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3rd Annual HU Research Symposium Program 2021

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3RD ANNUAL HU

Research Symposium

This year the Symposium is going Virtual!

April 21, 2021 | 4 – 7 pm

HARRISBURG UNIVERSITY OF SCIENCE AND TECHNOLOGY

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2021 Symposium Team

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Research Project Information

Engineering and Technology

Session 1.1

4.05 – 4.25 PM

A Machine Learning Approach to Methane Emissions Mitigation in the Oil and Gas Industry

Independent Research

Author: Lyra Wang

Other Authors: Arvind Ravikumar

Reducing methane emissions from the oil and gas sector is a key component of climate policy in the United States. Methane leaks across the supply chain are stochastic and intermittent, with a small number of sites ('super-emitters') responsible for a majority of emissions. Thus, cost-effective emissions reduction critically relies on effectively identifying the super-emitters from thousands of well sites and millions of miles of pipelines. Conventional approaches such as walking surveys using optical gas imaging technology are slow and time-consuming. In addition, several variables contribute to the formation of leaks such as infrastructure age, production, weather conditions, and maintenance practices. Here, we develop a machine-learning algorithm to predict high-emitting sites that can be prioritized for follow-up repair. Such prioritization can significantly reduce the cost of surveys and increase emissions reductions compared to conventional approaches. Our results show that the algorithm using logistic regression performs the best out of several algorithms. The model achieved a 70% accuracy rate with a 57% recall and a 66% balanced accuracy rate. Compared to the conventional approach, the machine learning model reduced the time to achieve a 50% emissions mitigation target by 42%. Correspondingly, the mitigation cost reduced from $85/t CO2e to $49/t CO2e.

Session 1.2

4.25 – 4.45 PM

Field Performance of New Methane Detection Technologies: Results from the Alberta Methane Field Challenge

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Independent Research

Author: Devyani Singh

Emerging methane technologies promise rapid and cost-effective methods to measure and monitor methane emissions. Here, we present results from the Alberta Methane Field Challenge – the first large-scale, concurrent field trial of eleven alternative methane emissions detection and quantification technologies at operating oil and gas sites. We evaluate the new technologies by comparing their performance with conventional optical gas imaging survey. Overall, technologies are effective at detecting methane emissions, with 8 out of 11 technologies achieving an effectiveness >80%. Importantly, results highlight the key differences in technology performance between those observed at controlled release tests versus those in field conditions. Intermittent emissions from tanks substantially affects detection and site-level quantification estimates and should be independently monitored while assessing technology performance. In this study, all technologies improved their effectiveness in detecting tank emissions when intermittency was considered. Truck- and plane-based systems have clear advantages in survey speed over other technologies, but for some their ability as effective screening technologies to identify high-emitting sites rests on their quantification effectiveness. Drone-based technologies demonstrated higher effectiveness than other technologies in identifying quantification rank compared to baseline OGI-based survey. Overall, quantification under in-field conditions is affected by several exogenous factors such as temporal variation in emissions and changing environmental conditions. We recommend that assessment studies of new methane detection technologies at oil and gas facilities include comprehensive, continuous, and redundant emissions estimates.

Session 1.3

4.45 – 5.00 PM

Setting up and configuring SLURM

Project II

Author: Sayed Sayed

This presentation will be explaining my progress on Project II working in HU's High performance computing lab. One my main projects is using SLURM for workload management.

Session 1.4

5.00 – 5.20 PM

Global Liquefied Natural Gas Expansion exceeds demand for coal-to-gas switching in Paris compliant pathways

Independent Research

Author: Shuting Yang

Other Authors: Arvind Ravihumar & Sara Hastings-Simon

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The shift from coal to natural gas (NG) in the power sector has led to significant reductions in carbon emissions, earning NG the moniker of a bridge-fuel. The cheap NG that led to this shift is now fueling a global expansion in liquefied natural gas (LNG) export infrastructure, particularly in the US, Canada, and Australia. In this work, we assess the viability of LNG expansion to reduce global carbon emissions through coal-to-gas switching in the power sector. In the near term (pre-2030), LNG-derived coal-to-gas substitution reduces global carbon emissions across all temperature targets – as there is significantly more coal power generation than the LNG required to substitute it. However, we find that long-term planned LNG expansion is not compatible with the Paris climate targets of 1.5ºC – here, the potential for emissions reductions from LNG use through coal-to-gas switching is limited by the total coal use to substitute away from. The rapid decline in the share of coal use of mitigation pathways limits the potential of LNG to be a decarbonization tool in the electricity sector through coal to gas substitution. In all scenarios analyzed, low upstream methane leakage and significant coal-to-gas substitution are critical to realizing the near-term climate benefits of LNG. Investors and governments should consider stranded risk assets associated with potentially shorter lifetimes of LNG infrastructure in a Paris-compatible world.

Session 1.5

5.20 – 5.40 PM

Aerial LIDAR to Prevent Wildfires

Independent Research

Author: Keegan Flahive

This project explores the usage of Aerial LIDAR data to find downed logs underneath the forest canopy. This project discusses what LIDAR is and how it can be used to find those logs and undergrowth. It also looks at the steps for processing that are done in ArcGIS software to see the logs. There is also so analysis steps to find out more information on undergrowth density.

Information Sciences

Session 2.1

4.05 – 4.20 PM

Collection and Analysis of a Training Data Set Designed for Neural Network Handwriting Analysis

Project I

Author: Devon Hilt

For my project, I am working with creating a neural network without using libraries for simple handwritten digit recognition, however, I am taking a slightly different approach. I am creating a data set myself from volunteers and comparing that data set to a similar set created for the same function, specifically the MNIST database. My project I has been focused on learning the technical background required for this project, and from now through my next semester when I take project II, I will be collecting data and then performing the mathematical analysis of my results.

Session 2.2

4.20 – 4.40 PM

Towards Diagnosing COVID-19 Using Deep Learning Approach

Independent Research

Author: Ziyuan Huang

Other Authors: Koel Ghosh, Thulasi Muthuramalingam & Roozbeh Sadeghian

Epidemics and pandemics co-exist with human beings throughout entire human history. Coronavirus disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of now, 2.74 million people have died from one of the worst pandemics in human history worldwide (1point3acres, 2021). Symptoms of COVID-19 are variable but often include fever, cough, fatigue, breathing difficulties, and loss of smell and taste. Symptoms begin one to fourteen days after exposure to the virus.

The R0 of COVID-19 was measured as between 2.2 to 5.7 (CDC, 2020; Sanche, 2020). That means one COVID-19 patient has a high possibility to infect 2.2 to 5.7 people. Such high viral transmissibility drove

the demand for radiologic analysis to an extremely high level and further worsened the overall COVID-19 treatment process nationally and internationally. The high efficiency in identifying COVID-19 could save millions of people's lives.

Our project intends to identify and classify COVID-19 infection from CT scans. We have analyzed CT scans from 307 patients using the IEEE SPGC-COVID dataset acquired from different medical centers, along with slice-level and patient-level labels for the training and validation purpose. This study tried several deep learning algorithms such as VGG16 and ResNet50 to detect COVID-19 with a reasonable accuracy rate. The expected result is that such algorithms could help physicians reduce a significant amount of time while doing COVID-19 diagnostic analysis. This study is still an ongoing project, and our current accuracy rate is around 70 percent.

Session 2.3

4.40 – 4.50 PM

Container Security

Class Project

Author: Felix Dominguez

I am working in the high performance computing research lab under Ronald Jones and Aditya. I am researching container-based cloud technology and security. For my Project 1, I am simulating a denial-of-service attack within a cluster of containers.

Session 2.4

4.50 – 5.10 PM

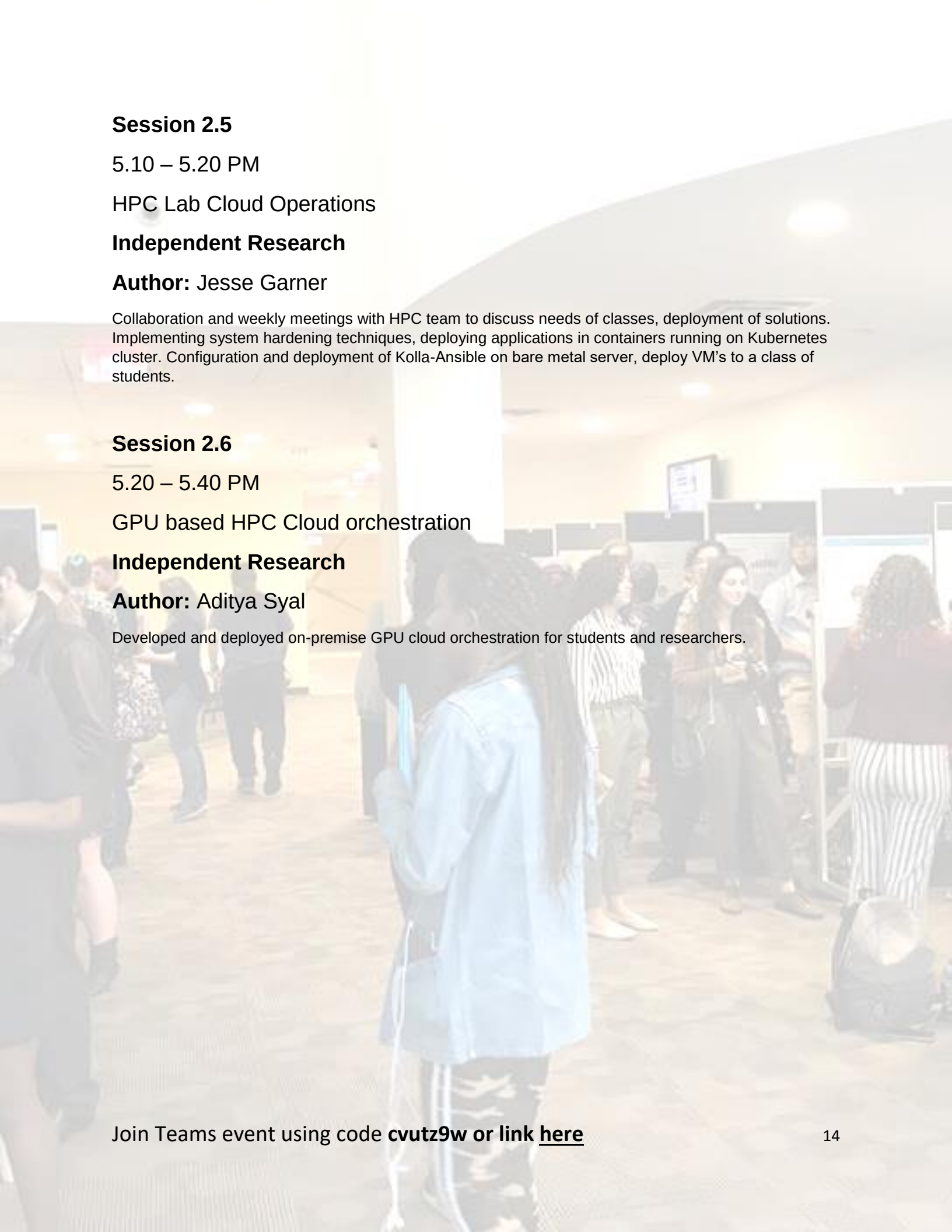
Towards High Performance Stock Market Prediction Methods

Independent Research

Author: Warren Landis

Other Authors: Sangwhan Cha & Majid Shaalan

Stock markets of today, and will continue to in the future, rely on the metrics of timeliness and efficiency to reach optimal profits. A way stockbrokers have continued to strive for the best of these two factors of the business is through the use of predictive machine learning systems to help aid in their decision making. However, among the many systems currently in use, it could be said that the myriad of data that they are based on may not be sufficient. In an effort to devise an ensemble learning predictive system that will utilize an array of big data sources, we conducted research into the use of long-term short-term recurrent neural networks in stock prediction and planned experiments around the optimization of the machine learning model's timeliness for it to be an effective implementation into our proposed predictive system.



Session 2.5

5.10 – 5.20 PM

HPC Lab Cloud Operations

Independent Research

Author: Jesse Garner

Collaboration and weekly meetings with HPC team to discuss needs of classes, deployment of solutions. Implementing system hardening techniques, deploying applications in containers running on Kubernetes cluster. Configuration and deployment of Kolla-Ansible on bare metal server, deploy VM's to a class of students.

Session 2.6

5.20 – 5.40 PM

GPU based HPC Cloud orchestration

Independent Research

Author: Aditya Syal

Developed and deployed on-premise GPU cloud orchestration for students and researchers.

Life Sciences & Medicine

Session 3.1

4.05 – 4.25 PM

Effects of Acid Mine Drainage Byproducts on the Formation of Aquatic Biofilm

Independent Research

Author: Karli Rathof

Other Authors: Erica Ward & Akeisha Belgrave

The purpose of this research is to study the effects of acid mine drainage on the byproducts on the formation of aquatic biofilms in watersheds. Measuring and imaging the growth of aquatic biofilm in various water conditions that includes, untreated healthy water, acidic water, water with high levels of iron, and water treated with limestone. The goal of this research is to find out if aquatic biofilm is a sufficient indicator for acid mine drainage remediation affected watersheds.

Session 3.2

4.25 – 4.35 PM

Duchenne Muscular Dystrophy

Class Project

Author: Madalyn Stoltz

Other Authors: Trenton Howard

This is a semester-long class project with a partner. We researched Duchenne Muscular Dystrophy and created a presentation about it.

Session 3.3

4.35 – 4.50 PM

Investigating the effect of Gibberellic acid on the production of chlorophyll in the Euphorbia milli flower

Class Project

Author: Alexandria Nickens

My project is observing the effect of treating a plant with increasing concentrations of Gibberellic acid a phytohormone important in growth regulation in plants. This project II was done at home with the experiment looking at the Euphorbia milli flower a succulent plant bought at a nursery. The total mg. of chlorophyll content of the leaves was measured and observed over six weeks in the experiment. This research I have been looking into since project I with plant pathogens that manipulate the concentration of phytohormones in plants to increase their virulence. My role in increasing the concentration of GA is to take the place of pathogens such as bacteria and fungus to learn more about the pathology.

Session 3.4

4.50 – 5.00 PM

Epidermylosis Bullosa

Class Project

Author: Leaha Mancuso

This is a final project for my Cell Biology course and discusses the skin disease Epidermylosis Bullosa.

Session 3.5

5.00 – 5.15 PM

Assessment of fecal hormone metabolite concentration stability in clouded leopard (*Neofelis nebulosa*) feces stored with silica gel desiccant exposed to natural environmental variation.

Project II

Author: Areebullah Mirza

This project aims to assess the use of Non-Invasive Hormone Monitoring (NHM) in analyzing the physiology of clouded leopards. NHM measures the amount of hormone metabolites within fecal samples to predict the physiology of an animal. Since hormones are biological molecules that control metabolic processes, their metabolites found in fecal samples are a clear reflection of what condition an animal was

in. progesterone, testosterone, estrogen, and cortisol metabolites were analyzed to see the significance of analyzing hormone metabolites derived from environmentally exposed sampled.

Session 3.6

5.15 – 5.25 PM

Fibrodysplasia Ossificans Progressiva

Class Project

Author: Oluwatomilola Taiwo

Other Authors:

Malaysia Murphy

Fibrodysplasia Ossificans Progressiva is a genetic disease that involves the gradual calcification of connective tissues.

Session 3.7

5.25 – 5.40 PM

Charactering the Physical Attributes of Fetal Alcohol Syndrome (FAS) in *C. elegans*

Project II

Author: Sharon Alot

This research aims to explore the effect of ethanol on the Physical Attributes of *C.elegans* (Nematode worm) embryos at various embryonic stages. These physical attributes include changes to the width, length, and appearance of the embryos. To do this, pregnant worms were added to agar plates with varying concentration of Ethanol and Light Microscopy and Imaging Software Image J were used to image and analyze these changes. The length of the worms increased for all embryonic stages studied while the width decreased.

Session 3.8

5.40 – 5.55 PM

Tumeric and Lead Toxicity

Project I

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Author: Sita Bastola

This is my project 1 research on lead's toxic effect that creates oxidative stress in the cell. The potential way to treat the disease.

Session 3.9

5.55 – 6.05 PM

Alpha-1 Antitrypsin Deficiency

Project I

Author: Aleandrjo Collins

This is my Cell Biology class project giving an overview on Alpha-1 Antitrypsin Deficiency.

Session 3.10

6.05 – 6.20 PM

Growth Inhibitory Effects of Snail Mucus on *C. acnes*

Project I

Author: Leaha Mancuso

My project discusses the potential inhibitory effects of snail mucus on the bacteria *C. acnes* and how snail mucus could possibly help treat acne.

Session 3.11

6.20 – 6.40 PM

An app to Provide Asynchronous, Collaborative, Patient Simulation Based Interprofessional Education for Medical and Pharmacy Students

Independent Research

Author: Melanie Stegman

Other Authors:

Kelly Karpa

http://ipe.harrisburgu.edu/demo

Penn State's medical school asked us to help them create and test an app that would allow medical

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students and pharmacy students to collaborate at a distance.

The app is designed to give students the opportunity to make all the decisions they would with a patient and to receive immediate feedback, to discuss their choices as they proceed with their partner student, and for longer-term feedback, students see the consequences of their choices as the case progresses over 2 years of the patient's life.

Session 3.12

6.40 – 6.50 PM

The study of Emery-Dreifuss muscular dystrophy (EDMD)

Class Project

Author: Nazir Powell

Other Authors:

Kafilat Akeeb-Abu

This is our Cell Biology class project investigating Emery-Dreifuss muscular dystrophy (EDMD).

Physical & Environmental Sciences

Session 4.1

4.05 – 4.20 PM

Antibacterial Effect of Rosemary and Black Cumin on *Cutibacterium acnes*

Project II

Author: Angelyz

Rohena-Franceschini

Other Authors:

Catherine Santai

Bacterial infection accompanying acne is primarily caused by the trapping of the Gram-positive, anaerobic bacteria *Cutibacterium acnes* (*C. acnes*) inside the hair follicles where the sebaceous glands are located. Due to the rise in antibiotic resistance, alternative treatments for *C.acnes* have been investigated. The effectiveness of plant extract monotherapies have been studied and compared to combinations of plant extracts *Rosmarinus officinalis* (rosemary) and *Nigella sativa L.* (black cumin) to determine effectiveness in treating C acnes infection. Black cumin extract was found to dictate the antibacterial effect when in combination with rosemary extract.

Session 4.2

4.20 – 4.35 PM

Green Synthesis of Fluorescent Carbon Dots and their Use as Fluorescent Probes for the Detection of Heavy Metals

Project II

Author: Parker Adams

My project consists of synthesizing carbon dots via microwave cooking for characterization and applications within water pollution detection.

Session 4.3

4.35 – 4.55 PM

Thermotolerance in *P. aquamarina*

Independent Research

Author: Catherine Santai

Other Authors:

Carrie Carpenter & Hannah Tucci

Climate change is currently affecting the Earth and will only increase with time. A change to the environment means that life at all levels will need to adapt. Adaptation occurs when an organism, over generations, changes physiologically or otherwise to permit continued growth in the environment in which it resides. *Psychromonas aquimarina* is a minimally characterized, psychrophilic (cold-loving) bacterium. Because climate change is affecting the poles of the Earth approximately two times the rate compared to more temperate regions, the growth characterization of this organism and thermal adaptation ability becomes increasingly relevant. Undergraduate student research in the area of microbiology and biochemistry will be presented.

Session 4.4

4.55 – 5.10 PM

Construction and Application of a Low-Cost, Low-Sensitivity Refractive Index Detector

Project II

Author: Dale Belles

I constructed a simple refractive index detector, an instrument that identifies pure samples based on their optical properties. The construction was done using inexpensive materials in order to test the limits of RID at its most fundamental. This also involved coding a program that analyzes the samples and setting up a microcontroller for the electronics.

Session 4.5

5.10 – 5.30 PM

The impact of a Novel Outpatient Telepharmacy Service on Hospital Admissions

Independent Research

Author: Erik Hefti

Background: Avoidable hospital admissions put increased pressure on already-strained healthcare resources, causing emotional and financial distress for patients and their families while taxing the health system. Pharmacists are responsible for optimizing pharmacotherapy by minimizing adverse drug reactions, increasing medication adherence, and educating patients on how best to take their medications. Telepharmacy allows for personalized interaction between the patient and pharmacist without many of the distractions typically encountered in an outpatient or inpatient clinical environment. The primary aim of this report is to explore the impact a personalized telepharmacy service has on hospital admission rate in an outpatient population.

Methods: A retrospective, multi-site comparative trial was performed. Hospital admission rates were tracked from 2019 to 2020 in an experimental group that opted into the telepharmacy service [n=2242] and compared to the control group opted out of the telepharmacy service [n=1540]. Retrospective statistical analysis was performed to explore how hospitalization rates changed in each group.
Results: Patients opted into the telepharmacy service demonstrated reduced hospital admission rates from 2019 to 2020 versus the patients in the opt out group [opt in: 12.86% vs. opt out: 40.23%, $p < 0.05$, Student t-test].

Discussion: Patients receiving telepharmacy services demonstrated reduced hospital admissions when compared to patients not receiving these services. While this represents a preliminary investigation into the potential impacts of telepharmacy on hospitalization rates, telepharmacy services may have a role in improving patient outcomes and cost savings.

Session 4.6

5.30 – 5.50 PM

Informal Science Education: Using Game Design Principles to Teach Molecular Science

Project II

Author: Melanie Stegman

Other Authors:

Andrea Nagy, Richard Jackson & Jamison Burrow

Science communication is what we call science education that happens in informal environments, it is also called informal science education. The reason we don't call it plain old "education" is because the audience comes to the content voluntarily, and can leave voluntarily. Additionally, the audience is broader, less well defined than a classroom: ages and prior knowledge of the audience entering a museum at noon on a Saturday is not as well defined as in a 6th-grade classroom, for example.

Science communication is vital, because people who are no longer in school need to keep up to date with current health concepts. Another reason, specific to HU, to look at communicating science to a broader audience, is to address the disparate state of science education that the average American student received in their K-12 experience. A college freshman needs to decide what to major in, and they may not have any idea what chemistry or biology is all about.

For these reasons, I am researching ways to convey fundamental concepts of chemistry and cell biology in an efficient and engaging manner. I have two projects, both using the same strategy: Create a simulation of science concepts, add graphics and game mechanics that illustrate the fundamentals to the player, and create follow up questions and iterate on the game designs until we are satisfied that the game is engaging and effective at teaching. ChemSimGame is a simulation of acid and bases and their interactions with water. Immune Defense is a simulation of white blood cells interacting with bacterial pathogens. I will discuss my work so far and the plans for future research on these two projects.

Session 4.7

5.50 – 6.00 PM

Developing GIS methods to find and access urban paleontological material from the Cambrian Kinzers Formation in Pennsylvania

Class Project

Author: Joshua Ramirez

The aim was to create a map deliverable that would show slopes greater than 10 degrees that contain Kinzers Formation within 4 counties in PA: Adams, Chester, Lancaster, and York. After working on the

map product, I realized the purpose of the map could be better presented using a web application so that it may become dynamic and professionals could add their own records onto the map.

Session 4.8

6.00 – 6.20 PM

Lost in the (virtual) woods: Developing a coherent VR Field strategy

Independent Research

Author: Michael Meyer

Virtual Reality (VR) technologies are expanding at a rapid rate, bolstered by the remote learning conditions of the past year. VR technology may possibly improve education, by allowing teachers to present contextualized information, such as a fieldtrip to a white blood cell or an environmentally sensitive site. More studies are needed to determine how best to take advantage of VR technologies: which lesson structures and which hardware are best to teach various types of materials. While we are investigating how best to use VR in education, it is important that we consider whether we are reaching all students, and in particular, the undergraduate student populations we focus on at Harrisburg University.

Session 4.9

6.20 – 6.40 PM

Replication Rate Effects on *Escherichia coli* Peptidoglycan Crosslink Density

Independent Research

Author: Erica Ward

Other Authors:

Akeisha Belgrave

The bacterial cell wall or peptidoglycan (PG) layer is a strong, mesh-like material. This structure has been the focus of many studies due to its importance in bacterial physiology and as a target for antibiotics. As drug resistant bacteria become more prevalent, the understanding on how the PG layer is formed and maintained is necessary for further development of antibiotic targets. During bacterial growth, there is constant turnover of the PG layer through a combination of biochemical and mechanical processes. To accomplish this, synthetic complexes severe existing PG, insert new PG units made in the cell, and re-crosslink new units to the cell wall. It was shown that PG synthesis is dependent on replication rate under the guidance of PG synthetic complexes. Cells with a higher replication rate are longer in length but have less cross-links those grown with a slower replication rate. To achieve this, synthetic complexes must control the severing of existing PG and the insertion of new PG units, but re-crosslinking of PG is independent of this process. Antibiotic susceptibility assays, cell length measurements, analysis of enzyme digested PG fragments, and fluorescently labeled PG are used to elucidate the independent

process of PG re-crosslinking.

Vancomycin works by interacting with D-ala-D-ala on the end of the pentapeptide stem in newly synthesized PG (nascent PG). The interaction of vancomycin and nascent PG prohibits the re-crosslinking of new PG units to the existing cell wall. The lack of PG material in the cell wall due to severed strands combined with internal osmotic pressure leads to cell membrane rupture and eventual lysis. Typically, gram-negative bacteria are resistant to vancomycin due the difficulty for vancomycin to cross the outer membrane. A vancomycin sensitive *E. coli* strain (NR698: LptDΔ330-352) will be utilized to elucidate PG cross-link density dependent on replication rate. Preliminary data shows that the rate of cell death due to vancomycin is dependent on replication rate.
In addition to using antibiotics to assay PG cross-linking, osmotic shock studies will be done by treating cells grown at different replication rates with 500 mM sucrose and measuring cell length. As replication rate increases, so does cell length. The increase in length is due to the over insertion of new PG material into the PG layer.3 The difference between the length before and after osmotic shock is minimal in slow growing cell. In contrast, fast growing cells have a significant difference in cell length before and after osmotic shock.

To quantify the number of crosslinks within the PG, purified and enzyme-digested PG fragments will be analyzed via high-pressure liquid chromatography (HPLC). This will allow for the direct comparison in percent of PG cross-links based on replication rate. Based on the antibiotic susceptibility and osmotic shock studies, we expect the slower growing cells to have more crosslinks compared to less cross-links in the faster growing cells.

Lastly, to visually differentiate the existing PG that is cross-linked and newly synthesized PG, fluorescent D-amino acids (FDAA) will be used. FDAAs have proven to be a critical tool for elucidating the nature of the PG layer. Specifically we will label the entire PG with blue FDAA (HADA) and treat the cells with green fluorescent vancomycin (Van-Fl) to highlight sites of existing PG material and nascent PG. In faster growing cells we expect to see increased Van-Fl attachment as opposed to slower growing cells. Providing a visual representation of the difference in cross-link density dependent on replication rate.

Session 4.10

6.40 – 7.00 PM

Characterization into the force dependence of *Myxococcus xanthus* motor proteins in Gliding Motility.

Independent Research

Author: Akeisha Belgrave

Other Authors:

Catherine Santai, Salim Timo, Joshua Shaevitz & Tam Mignot

In certain Gram-negative bacteria, motility on surfaces is mediated by a gliding motility mechanism that uses motorized transport of a substratum-adhered protein (Agl–Glt) motility complex. The model system in which to best study this phenomenon is in the Gram-negative bacterium *Myxococcus xanthus*. This

gliding is powered by a proton motive force aided by a series of spaced Agl-Glt complexes along the length of the cell. Gliding motility in this bacterium is through individual bacteria and is cell movement is directional. To determine is this movement or directionality is based on a forced that is shared among all of the motility complexes or individual complexes a optical trap was used to apply a force to polystyrene beads that carried along the length of the cell via attachement to immobilized *M. xanthus* cells. The protein complex Agl-Glt is composed of a series of motility proteins known to play important roles in cell motility, a few important proteins that are closest to the substrate are CglB and CglB. To help characterize these two proteins, an optical trap was used to measure the force that these proteins will exert and analyze them in comparison to the know gliding speed of 4.5 μm/min.

Evidence suggests that this gliding complex is believed to, in essence, "walk" through the Peptidoglycan (PG) meshwork, and each time it takes a step, it engages an outer-membrane protein to anchor it to the substratum (Islam, S and Mignot, T., 2015). However, the effect of PG in this process has never been tested. We propose that changes in PG crosslink density will affect the speed of the protein complex transport through the periplasm, thus affecting the speed of gliding cells. To test this, *M. xanthus* cells will be grown at varying growth rates by varying the nutrient concentration to increase/decrease the amount of PG crosslinking. These cells will be spotted on agar pads and imaged via bright-field microscopy. Using the MicrobeJ software, cell-tracking analysis will be used to quantify gliding speeds and reversal-of-direction events. Use of a strain expressing a fluorescently-labelled component of the protein gliding complex (AglZ-YFP) will also allow us to track and measure the size of the gliding complex. Data will be used to correlate this change in PG with the analyzed gliding speeds.

Acknowledgements

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