for more integrative perspectives of adolescents' development.

Conclusion: Higher academic stress had an adverse effect on adolescents' sleep quality and length. The strength of such associations does not vary on parental expectations, yet higher parental expectations itself also had a negative effect on sleep quality.

EDIS #: 1570883376	Title: Advancing Knee Arthroscopic Surgeries with Endoscopic and B Mode Ultrasound Imaging
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Author(s) with affiliation and country:

Catherine Ren (Havergal College, Canada); Yining Zhang (University of Toronto Schools, Canada)

Abstract:

Knee arthroscopy is a minimally invasive surgery where surgeons utilize arthroscopes to visualize the internal structure of the knee to evade the need of large incisions. Owing to its effectiveness in reducing pain, knee arthroscopy is one of the most used surgical procedures for treatment of various knee injuries, which is currently performed around 750,000 times each year in the United States. However, from an analysis of 9 studies, the pain reduction offered by knee arthroscopy is found to be temporary, with most participants reporting the benefits of the surgery did not last for more than 24 months. This is partially attributed to the lack of visibility: current arthroscopes employ optic fibres to transport two dimensional images of the knee to a monitor screen, which provides only superficial morphology of tissues and hence leads to inaccurate procedures.

To solve this issue, combining ultrasound imaging in conjunction with the traditional optical modality has been investigated. An external ultrasound can allow the surgeon to track the whereabouts of the surgical instruments inside the knee, while an ultrasound arthroscope using a modified intravenous ultrasound can allow the surgeon to receive depth-resolved information, such as evaluating the properties and integrity of cartilage and tissue around the joint in three-dimension (3D) structure. While current studies in this field focus on either using an external ultrasound or an adapted intravenous ultrasound to be used inside the knee cavity, the specific combination of both an external and arthroscopic ultrasound offers great promises for improving knee arthroscopy procedures with comprehensive

information. However, designing and fabricating an internal ultrasound imaging device for this specific purpose is resource-intensive and costly.

In this work, we developed a simulation program to mimic ultrasound arthroscopy implementations for optimizing the design of ultrasound arthroscopy devices for knee surgery. The simulation was built in MATLAB on the basis of an ultrasound propagation simulation tool-box (k-wave). A series of new functions were developed to build ultrasound transducers for imaging from inside the knee. A 3D model of the human knee was developed in SketchUp. The 2D cross-sectional images were captured from this model and then uploaded into the simulation program as imaging targets for ultrasound imaging tests. Ultrasound images with high consistency to targets were received in the simulation. The simulation program can be easily modified to fit specific needs and correct small problems, which allows researchers to test the effectiveness of the proposed designs without spending large amounts of money to create a genuine working model. The optimized combination of using endoscopic (internal) and B-mode (external) ultrasound imaging is a new design that can create positive outcomes for many different stakeholders. Patients will benefit from an improved surgery procedure which ensures less error and a better outcome. It is anticipated that this study will serve as a stepping stone for future research and eventually test trials that employ the dual ultrasound devices method in clinical settings.

EDIS #: 1570883378 | **Title:** Toward an Energy Saving Smart Campus - IoT Smart Light Switch

Author(s) with affiliation and country:

Tsz-Him Ma and Yuen-Ning Poon (Cognitio College Kowloon, Hong Kong)

Abstract:

Internet of things (IoT) devices have been widely adopted for energy-saving applications, including lighting. Inspired by a real-life problem on our campus, we created an IoT Smart Light Switch, an intelligent campus IoT device that aims to reduce the campus's energy consumption. In this poster, we present the background and motivation behind creating the IoT Smart Light Switch. The IoT Smart Light Switch is inspired by the lighting system installed on our campus, a traditional lighting system with a time switch. The corridor lights remain on even though the surrounding is bright, and nobody passes by, resulting in a waste of electricity.

We also introduce the details of the design and construction of the IoT Smart Light Switch. It was designed for an environment with abundant natural light, such as a corridor or semi-open areas. It is a WIFI-based smart switch that senses the presence of a passerby, the ambient light level of the surrounding environment, and the present time. It was built with a passive infrared sensor (PIR sensor), ambient light sensor, and WIFI-enabled ESP32 microcontroller, shielded by an outer case made of acrylic plates. The IoT Smart Light Switch connects with the Smart Relay and the cloud server via WIFI, and it transmits the switching command to the Smart Relay to turn on/off the light. The light control is achieved through three parameters: ambient light level, time of the day, and human presence detection. For example, lights are turned off when the ambient light is low outside working hours with no human detected. The IoT Smart Light Switch also periodically uploads data to the cloud server, such as light level, passerby presence, and light power status. An end-user can access the cloud server to retrieve data, access the dashboard, and control the IoT Smart Light Switch through their mobile devices.

Finally, the poster includes the results and future work of the project. Since the project is still a work in progress, we present an estimation of the energy and electricity bills that could be saved by adopting this prototype. Future plans include (i) conducting a trial in the school corridor or podium to compare the trial result with the estimation of electricity use, (ii) improving the IoT Smart Lighting Switch based on the trial result, and (iii) exploring other potential applications.

EDIS #: 1570883396 | **Title:** Can Deep Learning Models Trained on Small and Imbalanced Ultrasound Image Samples Detect Polycystic Ovary Syndrome (PCOS)?

Author(s) with affiliation and country:

Sophia Y Liu (Cherry Hill High School East, USA)

Abstract:

Polycystic ovary syndrome (PCOS) is the most common endocrine abnormality in women and a leading cause for infertility, affecting approximately 15% of reproductive-aged women globally. PCOS can also lead to illnesses such as

heart disease, endometrial cancer, stroke, and diabetes. Women with PCOS often develop small sacs of fluid, called cysts, in their ovaries, which can be identified through ultrasonography.

Several studies have applied deep learning methods to diagnose PCOS through analyzing ultrasound images. Recently, transfer learning has become increasingly popular for enhancing the performance of deep learning models. Transfer learning uses deep learning models pretrained on data from other domains to solve a problem in a new domain. This approach can be more effective because the pretrained model may store knowledge and information that could help solve the new problem. Last year, researchers began investigating the use of transfer learning in the diagnosis of PCOS based on large and moderate sized training sets (Suha and Islam, 2022 and Hosain et al., 2022).

My research aims to help develop a more thorough understanding of the effectiveness and efficiency of using deep learning to identify PCOS from ultrasound images. Specifically, the purpose was to shed light on the following questions: How do small and imbalanced training samples affect transfer learning? Will a transfer learning approach outperform a non-transfer learning approach? Will deeper neural networks result in higher accuracies?

I use four classical deep learning architectures, ResNet50, ResNet101, VGG16BN, and VGG19BN. The ResNet architectures have over 20 million parameters and the VGG architectures have over 130 million parameters. I implement a transfer learning model and a non-transfer learning model of each architecture. The transfer learning models were pretrained on the ImageNet which has over 16 million natural images but no medical images. The PCOS dataset has about 2000 images. All models are prepared using training and validation sets, and tested on the same test sets.

The experiments based on ResNet and VGG models generated consistent results. First, small and imbalanced training sets have minimal impacts on the performance of transfer learning models. Training sets of different sizes are used. The smallest, most imbalanced training samples only have 6 PCOS positive images and 60 negative images. All transfer learning models trained on these sets achieved average accuracies >99% on the test set of over 1500 images. Second, transfer learning models are more accurate and reliable, and have shorter and smoother training processes. Third, models with more layers don't perform better on this problem.

This is the first research that demonstrates transfer learning's capability of detecting PCOS using small and imbalanced samples of ultrasound images.

References

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Hosain, A.S., Mehedi, M.H.K. and Kabir, I.E., 2022, October. PCONet: A convolutional neural network architecture to detect polycystic ovary syndrome (PCOS) from ovarian ultrasound images. In *2022 International Conference on Engineering and Emerging Technologies* (pp. 1-6).

EDIS #: 1570883430	Title: General Optical Properties of Two-Dimensional Materials & Applications in Optoelectronics
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Author(s) with affiliation and country:

ZiRui Yu (Wuhan Britain-China School, China)

Abstract:

Two-dimensional (2D) materials are now prevalent in many avant-garde areas, such as maglev trains and optoelectronics. Since the beginning of 21st century, physicists have been delving deeper into the various physical properties of 2D materials. Graphene, a single-layer honeycomb lattice of carbon, is one of the most typical 2D materials. Despite its various fascinating properties, graphene is a gapless semimetal. This stimulated the search for 2D materials with semiconducting characteristics and more prominent optical properties. Beyond the conventional means of tuning material properties, 2D materials unlock a new knob for tuning: twist angles. Twist angles enable the tuning of band structures and exciton properties in 2D semiconductors, and thus their optical properties. For example, twist angles create a new displacement between holes and electrons thus forming distinct absorption and emission spectrum, specifying the light frequency absorption range. This research is based on a literature review of the band structure of typical mono-layer van der Waals 2D materials, such as MoS₂ and WSe₂, and simulated the optoelectric

properties of these 2D materials by analyzing the absorption intensity spectrum based on open data collected from the Material Project. The results of the research provided a better understanding of the band structure and applications in photo-detection of MoS2 and shed light upon the future use of these materials in optoelectronics.	
EDIS #: 1570883436	Title: Deciphering the Indus Script: Decoding Missing and Unclear Indus signs and Identifying Anomalous Indus texts from West Asia using Markov Chain Language Models
Author(s) with affiliation and country: Varun Venkatesh (USA)	
<p>Abstract: The Indus script developed between 2500 and 1800 BCE in the Indus Valley civilization in the Indian subcontinent and then died out. It has been deciphered yet and the language it encodes is unknown. Without decipherment, the details of this civilization have largely remained mysterious. Indus script texts found so far in the archeological digs include a lot of damaged artifacts with unclear and missing signs in the text. Identifying the missing and unclear signs and extending the Indus text corpus will hugely benefit decipherment efforts. While others have done work using the older corpus and simpler language models, this work aims at building advanced n-gram Markov chain language models using the latest ICIT text corpus and uses that to predict the missing and unclear signs and assist the catalogers. We also use the language models we built to recognize some anomalous Indus texts based on their geographical distribution.</p> <p>First, we analyzed patterns and concordances of the signs, pairs, triplets, and other n-grams and discovered how the signs behave with respect to their positions in the Indus texts. We then did statistical analyses focused on text length and sign positional distribution and built a positional probability model. With the understanding of sign behavior, we built Markov chain language models based on n-grams, augmented with the positional probabilities of the signs. We also devised and implemented an effective sign fill-in algorithm on top of these Markov chain language models using model scores of snippets of n-grams. We find that a group of three signs in a cluster capture a lot of information when the signs appear in the middle of a text. Signs appearing in the leftmost positions are the most difficult to predict. Using the language models and the sign fill-in algorithm, we identified missing single signs in the test dataset and tuned our parameters to improve the accuracy to about 63%. Then we filled in the actual unclear texts with our predicted signs and published our predictions in the order of probabilities. This adds a wealth of information that was previously missing to the Indus script corpus.</p> <p>Our results also show that the language model perplexity was high for several Indus texts that were found in the West Asian region in the contemporary bronze age civilizations of Sumer, Dilmun, and Elam. Some of these texts did not fit in well with the language model built with Indus texts from just the Indian subcontinent. From this, we conclude that the language in several West Asian Indus texts is quite different from the language used in the Indus script from the Indian subcontinent.</p> <p>We believe that the sophisticated language models and algorithms that we developed give a better understanding of how the Indus Script behaves, add more complete texts to the Indus text corpus by filling in the missing signs, and postulate that the Indus script encodes multiple languages that varied by geography. We think these are significant advancements toward deciphering the Indus script.</p>	
EDIS #: 1570883811	Title: Enhancing STEM Education to Communities with Low Access to STEM Resources
Author(s) with affiliation and country: Christine DiMenna (Gilman School & QuarkNet, USA); Arya Kazemnia, Aman Garg, Leo Wang, Abraham Karikkineth and Daniel Koldobskiy (Gilman School, USA)	
<p>Abstract: In the Baltimore community, supply of STEM education is being rapidly outpaced by demand. As a result, it is imperative that outreach programs be developed to function well with lower resources. This year, our team sought to develop methods of tech instruction through collaboration across communities and groups as well as innovative systems which allowed for the same degree of learning in spite of time and financial constraints. As a high school robotics team, we felt it was imperative to reach out and do our part this season, especially as, as little as 5 months ago, we had no outreach program whatsoever. Due to this, our success this year is an example of how outreach</p>	

programs can be built with minimal resources and limited time, while still significantly aiding STEM education. On our way to developing this, we met with a series of roadblocks, including logistical constraints such as time, space, and transportation, which impacted both us and the communities we were attempting to impact. However, by partnering with existing organizations, using connections of our team members, and developing personal connections with our students, we were able to build our STEM education program from the ground up. Throughout this season of our robotics program, we have experimented with different styles of teaching and learning. By using our workshops not just as opportunities to teach but also opportunities to learn, we were able to collect data on how students reacted in different environments: with different levels of hands-on learning, for example, or in a virtual vs. in-person environment. Through this process, we were able to develop strategies to maximize our outreach's effectiveness, but we also realized that we could not do this alone. To this end, we worked with other robotics teams we had connections to, organizing social events and collaborative outreach to cultivate a culture of mentorship. We also helped to mentor younger students, aiding 2 middle school robotics teams in their design and fabrication process. Our partnerships with Bridges MGP, a nonprofit that connects independent schools with public school students, as well as Cromwell Elementary School, where we organized many of our workshops, also yielded fruit, and we hope to continue with them for years to come. This year, we have shown that, through a combination of virtual and hands-on learning, strategic partnerships, and personal connection with mentees, an outreach program can be built with minimal resources and achieve a high degree of success. Although our project began as a secondary activity, it quickly grew to something that we found core to the team. The program's rapid growth offers hope that in the future, with more time, better foundations, and existing connections, we will be able to further build on our success in the coming months.

EDIS #: 1570884028 | **Title:** Mathematics Model of Honey Bee Colony

Author(s) with affiliation and country:

Qingyuan Yao (China); Yujie Chen, Haoxuan Wang and Fangzhou Dai (The High School Affiliate to Renmin University, China)

Abstract:

There was a wacky diminish of the population of honeybees called Colony Collapse Disorder(CCD), and it harms both nature and the economy of a society. We developed some models to find an intrinsic reason for this vast diminish and solved real problems about the decline of honeybees.

In the model, we drew upon a lot of academic papers and created a conclusion formula which displays the whole quantity of a colony. This model contains several factors which can affect the whole population. Apart from that, we considered about special winter behavior of honeybees, which can remarkably affect the final result.

EDIS #: 1570884208 | **Title:** Evaluating the Effectiveness of Design Processes in Mechanical Engineering Applications

Author(s) with affiliation and country:

Diana N Omar (Johns Hopkins University Applied Physics Laboratory, USA)

Abstract:

Mechanical design engineering is a field that has generated an increasing hold on societal functionality with technological advancements. However, it is important to understand how these valuable ideas came to be and how more can be made. Without valuable technology, the vast impact among the intended user will not be actualized. There are many current mechanical design methodologies and processes that are meant to strengthen the user-developer relationship, but some are flawed in their outcome. Some key valuable components include empathy associated with Design Thinking, nonlinearity with the Engineering Design Process, collaboration in Design Reviews, and expertise in various roles. However, some drawbacks are weaker communication in the Engineering Design Process, and slight reliance on the user's opinion in Design Thinking. The purpose of this study is to evaluate the effectiveness of current mechanical design methodologies through observation and determine ways to promote valuable technological contributions to society with organization and impact. Each process has their benefits and drawbacks, but a synthesis of both methodologies can help to mitigate any problems threatening valuable contributions to technology.

EDIS #: 1570884211	Title: Integration of Quantum Computing with Deep Learning
Author(s) with affiliation and country: Amin Boukari (Caesar Rodney High School, USA)	
Abstract: Machine learning is an algorithmic approach to modeling data computationally, by learning from features in a dataset. There is a growing interest in applying machine learning tools towards solutions to solve diverse problems related to multi-disciplinary fields. Deep learning is a subset of machine learning that specifically deals with modeling the data through a network of parameterized layers, called a Neural Network. The network architecture parameters are optimized through a process called training by minimizing a specific loss function through gradient descent algorithms. Deep learning techniques have been found to drastically improve prediction accuracy in many analytical models. Their predictive abilities are unmatched by today's technology. Quantum computing is a field of computing that involves using quantum particles, called qubits, to perform computation. This allows quantum computers to take advantage of quantum states, such as superposition and entanglement. Quantum computing is an evolving field that can be useful for many applications, including cybersecurity, encryption, medical research, and meteorology. In this, I propose to combine both Deep Learning and Quantum Computing by studying the integration of quantum computing methods with deep learning algorithms to improve the accuracy of the models. In this implementation, I added a parameterized quantum circuit that uses a specific number of qubits equal to the number of classes in a Convolutional Neural Network. The qubits in the circuit are rotated in the y-axis using a parameter theta, which is tuned through gradient descent during the training process. Limitations of latency and runtime from actual quantum computers make it necessary to run the quantum circuit in a simulated backend in the training system. To train and test this model, I used the CIFAR-10 dataset and a ten-layer Convolutional Neural Network. In this implementation, ten qubits were used to train and test a supervised classifier on the publicly available CIFAR10 dataset. While using a local simulated backend drastically improves training times, it still takes significantly longer to train than a completely classical network due to the sequential nature of quantum simulators and the inability to run them on GPUs, which necessitates GPU-CPU communications and poses a bottleneck in the training process. My results show significant improvements over the purely classical methods when using the same number of epochs and batches, even accounting for the bottleneck due to the simulated backend. This work shows that quantum computing can be successfully integrated with deep learning algorithms and shows promising results.	
EDIS #: 1570884224	Title: Machine Learning Predictive Model to Reduce the Harmful Environmental Effects of Pesticide Usage in Agriculture
Author(s) with affiliation and country: Kareem Boukari (Caesar Rodney High School & Delaware State University, USA)	
Abstract: Many of the challenges we face today around sea level rise, food, extreme weather, water equity, invasive species and climate change have direct impact and serious consequence on all living organisms, our health, and the quality of life and future. Our environment is changing around us for the worse due to our own actions. Addressing these challenges requires taking steps and building tools towards its protection. In agriculture, Crop and food production are necessary to provide supply, avoid hunger and inflation. To protect their crops, farmers need to use insecticides, pesticides, and nutrients. However, these chemicals are harmful to our health and ecosystem, as they pollute the environment. In agriculture, this is a trade-off between increasing crop production and reducing necessary land treatments. Reducing too much of these chemicals may lead to less production of food. To address this challenge and avoid unnecessary excessive use of pollutants, I propose to build new predictive supervised machine learning algorithms based on decision trees, Support Vector Machine and Random Forest that will assist farmers to continue to use pesticides in a way that benefits both them and the environment. Using this tool, the farmers can reduce chemical and frequency usage based on the predicted outcome on their crop health ahead of time by setting some experiments where they minimize the environmentally harmful chemical usage as much as possible while keeping good and sustainable crop productivity.	

The publicly available dataset used in this project is a three-class labelled dataset that contains the quantity of insecticides, pesticides, nutrients, and the soil category, frequency, season, and type of crop. To choose the best model, I ran multiple experiments and compared different models using different parameters using Python scikit-learn library. For training, k-fold cross validation was used to split the data into training and testing sets.

Using Bayesian Classifier, we obtained an accuracy of 82%. The SVM was not able to separate the classes very well especially because we obtained null precision and recall for two imbalanced classes. The decision tree classifier led to 83% accuracy. We also conducted multiple experiments for each random forest using 200, 500, 700, and 1000 trees at different depths. The best average accuracy result of 89% accuracy was obtained using the XGBoost Random Forest with 1000 trees of depth 12. However, precision and recall for the 2 imbalanced classes were low. To overcome the data imbalance, further work needs to be done using data augmentation or under sampling.

In conclusion, the proposed method can be used as a strategy to convince farmers to reduce the harmful chemicals for the environment while keeping good crop productivity. Findings will provide novel insights to farmers about the extent to which crops can be exposed to pesticides before having a major crop damage and how they can be reduced while keeping good crop productivity.

EDIS #: 1570884393	Title: Simulating Quantum Magnetism on Noisy Quantum Computers: An Analysis of Trotter-Suzuki and qDRIFT
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Author(s) with affiliation and country:

Peter C Seelman (Johns Hopkins University Applied Physics Laboratory & Glenelg Country School, USA); Taohan Lin (Johns Hopkins University Applied Physics Laboratory & Thomas Jefferson High School for Science and Technology, USA); Milan Tenn and Samuel N M

Abstract:

Quantum computing is a new computing paradigm that offers more efficient solutions to computationally intensive problems including drug development, breaking RSA encryption, and simulating quantum mechanical phenomena. However, current quantum computers are noisy, meaning that errors in the implementation of gates and quantum bits interfere with their ability to perform computations accurately. We study quantum algorithms on noisy quantum computers for simulations of material properties, particularly quantum magnetic materials described by Ising and Heisenberg models. This paper investigates two methods for implementing Hamiltonian simulation, the First Order Trotter-Suzuki method and qDRIFT [E. Campbell, Phys. Rev. Lett. 123, (2019).], two of the leading algorithms for simulating the time dynamics of various material properties. The First Order Trotter-Suzuki (FOTS) method creates a deterministic quantum circuit by repeating a set of quantum gates for each simulation time step. qDRIFT creates circuits through random sampling and can potentially significantly reduce the number of gates needed to perform an identical quantum simulation implementing FOTS. We examined the efficacy of the qDRIFT algorithm compared to the FOTS method with and without noise and compared the resiliency of these algorithms to the effects of noise. We ran tests via classical simulation and IBM Quantum hardware using the Ising and Heisenberg models for quantum magnets. Due to the limitations of publicly available quantum computers, we used an Ising chain with a maximum of six qubits. We tested a variety of parameters: (i) fixed time of evolution with a fixed initial state and observable, (ii) randomized initial state with a fixed observable, and (iii) randomized initial state and observable. When the initial state and observable were fixed, qDRIFT on noiseless simulation was found to have greater algorithmic error than FOTS. However, on IBM Quantum systems, the difference in accuracy between qDRIFT and FOTS was lower. This indicates that while the efficacy of qDRIFT was worse without noise for the models we studied, qDRIFT is less affected by noise. After the initial state and observable were randomized, the difference in error between the two algorithms significantly decreased. In addition, we showed that in cases where the Heisenberg model has one dominant ferromagnetic coupling interaction and other weaker interactions, qDRIFT could outperform the FOTS method. In future research conducted on more powerful computing hardware, we aim to test qDRIFT when applied to Hamiltonians with more terms and few dominant ferromagnetic interactions like those relevant to quantum chemistry.

EDIS #: 1570884403	Title: Novel Medical Sensor Design For Mass Casualty Triage and Trauma Care
Author(s) with affiliation and country: Diya Sharma (Johns Hopkins University Applied Physics Laboratory, USA)	
Abstract: Mass casualty incidents (MCI) are large-scale accidents that result in trauma or casualties. These events overwhelm hospitals because of the demand for equipment and trained personnel. The triaging system uses paper tags to categorize patients into four groups: deceased, emergent, delayed, and minor. The tags allow first responders (FRs) to direct resources to patients in critical condition. Tags are not frequently updated as vital signs change, so FRs are rushing to rapidly screen, categorize, and transport patients in a chaotic environment [2,3]. The goal of our project was to replace paper tags with a low-cost electronic alternative (\$70 for prototype) that can be quickly placed on patients in many different locations of the body, unlike other devices currently in development [4]. We focused on 2 main tasks: 1) identifying and designing an electronic sensor package that collects critical vital signs of trauma care patients and 2) redesigning an original prototype using a custom printed circuit board (PCB) to create a more compact and adhesive tag. By utilizing mechanical design tools like SOLIDWORKS and Onshape, we were able to implement an iterative design process and improve our electronic sensor tag's packaging. We also used the Arduino IDE to program the tag with open-source libraries from various vendors, and low-cost electronics to create our proof of concept. We identified blood oxygen levels, heart rate, temperature, and mobility being the critical metrics monitored in trauma patients. We designed a custom 3D printed case that integrated our programmed microcontroller and sensors assembly into a single package and had an LED to signal the status of the patient. To minimize size, weight, and usability, we designed our own PCB using KiCAD to only include the necessary components for our electronic tag. As a result, we were able to design a compact and adhesive electronic tag that can be easily placed on patients, efficiently collect vital signs, categorize patients into priority groups, and indicate patient status using a LED visual for FRs. This work is a basis for novel mass casualty triage tagging opposed to the current method of paper tagging. We hope to expand the project to search and rescue missions as well as military medicine, by combining the emplacement of tags onto patients with independent robots in future work.	
EDIS #: 1570884406	Title: Quantum Noise Mitigation Via Randomized Compiling
Author(s) with affiliation and country: Harry Rathbun (Johns Hopkins University Applied Physics Laboratory, USA); Alex J Zhang (Johns Hopkins Applied Physics Laboratory, USA); Colin La and Kenji Ishi (Johns Hopkins University Applied Physics Laboratory, USA)	
Abstract: Authors: Harry Rathbun, Alex Zhang, Colin La, Kenji Ishi Mentored by: Tom Gilliss, Gregory Quiroz, Paraj Titum, Leigh Norris Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, 20723, USA Quantum computers harness properties of quantum mechanics to make complex calculations that classical computers cannot. Thus, quantum computers have the potential to solve problems that today's best supercomputers cannot, such as problems in drug development, computational biology, prime factorization, and optimization. However, current quantum computers are greatly hindered by error, also known as noise. There are two primary types of noise: coherent and stochastic. Coherent noise is error created by the environment and systemic flaws. Some causes of coherent noise are detuning, calibration errors, and crosstalk (qubits interacting with one another in an uncontrolled way). Stochastic noise is random error. It is often caused by fluctuating fields in the environment or interactions with other systems. Errors caused by certain types of stochastic noise can be corrected by quantum error correction (QEC), a technique that uses redundancy to protect the information stored in a quantum computer. The same is not true for coherent noise, which generally leads to the highest error rates under QEC. Randomized Compiling (RC), which was introduced by Wallman in 2016, transforms coherent noise into a type of correctable stochastic noise [1]. Our objective is to study the effectiveness of RC on both coherent noise and stochastic noise. RC effectively alters the noise by inserting random gates into a quantum circuit. Since RC is random, it can produce the desired outcome after averaging over many circuit evaluations. Importantly, RC keeps the circuit	

logically equivalent and does not extend the circuit length. Unlike other error mitigation methods, it can be adapted to many different types of quantum circuits.

Using the Python library Qiskit, which is an open-source software development kit for working with quantum computers, and IBM's free online quantum computers, we simulated RC on coherent and stochastic noise. Our experiments showed that RC reduced the overall error. We found that the error for the bare circuit without RC grew exponentially as circuit depth increased, while the error for the RC circuit grew linearly. The standard deviation of outcomes was greater for the RC circuit due to the randomness. Despite this, the RC circuit clearly showed superior performance to the bare circuit.

[1] J. J. Wallman and J. Emerson, *Physical Review A* 94, 052325 (2016).

EDIS #: 1570884419	Title: First Ever Whole Genome Sequencing and De Novo Assembly of the Freshwater Angelfish <i>Pterophyllum Scalare</i>
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Author(s) with affiliation and country:

Indeever Madireddy (USA)

Abstract:

The freshwater angelfish, *Pterophyllum scalare*, is a popular freshwater cichlid kept by aquarium hobbyists around the world. Originally from South America, these fish are well known for their monogamous breeding patterns and thorough parental care of offspring. Although the behaviors of the angelfish have been well studied, very little is known about the nuclear genetics of the angelfish as its genome has never been fully sequenced and assembled. Cichlids are of especial importance to biomedical research, for they have been used as model organisms to study craniofacial variation and neurobiology. Investigating the genome of the angelfish may enable its use as a model organism for further biological research. In this work, I sequenced, assembled, and annotated the complete genome of the freshwater angelfish in addition to the full mitochondrial genome with Oxford Nanopore Technologies.

With the MinION MK1B device, 6.94 million sequencing reads and an estimated 10.1 gigabases at a 3.24 kb N50 read length were collected. Two flow cells were used to collect this sequencing data, and the flow cells were run for 72 hours each. The reads collected had a mean read quality of 15.06 and a median read quality of 14.58, corresponding to an estimated 97% sequencing accuracy. Reads were collected at an average translocation speed of 220 bases per second.

Collected reads were then screened to identify potential contaminant organisms in the sequencing data. The kraken2 tool identified that *Pseudomonas aeruginosa*, a common opportunistic aquatic pathogen, was the largest contaminant of the sequencing reads.

The mitochondrial genome of the angelfish was assembled from the sequencing reads. All 37 conserved mitochondrial genes, including 2 rRNAs, 13 genes, and 22 tRNAs common to eukaryotic organisms, were identified, indicating a complete and robust assembly. This new assembly was 25 bp longer than the reference mitochondrial assembly, with a 99.1% similarity.

The final nuclear genome assembly consisted of 15,486 contigs totaling 734.79 Mb with a final BUSCO score of 86.5% and a 41% GC content (Simão et al., 2019). The genome size and GC content is similar to other fish species, such as the Asian seabass and the Nile tilapia. The N50 contig length of the assembled genome was 96,962 bp, and the longest contig was 543,394 bp. Repeatmasker masked 12.47% of the genome containing simple repeat sequences.

NCBI blastp (ver. 2.12.0) performed functional annotation of the genome through the GenSAS platform. 24,247 unique protein-coding sequences orthologous to other species were identified in the angelfish genome against the refseq vertebrate-other database. Most genes, 59%, were orthologous to *Archocentrus centrarchus*, a closely related South American cichlid. Timetree suggests that *A. centrarchus* and *P. scalare* diverged between 28.7 to 72.4 million years ago.

Future work would involve RNA sequencing of the angelfish to build an appropriate transcriptome of the organism. Illumina sequencing could also be performed to improve the current assembly.

EDIS #: 1570884435	Title: Chat Bot Implementation on Mattermost Servers Using APIs
Author(s) with affiliation and country: Taylor Ann Benning (Johns Hopkins University Applied Physics Laboratory, USA)	
Abstract: Today, chat bots play a vital role on a variety of online spaces including online retailers and technical support. Although they have been largely utilized for simple and repetitive information sharing up to this point, many chat bot's capabilities have the ability to become more widely distributed through integration into chat servers such as Mattermost and Slack. Additionally, the introduction of ChatGPT (based on GPT-3) has shifted chat bots from repetitive sharers to active conversational participants. To research the capabilities of chat servers to host chat bots, we first launched a Mattermost chat server hosted on a Linux virtual machine. After setting up the server, we used the Mattermost API and the Mattermost Python Bot plugin to write code to implement two chat bots onto the server. Both bots are equipped with the capability to recognize when the user mentions them in the chat, but the two chat bots are of varying complexities. One chat bot understood only a handful of phrases, while the other (ELIZA) utilized a separate library of prewritten responses to facilitate more advanced communication. Finally, we utilized the GPT-3 API to create the most advanced chat bot of the three. Although this last chat bot generated significantly more human-like messages than the other two, it still made frequent grammatical errors when responding. These various chat bots were all implemented into the chat server using almost identical techniques, revealing an easily repeatable method for AI capabilities to be showcased on widely used chatting platforms. Providing widely available showcases of different chat bot capabilities could serve as an impactful source of education on discerning AI generated text from human created text.	
EDIS #: 1570884451	Title: Min-Max Optimal Matching
Author(s) with affiliation and country: Yibo Cheng (USA)	
Abstract: We design algorithms for the One-Sided Matching problem, in which a set of graduates must be matched to a set of jobs over which each graduate has a preference list. In particular, we study a novel criterion called Min-Max Optimality, which is achieved by the matching that gives the fewest graduates their ℓ th choice; subject to this, the fewest graduates their $(\ell - 1)$ th choice, and so on, where ℓ is the maximum length of any graduate's preference list plus 1. In this paper, we give algorithms for this problem that combine classic results in matching theory to compute a Min-Maximal rank in time $O(m \cdot \sqrt{n \cdot \log \ell})$ and find the Optimal matching in time $O(n^3)$, where n is the total number of graduates and jobs.	
EDIS #: 1570884481	Title: The strategy formation process of publicly listed firms under the "Double Reduction" Policy - a pilot study of factors impacting firm survival
Author(s) with affiliation and country: Leming Liu (China); Lufan Wang (Florida International University, USA)	
Abstract: The 2021 "Double Reduction" policy made by the Chinese government banning all K-12 (Kindergarten through twelfth grade) for-profit tutoring firms from operating in a profit-seeking model, vanished 2 billion dollars (over 10 billion RMB) from the market, causing destructive damage to both public and private firms. From December 2020 to December 2021, 40 listed public firms experienced a decrease of an average of 68.815% in their stock price. In this work, we focused on publicly listed firms to study the strategies of their business reconfiguration in the occurrence of an unexpected, drastic external shock, which forced them to change revenue models in no time. By collecting data on 71 publicly listed firms registered in mainland China under the category of education, we found the following statements. We found 87.5% turned their K12 business into non-profit, and 10% of firms entered the market irrelevant to general education marketing. Second, 30.7% of publicly listed firms claimed bankruptcy after a year of policy release. Third, 75% are still pivoting their potential sustainable business model, as well as dealing with customers' refunds. Fourth, 15% have finished their navigation phase and entered the alternative profit-seeking market.	

<p>By collecting, coding, and analyzing the data about firms' pivoting behaviors during the transition, as well as firms' demographic characteristics, we found that firms' accumulated assets and revenue model diversity both positively correlated to the possibility of firms' survival.</p> <p>In theory, the work contributes to the literature regime of strategy formation under unexpected shock. It provided an extreme case of how market-wide publicly listed firms pivot their surviving strategies in a very short period. In practice, it is the first academic analysis providing insights to Chinese policymakers and public firm stakeholders about the impact of the "Double Reduction" policy. It alerted the big firm's higher managing teams to be aware of potential political shocks.</p>	
EDIS #: 1570884507	Title: Paving the on-ramp to AI learning in the classroom
Author(s) with affiliation and country:	
James Murray (Holy Ghost Preparatory School, USA)	
Abstract:	
<p>Autonomous technology is used in many different avenues of life. Industrial, Technological, and Automotive industries all use autonomous technology, with recent headlines containing the promise of fully autonomous cars in the near future. In this project our group utilized a resource called AutoAuto cars to control automotive exploration in virtual and classroom settings. Over the course of the school year we used a combination of physical cars and an online learning resource, AutoAuto Labs, to deepen our understanding of Python and its applications for machine learning and artificial intelligence. Lessons included programming and artificial intelligence, computer vision, object detection, natural language processing, and intro to data science. We worked in a virtual environment and engaged with Github libraries to understand the code within and further our experience.</p> <p>Using hands-on physical projects we were able to perform various tasks related to autonomous driving to establish a driving baseline for current capabilities for driving with code and object detection with frame recognition. These included cautious driving, screenshots from various reference points, color detection, and buzzer noises. We've applied Python programming skills to navigate many different virtual and physical challenges and have also designed custom challenges to create a fun learning process. All of these challenges are highly competitive among classmates as the title of the best programmer/driver in the class is always on the line. In the future we plan to further developing these projects using AI to focus on making the car self-sufficient so that it can demonstrate making decisions completely on its own without any human input.</p>	
EDIS #: 1570884518	Title: Low-cost, High Accuracy Smart Parking Solution for Urban Areas
Author(s) with affiliation and country:	
Vivek Pragada (Central Bucks South High School, USA)	
Abstract:	
<p>Intelligent parking systems are essential for enabling sustainable parking solutions. Searching for a free parking spot in urban areas wastes a significant amount of driver's time and fuel, majorly contributing to total traffic congestion and resulting emissions. In urban areas, an estimated 45% of total traffic congestion is due to drivers looking for parking, with an estimated cost impact of \$345 per driver because of wasted time, fuel, and emissions. In New York City, car drivers waste an average of 107 hours searching for parking. Automated and sustainable parking will be critical in our future, when 70% of the global population is anticipated to live in urban areas.</p> <p>Vehicle presence detection is a fundamental aspect of intelligent parking systems - systems that would inform users about parking spot occupancy throughout their area in order to minimize wasted search time. This can only be efficiently accomplished by smart parking sensors that can convey real-time information about parking spot occupancy. One of the key requirements for smart parking sensors is the high accuracy detection capability of parking slot occupancy for various automobile makes and models, including recent electronic vehicles (EVs), under a multitude of practical parking events. Also crucial are long battery life, easy installation, and low maintenance, all of which need to be met under the strict constraints of low cost, high durability, and operation under numerous environmental conditions.</p> <p>While several approaches are proposed by recent studies, most are either unreasonably expensive, require considerably high power consumption, or cannot provide the accuracy necessary for most practical parking scenarios.</p>	

There is an urgent need for low-cost smart parking sensors that can provide high accuracy in almost any environmental conditions.

In this paper, we propose a smart parking sensor that consists of a magnetometer and a low-power wide area (LPWA) connectivity module. Unlike other state-of-the-art approaches, data from multiple parking sensors in adjacent parking spots are synthesized, dramatically increasing accuracy of detection. The accuracy of parking spot occupancy increases especially when the magnetometers are distributed evenly across parking spaces, fitting nicely with typical parking lot deployments. Our research shows that this technique helps in determining parking spot occupancy significantly better than independent sensors for practical parking events, including front-park, reverse-park, pass-through-park, double-park, and drive-by events, as well as various automobile makes and models, including EVs. To implement this multi-sensor approach efficiently, the magnetometers cannot continuously broadcast its readings, and are configured with specific thresholds, in both measured magnitude and duration, that determine when to upload information. When the configured thresholds are met, the magnetometer in the smart parking sensor triggers an event to its corresponding LPWA LoRa communication module, via a simple microcontroller, to the LoRa base station, which then sends it to the smart parking server in the cloud. The smart parking server synthesizes event data received from multiple smart parking sensors. Since the smart parking server is aware of each specific deployment, a reliable algorithm can be implemented to accurately determine parking spot occupancy changes due to the new parking event.

EDIS #: 1570884521	Title: Predicting Patient Hospital Admission for Emergency Department Triage with Machine Learning Models
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Author(s) with affiliation and country:

Rishi Mulchandani (Johns Hopkins University Applied Physics Laboratory, USA); Soma S Hebbar (Johns Hopkins University Applied Physics Laboratory (JHUAPL), USA); Jayant Maheshwari (Johns Hopkins University Applied Physics Lab (JHUAPL), USA)

Abstract:

Background:

Artificial intelligence and machine learning (ML) techniques in healthcare has become increasingly important due to advancements in computing, increasing amount of data, and the difficulties of manual analyses. The objective of this study is to employ supervised ML models to accurately predict hospital admission outcome among emergency department (ED) patients at the time of ED triage leveraging individual patient data on demographic and clinical factors.

Methods:

Leveraging data from the National Hospital Ambulatory Medical Care Survey (NHAMCS), we developed a predictive analytics framework to predict admission and critical care outcomes in patients presenting to ED. Our objectives were to accurately (1) predict the ED patients that will (i) need to be admitted to hospital and (ii) require critical care and (2) identify the socio-demographic and clinical factors associated with admission and critical care outcomes Data included demographic and clinical features such as sex, age, blood pressure, temperature and were based on approximately 80,000 patients. Utilizing this dataset, we built, trained and validated several ML models using logistic regression (LR), random forest (RF), and XGBoost algorithms. We used 10-fold cross validation to determine the hyperparameters of the models we built and 80%-20% training-testing split to respectively learn the model parameters in the training dataset and assess the performance of the models we built in the testing dataset. We used a threshold optimization technique to convert predicted admission and critical care probabilities into binary predictions.

Expected Results:

The study aims to achieve high accuracy in predicting patient hospital admission based on patient-level electronic health records data collected at EDs. The results of this study highlight the potential of machine learning in healthcare and the usefulness of ML models as a clinical-support tool.

Conclusion:

This study demonstrates the significance of using machine learning techniques in healthcare, particularly in the prediction of patient hospital admission. The results of this study show the potential of XGBoost as a powerful tool in healthcare and emphasize the importance of accurate patient classification during the triage process for the benefit of patients and the overall healthcare system. Future studies could aim to expand the dataset and evaluate the models on a larger scale, as well as investigate the use of unsupervised learning techniques in healthcare prediction.

EDIS #: 1570884533 | **Title:** Wearable ultrasound devices for blood pressure measurement: a simulation study

Author(s) with affiliation and country:

King Ho Guo (UWC CSC Chang Shu College, Japan)

Abstract:

High blood pressure is closely linked with diseases such as stroke, heart disease, heart attack and in numbers stroke alone causes 5 million lives each year in the world yet another 5 million are permanently disabled. A study shows that more than 75% of the population that has the age over 70 are affected by blood pressure problem. Therefore, a real-time monitor is of importance for reducing serious diseases associated with high blood pressure.

Cliffs is commonly used for measuring blood pressure in hospital; however, it is challenging to use such a device for real-time monitoring. ECG is another method to measure blood pressure, however, the need to carry the ECG machine in 24 hours makes it unrealistic. In contrast, a light sensor that is more portable and real-time is highly desired for practical and daily use.

Wearable ultrasound devices have been studied to address this challenge. A recent study reported a design of an ultrasound array that can be easily wore and can measure the blood pressure by characterizing the distance between two blood vessels. Due to high portability and small size, this wearable ultrasound device can provide real-time, 24 hour monitoring of blood pressure. Since this device uses ultrasound penetration, the sensitivity of the device is very important to ensure the accuracy of measurement in deep tissue. The reported device employed a piezoelectric element array distributed in a 4 by 4 grid to generate and receive ultrasound and managed to measure blood pressure at a depth up to (find the value in literature) cm. Changing the distribution of the array is promising to further improve the sensitivity and hence the depth of use, however, fabricating a series of such devices is very resource-intensity.

In this work, we designed an ultrasound simulation program to mimic a wearable ultrasound device for optimising the array design. The ultrasound transmission and detection were achieved with K-wave, a MATLAB toolbox for mimicking ultrasound propagation in various media. Blood vessels, blood, and surrounding tissues were mimicked by setting different medium density and the speed of sound. The simulated devices use ultrasound to calculate the time taken to travel and bounce back between the two blood vessels. With the pre-knowledge of the speed that ultrasound travels in blood, the distance between two blood vessels was calculated and correspondingly, the blood pressure can be read out. We designed and tested different array shapes and distributions to maximize the signal-to-noise ratio of the ultrasound signal, which provided the highest sensitivity in blood pressure measurement. Limited by computing power, the current simulation is under a 2D model instead of a 3D model. In future works, 3D model will be setup and tested on a more powerful workstation to further test and improve the design of wearable ultrasound device. In future work, a wearable ultrasound device will be fabricated under the guidance of the simulation results, which could increase the effectiveness and the scope of the use of wearable ultrasound devices.

EDIS #: 1570884568 | **Title:** Engineering Kits to Prevent Summer Learning Loss

Author(s) with affiliation and country:

Anna R Rosner (Albemarle High School, USA)

Abstract:

Over the summer, many students forget what they learned in a previous year, resulting in a lower academic level when they start the next grade than when they left the previous. This is especially present in the transition from fifth to sixth grade, with 84% of students demonstrating learning loss according to MAP Growth Assessments (Kuhfeld, 2019). Additionally, most opportunities for students to engage with science and engineering are expensive camps, some of which additionally require daily transportation, making them even more inaccessible to working-class families. Early STEM education can both increase student performance and the likelihood that students will express

interest in STEM degrees and careers later on. In order to make summer STEM education more accessible, this proposal entails a series of twelve engineering kits aimed towards rising sixth graders. Each kit consists of a paper bag, a postcard depicting an inspiring STEM figure, an interactive storybook containing five engineering challenges, all supplies needed to complete the engineering challenges, and discussion questions to be used after completion of the challenges. Each storybook depicts a different character facing challenges as they reach a goal, and students will solve the engineering challenges to help the character succeed. Each challenge is designed to take approximately an hour and to emphasize creativity and problem solving instead of simply following instructions. The kits will be distributed weekly to Boys & Girls Clubs located in the Charlottesville, Virginia area, with any surplus provided to the Jefferson-Madison Regional Libraries. These kits combine interactive story-telling and engaging problem solving to give students a valuable summer engineering experience and help prevent summer learning loss in reading. Additionally, the provided discussion questions will ensure that students are able to take away valuable skills and fully comprehend the content of the storybook.

EDIS #: 1570885084 | **Title:** Commercial truck parking conceptual design

Author(s) with affiliation and country:

Trung Q Tchiong (Upper Darby School District, USA); Nelson Dennis (Main Author, USA)

Abstract:

Develop an innovative approach to increase commercial truck parking that can accommodate up to 30 semi trucks and space requirements for commercial trucks that are generally 48 ft-53 ft long. It will also have restroom facilities, gas services, an on-site medical center, water drainage, and conventional energy security systems to protect all types of drivers-a green energy gadgets from promoting the echo system and reducing waste. Future work involves applying Autodesk Revit for restaurant design, Autodesk Fusion 360 for loading analysis (Autodesk.com), Autodesk Civil (https://www.autodesk.com/products/civil-3d/overview?us_oa=dotcom-us&us_si=8654128c-febf-4e89-abcf-836b1baa9492&us_st=Civil%203D&us_pt=Civil%203D&term=1-YEAR&tab=subscription&plc=CIV3D) to design the water and waste systems, and the NREL's PVWatts calculator to design and estimate the performance of the photovoltaic (PV) installations (<https://pvwatts.nrel.gov/>)

EDIS #: 1570885123 | **Title:** The Ethics and Privacy Risks of Artificial Intelligence in Education: Balancing the Benefits and Concerns with More AI

Author(s) with affiliation and country:

Cynthia C Zhang (Canada)

Abstract:

Artificial Intelligence (AI) is rapidly changing the way we live and work, with the potential to bring many benefits such as availability, digital assistance, labour assistance, and daily applications that render general functions more efficient. However, as technology becomes more pervasive, there is a growing concern about the impact it may have on privacy and ethics. AI systems are often designed to collect and process large amounts of data, which can raise significant privacy concerns if this data is misused or mishandled.

A subfield of AI, Educational Data Mining (EDM), specifically focuses on the application of AI to educational data. This refers to the process of using data mining analytics to interpret data from educational systems to improve student outcomes. EDM applies machine learning (ML), neural networks, and statistical methods to educational data to uncover patterns, trends and relationships. Specifically, ML algorithms are used to build predictive models based on educational data. For example, a decision tree algorithm can predict student exam performance based on factors such as prior grades, attendance, and demographic information. This, coupled with Neural networks- a type of ML algorithm inspired by the structure of the human brain used to model relationships such as student behaviour or demographic correlation - allows EDM to perform the following:

-Student performance prediction: Predict student performance on assessments and courses based on their demographics and learning behaviour.

-Adaptive learning: Personalizing the learning experience for individual students based on their performance and preferences.

<p>-Student behaviour analysis: Understanding how students interact with educational technology and what factors influence learning.</p> <p>-Early warning systems: Identifying at-risk students early on and providing targeted interventions. However, there are several privacy and ethical risks associated with EDM:</p> <p>-Data collection: EDM involves collecting large amounts of sensitive data.</p> <p>-Data sharing: Sharing of educational data between different stakeholders, such as schools, government agencies, and companies, can increase the risk of data breaches and unauthorized access to information.</p> <p>-Data security: Storing and managing large amounts of student data presents a risk of data breaches, hacking, and theft.</p> <p>-Profiling and discrimination: EDM algorithms can be used to create profiles of students based on their data, which could lead to biased decisions and discrimination.</p> <p>-Student rights: EDM may infringe on students' rights to control their own personal information.</p> <p>This is only one of the many examples of AI systems and their moral implications, particularly if they are designed or used in ways that discriminate against certain groups of people. As a result, there is a growing need for a robust and comprehensive framework for privacy and ethics in AI which could address the various challenges and benefits posed by AI, as well as the need to provide guidance on how to build and utilize AI in a manner that considers both privacy and ethics. This document provides an overview of the key privacy and ethical issues in educational AI and discusses the possibility of a framework to address these challenges in order to balance AI's potential benefits and concerns.</p>	
EDIS #: 1570885575	Title: A Novel Pre-Hospital Indoor Rescue Drone For Locating Cardiac Arrest Patients at Home Instantly and Delivering Emergency Medication Under Surveillance Before an EMS Arrives
Author(s) with affiliation and country: Max Du (Canada)	
<p>Abstract: Out-of-hospital cardiac arrest patients have 2 challenges. First, they need immediate rescue since the survival chances are close to zero within 10 minutes. However, the average EMS response time is 9 minutes or longer in US/Canada. Second, if they are home alone, only 4% survive and over half of them are unwitnessed.</p> <p>In this project, a novel Pre-Hospital Indoor Rescue Drone is designed and constructed to solve the two challenges and save more lives by aiming to start rescue faster and to witness more patients, including those home alone, in the first critical minutes before EMS arrives. The drone system is designed for indoor use, like personal home drone standby. It has four design features: 1) auto-activate the drone and locate the patient instantly after receiving wireless alert from the patient; 2) live-video surveil the patient with an EMS; 3) deliver patient's prescribed emergency medication under surveillance; 4) open room doors if necessary. A drone homebase is designed to enable auto-activation of the drone and keep it on power standby 24/7, by using ESP32 C3 M5 Stamp wireless communication, and a pulley mechanism driven by a stepper motor. A web server is created for EMS to activate remote surveillance and phone calls with the patient. Through a low-cost Android phone mounted on the drone with a screen mirroring app, first responders can know the patient's situation and specific position in the house instantly. An auto injector is designed which consists of a modified linear lift system and an intramuscular needleless injector; a web server is created for EMS to remote control the speed and direction of motors on the auto injector; and a medicine pill box is designed and attached on the top of the drone beside the auto injector. A door-mounted servo system is designed to open a room door through a wirelessly controlled gripper.</p> <p>The current prototype of the Pre-Hospital Indoor Rescue Drone is constructed, automated, and operational. As tested in a residential setting to simulate a real scenario for a random patient, the design is valid for 1) drone auto activation and approaching patients instantly, as tested 55 seconds flying upstairs; 2) patient live video surveillance and phone call communication from 11km away; 3) delivering emergency medication smoothly with a pillbox and intramuscular auto-injector 3-4 centimeters close to patients; 4) room door opening through remote control. This innovation is the first indoor prehospital rescue drone to help save cardiac arrest patients, which can be affordably integrated into the existing EMS rescue process to help survival chances, shorten recovery time, and reduce healthcare costs.</p>	

EDIS #: 1570885729	Title: Wireless Networked Motion Planning Control for a QBOT2
Author(s) with affiliation and country: Saami Ali and Jakub Pienkowski (Cold Spring Harbor High School, USA); Sabiha Wadoo (New York Institute of Technology, USA)	
Abstract: This work investigates the trajectory tracking motion control problem for a QBOT-2 using wireless network communication with a delay. QBOT2 is an autonomous wheeled mobile differential drive ground robot designed by Quanser. The QBOT2 kinematics are modeled by a nonlinear kinematic mathematical model. This work introduces a control methodology that deals with the perturbations added into the system model due to communication through a wireless channel. The system thus becomes a wireless control system (WCS) and the perturbations can be instrumental in interfering with the feedback signal and in causing errors in the system response. The work proposes a control methodology to eliminate these errors with the main focus on the uncertain time-varying delays that are inherent in wireless communication links. This work proposes a modification in the mathematical model that incorporates the delay in the feedback signal. The first step is to design a PID control based on the nonlinear model. Then a delay will be introduced into the feedback signal and the effect of the delay on tracking will be studied. In the next step changes are brought in the PID control gains to counter the effect of delay on the closed-loop response. The controllers are simulated in MATLAB software simulation environment.	
EDIS #: 1570886245	Title: The "Rock Candy Approach for Lithium Extraction"
Author(s) with affiliation and country: Qixiang Feng (USA); Zhiyong Ren (Princeton University, USA); Qiang Chen (Princeton International School of Math and Science, USA)	
Abstract: To achieve Sustainable Development Goals, the use of electric vehicles (EV) is being increasingly encouraged and many states have come up with no-fuel vehicle deadlines in coming decades. However, lithium-ion, a critical mineral in EV batteries, is still facing a huge gap between production and consumption especially compared to the surge in need for EV batteries in the coming decades. Under the International Energy Agency's most ambitious climate scenario, lithium supply will have to grow fortyfold by 2040 from today's levels. Even today there's already a capacity gap of about 10000 tons of lithium carbonate equivalent. Lithium is an important strategic resource but currently, the US only has a limited capacity for it. The only active lithium mine in the US is the Silverpeak in Nevada, which only contributes less than 1% of global lithium production, becoming a major barrier and national security issue. The current approach to lithium extraction mostly relies on sunlight and geothermal evaporation of seawater or brine, but these methods are generally energy inefficient and ineffective in separating lithium from other ions in the brine. The issue here really encouraged me to start this project about the "rock candy approach" for lithium extraction. My method uses the difference in solubility and mobility of different ions to separate lithium from other ions and the goal is to find the most efficient fabric structure to carry on this process.	
EDIS #: 1570886686	Title: Beauty or the Beast: Understanding the Durability of Nail Polishes
Author(s) with affiliation and country: Anwita Wadekar (St. Bernadette School, USA)	
Abstract: Plasticizers are chemicals that are added to nail polishes to increase their durability so that they last long, and do not chip or fade away easily. In this project, I designed experiments to confirm the hypothesis that a nail polish that contains a greater number of plasticizers has higher durability. I chose three nail polishes from Sally Hansen; Xtreme Wear which contains two plasticizers, Complete Manicure which contains one plasticizer, and Good Kind Pure Vegan which has zero plasticizers. I painted five fake nails with each of these three nail polishes and attached them to fake hands. I then put these fake hands through rough, moderate, and light-use conditions. The rough use experiment was rubbing sandpaper against each nail and counting the number of rubs until the nail polish started to chip. The moderate use experiment mimicked dishwashing. I put dish soap into a bucket of water and rubbed a sponge gently across the nails and measured the time it took for the nail polish to fade.	

The last experiment was the light use experiment which simulated handwashing. I put hand soap and water into a bucket and moved the hand around while tracking the time taken for the nail polish to fade. I found that the Xtreme Wear nail polish takes longer to fade and chip compared to the Complete Manicure, which takes longer than the Pure Vegan nail polish.

I then studied the harmful effects of the two plasticizers, Ethyl Tosylamide and Triphenyl Phosphate, which are used in the Xtreme Wear nail polish. Using the Skin Deep Database from the Environmental Working Group I found that Ethyl Tosylamide is not extremely toxic but it still can affect the endocrine and hormonal system causing cancers and birth defects along with some allergic reactions. Triphenyl Phosphate also known as TPHP, is more toxic than Ethyl Tosylamide. It causes reproductive issues and a couple of animal studies revealed neurodevelopmental effects with small doses. Some human case studies showed disruption to the endocrine system too. It is used in the manufacturing of plastics and as a flame retardant. TPHP is also an environmental toxin. When nail polishes are thrown away the remaining polish from the bottles can diffuse into the soil and water, coming into contact with other species and disrupting their bodies.

Through this project, I have learned that many cosmetics and personal care products can contain chemicals that can cause short-term and long-term health problems. I plan to use this knowledge to raise awareness amongst my friends and in my community about toxic chemicals found in everyday cosmetics. I would also like to advocate for a law that prevents the use of such toxic chemicals in cosmetics. In California, legislation was signed to ban toxic chemicals in cosmetics back in 2020. 24 toxic chemicals were banned and California was the first state to stop using these perilous ingredients. I hope to do the same in Massachusetts and inform the community how toxic and harmful some cosmetic products can be.

EDIS #: 1570886731 | **Title:** Federated Learning with Prioritized Data Sample Selection

Author(s) with affiliation and country:

Rebekah Wang (West Windsor-Plainsboro High School South, USA)

Abstract:

Machine Learning (ML) performs many tasks such as predictive text and ad recommendation. Its success lies in the training dataset used to create effective models. However, valuable training dataset is not always readily available due to data privacy concerns. To ensure data privacy when training ML models, federated learning was developed. In federated learning, an initial global model is distributed to clients (e.g., mobile devices) from a server. Each client independently trains the model with their own data, and only needs to send model updates back to the server. The server then aggregates these updates and creates a new global model. This process is repeated until the global model converges and a final global model is produced. Federated learning enables data to stay on each client device, maintaining data privacy.

However, when using federated learning to predict user preferences, not all data samples are equally useful. For example, when predicting what videos a user might want to watch next, a user's more recent watch history would be more useful than a user's older watch history. In this case, data samples with a small age could be more useful, where the age of a data sample is defined as the amount of time that has passed since the data sample was generated. Training the model with a higher number of useful data samples would allow the model to make more relevant and accurate predictions.

Thus, a new federated learning approach with prioritized data sample selection is proposed. When training federated learning models, each client device should deploy a data sample selection process that prioritizes useful data. The essential idea is to give useful data samples a higher priority or probability, while maintaining the randomness in selected data samples for each training round.

Continuing the previous example, the training dataset should be sorted based on increasing age. To reduce complexity, the training dataset does not have to be strictly sorted. It can be divided and sorted in coarser granularity; for example, weekly or biweekly. If the granularity is not too coarse, the results of the model should not be drastically different. Once the training dataset is sorted, a data batch for each training round can be compiled using the following technique. Assume a data batch of size $n \cdot k$ (e.g., $n=4$, $k=8$) had to be selected from a training dataset of size 1000. The following n data sample selection iterations are needed: 1) k data samples are selected randomly from the entire

training dataset; 2) k more data samples are selected randomly from the first 800 data samples; 3) k more data samples are selected randomly from the first 600 data samples; and so on. With each iteration, the data samples are selected from a smaller range of data samples so that there is a greater chance that a newer data sample will be selected. By training the model with a higher ratio of more useful data, the model is more accurate.

EDIS #: 1570886743 | **Title:** Study on Projects of Natural Restoration of Rivers in Korea and Other Countries

Author(s) with affiliation and country:

Sahng-Won Lee (Seoul International School, Korea (South)); Richard Kyung (CRG-NJ, USA)

Abstract:

Natural environment restoration of the rivers surrounding our living spaces is performed all over the world. This field combines principles from ecology, hydrology, and engineering to develop and implement strategies for restoring damaged rivers and their ecosystems.

The goals of river restoration include improving water quality, restoring habitat for native species, and enhancing recreational opportunities. Effective river restoration requires careful planning, monitoring, and collaboration among various stakeholders, including local communities, government agencies, and scientific experts.

This study addresses recent river restoration projects in progress both internationally and in Korea and introduces relevant study cases and reviews. Since river restoration is a complex subject that involves more than simply environmental protection, the perspectives of communities living near and sometimes dependent on a river are considered and discussed in the presented study.

The natural sciences and engineering may effectively resolve the technical issues, but cooperation with experts in the social sciences and humanities is required to achieve lasting solutions.

EDIS #: 1570886760 | **Title:** Modeling atmospheric ablation of iron meteors undergoing thermal decomposition

Author(s) with affiliation and country:

Jonathan Wu (Applied Physics Lab, USA)

Abstract:

Threatening the world mass extinction, meteors enter Earth at high velocities and degrade at some rate. With computational chemical and fluid dynamic models, an estimated rate can predict the progression of a falling meteor. Given known conditions of an altitude, assumed conditions of a hypothetical meteor, and assumed steady-state conditions of the boundary layer, two equations modelling the flow of energy and mass in and out of the system can be formulated, namely the surface energy balance (SEB) and surface mass balance (SMB) equation. Due to the difficulty of calculating the surface mass balance equation, thermodynamic calculations of the surface energy balance equation as a function of temperature is more feasible, with the assumption that the Lewis number is one-when Stanton's number for thermal diffusivity equals to Schmidt's number for mass diffusivity. By solving the SEB equation using software such as Cantera and the CFD program, the value of the outwards diffusive flux as a result of high-enthalpy reactions can be computed for each point-system of the meteor. With spherical integration, the average outwards diffusive mass flux and predicted burn-up time is determined.

EDIS #: 1570886761 | **Title:** Study on the Electron Carriers in the Active Layers to Improve Photocurrent in Polymer Solar Cells

Author(s) with affiliation and country:

Geonwoo Bae (Choate Rosemary Hall, USA); Richard Kyung (CRG-NJ, USA)

Abstract:

Polymer-based solar cells are a type of photovoltaic (PV) technology that uses organic materials, such as small organic molecules, as the photoactive layer for converting light into electricity. These cells have the potential to be used in a wide range of applications, including portable electronic devices, building-integrated photovoltaics, and large-scale renewable energy systems. They have several advantages over conventional silicon-based solar cells, including low cost, lightweight, and flexibility. However, their performance is lower compared to traditional silicon-based solar cells, and they have a shorter lifespan. Despite their limitations, the development of organic solar cells is an active area of research, and significant progress has been made in recent years to improve their efficiency, stability, and longevity.

In this paper, the active layer of the cell which contains an electron-rich material and an electron-deficient material was theoretically and computationally studied to enhance the efficiency of conduction in the unit. The properties of the polymers in the photoactive layers, such as the optimized energy, electron distributions, bandgap energy, and electron mobility, were found or discussed to determine the efficiency of the unit. The objectives of this research are to develop new potential materials to improve the performance of the photoactive layer and increase the overall efficiency of solar cells.

EDIS #: 1570886776 | **Title:** Study on Hospitality Industry Trends and Changing Demands

Author(s) with affiliation and country:

Keonha Bae (Choate Rosemary Hall, USA); Richard Kyung (CRG-NJ, USA)

Abstract:

A study on hospitality can include an analysis of various aspects of the hospitality industry, including hotels, restaurants, and tourist destinations.

The insights gained from hospitality research can inform decision-making and improve overall business performance by conducting surveys, focus groups, market analysis, and other methods. In the hospitality industry, there are a few factors to consider for successful management. Personalization: offering customized experiences to guests, such as tailored recommendations and services.

Technology: using technology to improve guest experiences, such as mobile check-in, smart room technology, and virtual assistants. Wellness: providing guests with health and wellness experiences, such as fitness centers, healthy food options, and spa services. Lastly, unique and experiential accommodations are important since they offer unusual or distinctive accommodation options, such as treehouses, yurts, and tiny homes.

In this paper, these factors and trends are studied to shape the future of the hospitality industry so that many hotels and resorts can incorporate them into their operations to stay competitive and meet the changing demands of guests.

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