School of Engineering and Technology (SET) Research Showcase. May 9, 2025.

Agenda-at-a-glance

Panel Discussions at William Philip Hall
Noon - 1:00 pm: Engineering and Infrastructure
1:00 - 2:00 pm: Research and Industry in Collaboration

Concurrent Sessions between 2:00 - 2:50 pm on the 1st floor of Cherry Parkes (CP)
CP 105 Speed granting (Associate Dean Yan Bai and Assistant Teaching Professor Thillainathan Logenthiran)
CP 106 Networking with SET alumni (Andrew Fry, Director of Industry Partnerships)

Lab tours between 2:00 - 2:50 pm at various locations

- Radio Frequency Wireless IC Laboratory in CP 206M (Professor Debasis Dawn, Electrical and Computer Engineering)
- Information Assurance and Networking lab in CP206H (Professor Yan Bai, Information Technology)
- Civil Engineering lab tour in MLG 128 (Assistant Professor Lorne Arnold, Assistant Teaching Professor Nara Almeida**)**

Poster presentations at William Philip Hall
3:00 - 3:10 pm Welcome speech (Dean Raj Katti)
3:10 - 3:15 pm Honoring students' research accomplishments
3:15 - 3:50 pm Lightning talks (3 minutes each)
3:50 - 4:30 pm Posters #1-25
4:30 - 5:10 pm Posters #26-46
5:10 - 5:15 pm Best poster award

Acknowledgement

We would like to thank Raj Katti (Dean, School of Engineering & Technology), Judy Bridges (Innovation Manager, UW CoMotion), and Steven Golob (PhD student and winner of 2024 Best Poster Award) for serving as judges for the Best Poster award.

Steering Committee (in alphabetical order of last name)
Faculty: Yan Bai (Information Technology), Joel Baker (Civil Engineering), Thillainathan Logenthiran (Electrical and Computer Engineering), Zhiquan (Andy) Shu (Mechanical Engineering), Ka Yee Yeung (Computer Science & Systems)
Staff: Brian Chambers, Andrew Fry

Administrative and logistics support (in alphabetical order of last name)
Gabi Crosby, Ebony Peterson, Marife Tabao

Panel Discussions at William Philip Hall
Session Chair: Andrew Fry, Director of Industry Partnerships

Noon - 1:00 pm: Engineering and Infrastructure
Panel Chair: Thais Harmon Director of Engineering Port of Tacoma

Panel: Mechanical, Civil and Electrical Engineering Firms from Around Tacoma/Pierce County
Jim Dugan, Parametrix
Chelsea Bennett, KPFF
TBD, GeoEngineers

1:00 - 2:00 pm: Research and Industry in Collaboration
Panel Chair: Dr. Ka Yee Yeung
Virginia and Prentice Bloedel Endowed Professor
School of Engineering and Technology/UWT

Panel: Industry and research faculty/students
Judy Bridges, UW Commotion
Somnath Mukherjee, Aquagga
Jason Seawall, Numurus
Matt Tolentino, Namatad and School of Engineering & Technology, UW Tacoma

Speed Granting: Networking for Research Success
2:00 - 2:50 pm, CP 105
Session Co-chairs: Associate Dean Yan Bai, Assistant Teaching Professor Thillainathan Logenthiran

Speed Granting is a dynamic, fast-paced event designed to spark research collaborations and boost grant success. In an hour, participants engage in structured pitch sessions where they present their research ideas, receive feedback, and explore potential partnerships.

Event Highlights:

- 2-minute research pitches followed by collaborative discussions
- Curated pairings based on research interests
- Networking opportunities to build lasting connections
- Mentor insights from experienced grant recipients
- Follow-up resources including funding lists and proposal writing workshops

Whether you are looking for co-investigators, fresh perspectives, or just inspiration, Speed Granting is your Launchpad for impactful research partnerships.

This session is open to faculty and others who are interested in research — more participation is welcome and encouraged!

LIGHTNING PRESENTATIONS AT-A-GLANCE

(ordered by poster numbers)

Poster #	Primary Presenter	Title
1	Raunaq Ray	Development of Signal Interface for Band-Switchable RF Transceiver IC
3	Kasra Amirsoleymani	Enhancing Grid Reliability Through Precise Forecasting and Supply-Demand Optimization
9	Ruidong Ma	Cryoprotectant Development to Reduce Thermal Runaway under Dielectric Heating in Cryopreservation
14	Donald Ramon Garcia-Rivas	pySLAMMER: A modern tool for legacy analysis
15	Carla Peterson	Automated Detector Comparison for the North Pacific Fin Whale using Low-Frequency Hydrophone Data
16	Daniil Filienko	AI-based Conversational Agents to Augment Tuberculosis Care
17	Shane Menzies	Advancing Privacy-Preserving AI: UW Tacoma as a NAIRR Pioneer
20	Andrew Cole	From the Benchtop to the Bedside: Revealing objective targets for management of Post-Acute Sequelae of COVID-19 (PASC)
21	Ruize Jia	Clustering Multimodal Spatial Transcriptomics Data
25	Naomi Meyer	Disaster Ready Cybersecurity Guidelines: Building resilient support systems for domestic violence survivors

POSTER PRESENTATIONS AT-A-GLANCE

(grouped to allow authors to present multiple posters)
Legend: *CE* = Civil Engineering, *CSS* = Computer Science & Systems, *ECE* = Electrical & Computer Engineering, *IT* = Information Technology, *ME* = Mechanical Engineering

1. *Development of Signal Interface for Band-Switchable RF Transceiver IC*. Raunaq Ray, S. Babak Hamidi, Debasis Dawn (ECE)
2. *Development of a Phase-Locked Loop (PLL) Systems Interface for RF Transceiver IC*. Conrad Motis, S. Babak Hamidi, Debasis Dawn (ECE)
3. *Enhancing Grid Reliability Through Precise Forecasting and Supply-Demand Optimization*. Kasra Amirsoleymani; Thillainathan Logenthiran (ECE)
4. *Optimized Renewable Energy Management in a University-Hospital Microgrid Using the Dragonfly Algorithm*. Janice Ayuso; Thillainathan Logenthiran (ECE)
5. *Power Systems Fault Detection Using Machine Learning*. J.S.S Aditya, Thillainathan Logenthiran, and Jie Sheng. (ECE)
6. *A Study on Airplane Power Distribution.* Huy Quang Tran, Thillainathan Logenthiran (ECE)
7. *Design and FPGA implementation of an Optimized AES Encryption Core.* Yi Zhang, and Jenny Sheng (ECE)
8. *Comparing Audio Data with SAD Architechture*. Ashleigh Roppolo, and Jenny Sheng (ECE)
9. *Cryoprotectant Development to Reduce Thermal Runaway under Dielectric Heating in Cryopreservation*. Ruidong Ma, Hwsung Kim, Rebekah Cureg, Zhiquan Shu (ME)
10. *Design and Evaluation of a New, Student-Centered Multidisciplinary Course in Mechanical Engineering: Artificial Organs*. Ruidong Ma, Frank Gao, Renee Desing, Zhiquan Shu (ME)
11. *Self-reflection: Lessons learned from three years of teaching as an international Ph.D. student engineering instructor*. Ruidong Ma, Renee Desing, Zhiquan Shu (ME)
12. *Designing an Effective Broadband Resonant Cavity for Rewarming Cryopreserved Samples of Various Sizes.* Ruidong Ma, Wenzhao Wang, Zhiquan Shu (ME)
13. *A Study Of Temperature And Concentration Impacts On The Viscosity Of Cryoprotective Agent Solutions.* Jade Nascimento, Nathanael Konwent, Vyn Mamaril, Ziyuan Wang, Ruidong Ma , Dayong Gao, and Zhiquan Shu (ME)
14. *pySLAMMER: A modern tool for legacy analysis*. Donald Garcia-Rivas, Lorne Arnold. (CE)
15. Automated Detector Comparison for the North Pacific Fin Whale using Low-Frequency Hydrophone Data. Carla L. Peterson, Heather Dillon, Ben Tribelhorn, and Juhua Hu (ME/CSS)
16. *AI-based Conversational Agents to Augment Tuberculosis Care*. Daniil Filienko, Mahek Nizar, Javier Roberti, Denise Galdamez, Haroon Jakher, Sarah Iribarren, Weichao Yuwen, Martine De Cock. (CSS)
17. *Advancing Privacy-Preserving AI: UW Tacoma as a NAIRR Pioneer* . Sikha Pentyala, Shane Menzies, Jineta Banerjee, Paulo Barreto, Daniil Filienko, Luca Foschini, Steven Golob, Geetha Sitaraman, Martine De Cock (CSS)

18. *withdrawn*
19. *PartFlow: A Visualization Tool for Application Partitioning and Workload Offloading in Mobile Edge Computing.* Boda Li, Minghao Li, Jian Zhao, Wei Cai (CSS)
20. *From the Benchtop to the Bedside: Revealing objective targets for management of Post-Acute Sequelae of COVID-19 (PASC)*. Andrew Cole, Thomas Dahlstrom, Jesse Flores, Bryce Fukuda, Ling-Hong Hung, Ka Yee Yeung (CSS)
21. *Clustering Multimodal Spatial Transcriptomics Data.* Ruize Jia, Ling-Hong Hung, Ka Yee Yeung (CSS)
22. *Single Cell RNA/Perturb Sequencing and gRNA Enrichment Data Processing Pipelines*. Ling-Hong Hung, Bryce Fukuda, Thomas Dahlstrom, Ka Yee Yeung (CSS)
23. *Graphical and Containerized Spatial Proteomics Image Analysis Workflow*. Pritpal Singh, Bryce Fukuda, Jocelyn H. Wright, Kimberly S. Smythe, Ling-Hong Hung, Cecilia CS Yeung, Ka Yee Yeung (CSS)
24. *Scaling complex bioinformatics workflows using asynchronous execution and a hybrid HPC/cloud architecture*. Patrick McKeever, Varun Mittal, Ka Yee Yeung, Ling Hong Hung (CSS)
25. *Disaster Ready Cybersecurity Guidelines: Building resilient support systems for domestic violence survivors*. Naomi Meyer, Dea Angeles Quiroz, Alex Worsham, Jessie Lowell, PhD, Andrew Wolfe (IT)
26. *Maximum Information Correlated Differential Privacy: Enhancing Utility in Privacy-Preserving Data Analysis*. Wenjun Yang, Eyhab Al-masri, Olivera Kotevska (CSS)
27. *Toward Comprehensive Computer Vision based Sign Language Research*. Yiming Ni, Jiayu Li, Zhiqi Cheng, Wei Cheng (CSS)
28. *Distributed FaaSRunner: Enabling Reproducible Temporal and Spatial Function-as-a-Service Endpoint Testing*. Tomoki Kondo, Austin Bomhold, Robert Cordingly, Wes Lloyd (CSS)
29. *Sky Computing for Serverless: Towards Infrastructure Prediction and Performance Enhancement*. Robert Cordingly, Wes Lloyd (CSS)
30. *Large language models for Serverless Function Generation: An Investigation on Performance and Code Quality*. Xinghan Chen, Vishnu Priya Rajendran, Robert Cordingly, Wes Lloyd (CSS)
31. *GraphQL vs. REST interfaces - Performance and Cost Investigation for microservice and database APIs*. Runjie Jin, Robert Cordingly, Dongfang Zhao, Wes Lloyd (CSS)
32. *VecLSTM: A Vectorized Deep Learning Framework for Scalable Trajectory Prediction and Activity Recognition*. Solmaz Seyed Monir, Dongfang Zhao (CSS)
33. *A Point-Based Algorithm for Distributional Reinforcement Learning in Partially Observable Domains.* Larry D. Preuett (CSS)
34. *A Markov Decision Process for Trauma Patient Resuscitation*. Larry D. Preuett, Catherine Beni, Qian Qui, Blake Murphy, Grant O'Keefe, Ankur M. Teredesai (CSS)
35. *RAGE: RAG Enhanced LLM Explainer for Heterogeneous Graphs*. Raghvi Baloni, Yihui Chong, Ankur Teredesai (CSS)
36. *MIRAGE: Medical Image Retrieval Augmented Generation for Enhanced Pneumonia Diagnosis*. Nicole Guobadia, Jay Estacio, Grant O'Keefe, Juhua Hu (CSS)

37. *Customized Multiple Clustering via Multi-Modal Subspace Proxy Learning*. Jiawei Yao, Qi Qian, Juhua Hu (CSS)
38. *Older Adults and Comfort in Sharing the Road Alongside Autonomous Vehicles: An Examination of Travel Stress, Labeling, and Dedicated Lanes*. Panick Kalambay and Angela Kitali (CE)
39. *Low-Temperature Alkaline Treatment of PFAS Precursors.* Ansaf V. Karim, Emese Hadnagy, Joel Baker, Brian Pinkard, Annie Heble, Conrad Austin (CE)
40. *Identifying key drivers of habitability loss reveals pathways for climate change adaptation in the Pacific*. Emily Nabong, Jeff Walters, Aaron Opdyke (CE)
41. *Bioinspired Design from Fish Armor: Mechanics, Hydrodynamics, and Engineering Applications*. Cassandra M. Donatelli, Karly E. Cohen, Jonah W Armendariz, Inaya Kamal, James A Kimpel, Bryan Lemus, Ellen Pak, Cody T Peradotto, Megan L. Vandenberg (CE)
42. *Assessment of end-of-life Design in Consumer Coffee Makers*. Ryan Lindbom, Kara Nichols, Dennis Tanner, Seung-Jin Lee, and Heather E. Dillon (ME)
43. *The Importance of "Place" in the Building and Establishment of a New Engineering Program.* Mark Pagano and Michael Sullivan (ME)
44. *Time Series Analysis and Clustering for Cybersecurity*. Hongtai Yang, Shiva Kumara, Raed Alashor, DC Grant, Greg Dalcher (IT)
45. *Small Business Data Breaches: How does poor data quality impact data governance?* Deveeshree Nayak, Kush Juneja, Andres Gamboa (IT)
46. *Small Business Data Breaches: The Role of Data Quality Dimensions.* Kush Juneja, Deveeshree Nayak (IT)

ABSTRACTS OF PRESENTATIONS

Poster #1: Development of Signal Interface for Band-Switchable RF Transceiver IC
Authors: Raunaq Ray, S. Babak Hamidi, Debasis Dawn
Abstract: This work presents a user-defined signal framework for generating and testing Automatic Dependent Surveillance-Broadcast (ADS-B) signals, enabling comprehensive validation of transceiver systems and aviation communication components without reliance on expensive hardware setups. Implemented in MATLAB and interfaced with Cadence Virtuoso, the framework facilitates precise signal generation, modulation and simulation of ADS-B protocols.
The approach involves generating ADS-B messages using MATLAB functions, which are then verified using pyModeS, an open-source tool for decoding Mode-S and ADS-B signals. These messages are encoded into Pulse Position Modulation (PPM) signals and tested for accuracy using Software Defined Radios (SDR). The generated signals were then transmitted and received through the band-switchable multi-band RF transceiver IC. The results demonstrate successful signal transmission and recovery, maintaining signal integrity and precise timing while validating the performance of the multi-band transceiver IC to handle aviation communication protocols. Additionally, an experimental approach to ADS-B message encryption using AES-ECB has been explored, identifying potential avenues for addressing Radio Frequency Interference (RFI) events affecting Global Navigation Satellite System (GNSS) applications. This framework offers a scalable testbed for evaluating transceiver performance while adding to the research on addressing security concerns in ADS-B and similar unidirectional broadcast protocols.

Poster #2: Development of a Phase-Locked Loop (PLL) Systems Interface for RF Transceiver IC
Authors: Conrad Motis, S. Babak Hamidi, Debasis Dawn
Abstract: This project focuses on integrating a Phase Locked Loop (PLL) system with a band-switchable multi-band Radio Frequency (RF) transceiver IC chip and developing a control interface for band selection. The PLL integration was achieved by connecting two additional main components to the transceiver: a multi-frequency PLL and a microcontroller. The PLL monitors the output frequency of the Voltage Controlled Oscillator (VCO) inside the RF transceiver chip and makes micro-adjustments to the tuning voltage to lock the free-running VCO at a particular band of interest in the transceiver chip. As the transceiver chip operates on multiple frequency bands, a microcontroller is required to change the frequency the PLL is operating at and may also be used to change frequency band selection by using digital bits to quickly adjust the transceiver's VCO to operate more precisely anywhere inside its allowable operating frequency range of 900MHz to 2.4GHz. As the VCO's output oscillation frequency is locked by the PLL, it allows for precise operation of the entire RF transceiver chip. Further research is progressing to create a custom PLL IC or discrete component solution for this specific application.

Poster #3: Enhancing Grid Reliability Through Precise Forecasting and Supply-Demand Optimization

Authors: Kasra Amirsoleymani; Thillainathan Logenthiran
Abstract: This project focuses on precise forecasting and optimal supply-demand matching in power systems to improve grid reliability and efficiency. Accurate forecasting is crucial for balancing energy supply with demand, reducing operational costs, and enhancing grid stability. We tackled the challenge of day-ahead load forecasting using real-world data from American Electric Power (AEP), which included 10 years of hourly power consumption records. Given the temporal nature of the dataset, we employed a Long Short-Term Memory (LSTM) neural network, a deep learning model well-suited for capturing long-range dependencies in sequential data. To enhance prediction accuracy, we incorporated meteorological variables such as temperature, humidity, and wind speed, as weather significantly influences power consumption. Our model was trained and validated on historical data, demonstrating superior performance compared to traditional statistical methods.
The results indicated that LSTM-based forecasting significantly reduced prediction errors, improving grid planning and operational efficiency. By providing more accurate demand forecasts, utilities can optimize power generation, minimize reliance on expensive reserves, and reduce the risk of blackouts. This research contributes to smarter grid management, supporting the transition to a more sustainable and resilient power system. Future work will explore hybrid models and real-time forecasting integration.

Poster #4: Optimized Renewable Energy Management in a University-Hospital Microgrid Using the Dragonfly Algorithm
Authors: Janice Ayuso; Thillainathan Logenthiran
Abstract: The growing energy demands of critical infrastructures, such as hospitals and universities, necessitate efficient, reliable, and sustainable power management solutions. This project aims to optimize the generation scheduling of a university-hospital microgrid by integrating renewable energy sources, including solar panels, wind turbines, and diesel generators, alongside battery storage systems. The primary objective is to achieve a 100% reliable power supply while minimizing operational costs and reducing carbon emissions.
To accomplish this, the Dragonfly Algorithm (DA), a nature-inspired optimization technique, is employed to determine the most efficient energy dispatch strategy. DA dynamically balances energy generation, storage, and consumption, ensuring stability and resilience against power fluctuations. The proposed model considers real-time load demand, weather conditions, and energy pricing to enhance efficiency.
Simulation results demonstrate that the optimized microgrid significantly improves energy utilization, reduces dependence on fossil fuels, and ensures uninterrupted power supply to critical facilities. Compared to conventional scheduling methods, the DA-based approach enhances system resilience and cost-effectiveness. This research contributes to the advancement of smart grid technologies, promoting the adoption of renewable energy in critical infrastructure. Future work includes incorporating demand-side management and exploring hybrid optimization techniques for further efficiency gains.

Poster #5: Power Systems Fault Detection Using Machine Learning
Authors: J.S.S Aditya, Thillainathan Logenthiran, and Jie Sheng

Abstract: Electrical faults in transmission lines are a critical concern in power systems, as they impact the stability and reliability of electricity distribution. Rapid fault identification and classification are essential for timely intervention and the prevention of larger systemic failures. This research aims to develop a sophisticated machine learning model to accurately detect and classify various types of electrical faults in transmission lines. By leveraging advanced algorithms and comprehensive data analysis, the goal is to enhance the efficiency of power distribution and significantly reduce risks associated with electrical faults. Our solution contains mainly 2 phases. In the first phase, fault data is simulated using MATLAB to generate signals that exhibit characteristics of different fault types. In the second phase, machine learning models, such as Support Vector Machines (SVMs) and Artificial Neural Networks (ANNs), are used to train the system to recognize and classify faults in real time.
Results showed that machine learning models, particularly decision trees, when combined with appropriate feature engineering, can significantly enhance fault detection in power systems, improving both efficiency and reliability. Meanwhile, the integration of Wavelet Transform for feature extraction and machine learning models for classification provided a robust framework for fault detection.

Poster #6: A Study on Airplane Power Distribution
Authors: Huy Quang Tran, Thillainathan Logenthiran
Abstract: In this project, we study airplane power distribution, an engineering concept that involves managing and distributing electrical energy throughout the aircraft. This research examines the main components of power distribution systems, including generation, where primary power sources come from generators driven by engines that support the aircraft's main systems. Additionally, key components such as secondary power sources, including batteries and Auxiliary Power Units (APUs), are explored. Special focus is given to the role of power conversion, distribution efficiency, redundancy mechanisms, and safety considerations in ensuring a reliable power supply for critical and non-critical aircraft functions.
The study also investigates advancements in modern aircraft power systems, including more-electric and all-electric aircraft concepts, which aim to improve efficiency and reduce reliance on traditional hydraulic and pneumatic systems. By analyzing these aspects, the project provides a comprehensive understanding of how power distribution systems contribute to the overall performance and safety of an aircraft.

Poster #7: Design and FPGA implementation of an Optimized AES Encryption Core
Authors: Yi Zhang, and Jenny Sheng
Abstract: This research aims to provide insights into high-performance FPGA-based cryptographic acceleration. One objective is to explore hardware acceleration techniques for AES while evaluating the feasibility of Elliptic Curve Cryptography (ECC) on FPGA platforms. Specifically, design and FPGA implementation of an optimized AES encryption core on the Altera DE2-115 FPGA will be presented.
The AES implementation follows a hardware-optimized pipelined structure, designed in SystemVerilog and synthesized using Quartus II. Several optimization techniques are applied to improve efficiency, including loop unrolling, parallel S-box computation using BRAM-based lookup tables, MixColumns optimization, and register balancing to reduce critical path delays.

The impact of round key precomputation and optimized finite field arithmetic on overall performance is also considered.
For ECC, the implementation focuses on efficient modular arithmetic and scalar multiplication, ensuring compatibility with FPGA constraints. The integration of AES for symmetric encryption and ECC for key exchange is investigated, analyzing their combined impact on performance and resource utilization.
Performance evaluation focuses on hardware resource utilization (LUTs, FFs, BRAMs), achievable clock frequency, and potential bottlenecks in both AES and ECC implementations. Additionally, trade-offs between latency, throughput, and hardware complexity are considered to assess the viability of deploying these cryptographic algorithms on resource-constrained FPGA platforms.

Poster #8: Comparing Audio Data with SAD Architechture
Authors: Ashleigh Roppolo, and Jenny Sheng
Abstract: This research project investigates the feasibility and usefulness of implementing a Sum of Absolute Difference (SAD) architecture to compare two sources of audio data on an FPGA board with SystemVerilog. An FPGA (Field-Programmable Gate Array) board integrates important engineering concepts relating to electronic system coding, simulation, and verification. It also allows users to create custom digital circuits for various applications. One goal of this research project is to open the way to using this tool for projects relating to machine learning and pattern recognition; and specifically, to implement an SAD architecture, and use this comparison tool to build an audio tuner which detects whether a given audio file matches a specific musical note. Results of function testing using ModelSim will be presented. Moreover, the proposed design will be synthesized and implemented in FPGA Altera DE2-115, followed by a discussion on the allowable maximum frequency and the usage of resources including memory bits, registers and combinational logical elements. The effectiveness of the design will be demonstrated through a comparison - if the live audio matches the specific musical note contained in a downloaded audio, the FPGA board will give an output for confirmation.

Poster #9: Cryoprotectant Development to Reduce Thermal Runaway under Dielectric Heating in Cryopreservation
Authors: Ruidong Ma, Hwsung Kim, Rebekah Cureg, Zhiquan Shu
Abstract: The rewarming process of tissues and organs in cryopreservation requires a rapid rewarming rate and uniform temperature distribution to avoid ice recrystallization and temperature gradient-induced thermal stress. Dielectric heating utilizes the electric field to rewarm cryopreserved samples fast; however, the thermal runaway effect limits the use of electric field heating, where areas of the sample that has higher temperature can absorb more energy and results in an increasing temperature gradient between the hot and cold regions. This leads to escalated uneven warming and severe damage to the biological samples, highlighting the need for understanding of this thermal runaway phenomenon and precise control of the rewarming process. Thus, this study utilizes the numerical simulation to study the thermal runaway effect and design optimized cryoprotective agents (CPAs) to mitigate this impact. We first study the temperature profiles during heating in a normal cryopreserved sample (i.e., dielectric loss increases with temperature) when either the electromagnetic field or sample

dielectric properties are nonhomogeneous, which explains the origins of thermal runaway phenomenon. We then proposed novel CPAs, which present an inverted U-shaped correlation between dielectric loss and temperature. The study reveals the mechanism of thermal runaway effect during dielectric heating and provides guidance on the design of CPAs to mitigate this effect.

Poster #10: Design and Evaluation of a New, Student-Centered Multidisciplinary Course in Mechanical Engineering: Artificial Organs

Authors: Ruidong Ma, Frank Gao, Renee Desing, Zhiquan Shu

Abstract: This paper describes the development of a novel "Artificial Organs" course in the Mechanical Engineering department at a large public university in the northwest. The course responds to growing healthcare opportunities for mechanical engineers beyond traditional fields, preparing students for careers in pharmaceuticals, biomedical engineering, and healthcare consulting. Co-designed by a graduate student and faculty instructor, the course employs backwards design principles to create a student-centered learning environment. Students explore interdisciplinary concepts through peer discussions and teamwork, culminating in final projects and presentations. Graduate students take leadership roles by facilitating discussions and inviting PhD candidates as guest lecturers.

The curriculum covers critical organ failure, increasing demand for artificial organs, historical development, innovation challenges, and mechanical principles. Learning objectives include identifying design challenges, applying mechanical engineering concepts to artificial organ design, and developing application-specific prototypes.

First offered in fall 2023, the course attracted students from mechanical, bioengineering, and industrial engineering departments. Effectiveness was evaluated through project assessments, informal feedback, and formal course evaluations. While continuous improvements are planned, this innovative educational initiative successfully equips engineering students with knowledge and skills to address complex biomedical challenges in an increasingly interdisciplinary field.

Poster #11: Self-reflection: Lessons learned from three years of teaching as an international Ph.D. student engineering instructor

Authors: Ruidong Ma, Renee Desing, Zhiquan Shu

Abstract: This paper reflects on the author's three-year experience as an international graduate student instructor in engineering disciplines. The study addresses a significant gap: Ph.D. students increasingly take on independent teaching roles at universities without formal pedagogical training or guidance on balancing teaching with research and other responsibilities. Using autoethnography and reflexivity, the author critically analyzed their experience teaching nine courses to approximately 700 students across three institutions. The study draws on self-reflection journals, teaching evaluations, and student feedback collected while teaching various mechanical engineering courses including thermodynamics, fluid mechanics, heat transfer, and specialized subjects.

The analysis reveals the author's growth as an instructor and documents lessons learned in several key areas: teaching skills development, effective time management strategies, professional career development, and implementing diversity, equity, and inclusion (DEI) practices in STEM classrooms.

The paper aims to provide practical guidance for fellow Ph.D. students interested in teaching while pursuing their research degrees. It offers insights on how teaching experiences can complement dissertation work and strengthen professional development, ultimately serving as a resource for graduate students navigating the dual roles of researcher and instructor.

Poster #12: Designing an Effective Broadband Resonant Cavity for Rewarming Cryopreserved Samples of Various Sizes
Authors: Ruidong Ma, Wenzhao Wang, Zhiquan Shu
Abstract: Rewarming of cryopreserved sample is one of the challenges problems in cryopreservation. Although the resonant cavity is studied previous, however, the system design protocol and guideline line about the loaded sample are not available. In this paper, we include the TE101 and TE102 design method with an example at 915MHz. Further, we overcome the engineering issue in adopting the solid state generator. Later, we derived relationship and the maximum loaded sample and the critical rewarming relate to avoid recrystallization during thawing process.

Poster #13: A Study Of Temperature And Concentration Impacts On The Viscosity Of Cryoprotective Agent Solutions
Authors: Jade Nascimento, Nathanael Konwent, Vyn Mamaril, Ziyuan Wang, Ruidong Ma , Dayong Gao, and Zhiquan Shu
Abstract: Cryopreservation is an essential technique in modern medicine that enables biological materials to be stored at low temperatures to halt the biological processes and metabolism. This preserves the viability and functionality of the biological sample for an extended period, without the risk of degradation. One major challenge during cryopreservation is ice crystallization, which is the core problem in cryopreservation leading to cell death. Viscosity of the solution is an important characteristic that determines the kinetics of ice nucleation and growth. In the case of addition and removal of cryoprotective agents (CPAs) before and after cryopreservation, respectively, solution viscosity is the key property impacting the speed of CPA loading and unloading. However, viscosity of CPA solutions, particularly for the vitrification solutions at low temperatures, are not available yet. This study aims to investigate the viscosity of vitrification solutions and better understand viscosity's role in vitrification, focusing on three cryoprotective solutions. Data indicates that the viscosity of these solutions depends on the solution concentration, composition, and temperature. Higher viscosity restricts molecular movement, reducing water mobility and thus minimizing ice formation. Using higher viscosity solutions can lead to slow loading/unloading of CPAs, impacting the sample's viability after cryopreservation. Viscosity also shows a correlation with the vitrification tendency of the solutions. This study improves knowledge of the viscosity of CPA solutions and can help improve cryopreservation by optimizing the protocols for CPA loading/unloading and minimizing ice crystallization.

Poster #14: pySLAMMER: A modern tool for legacy analysis
Authors: Donald Garcia-Rivas, Lorne Arnold
Abstract: Newmark sliding block displacement analysis is a qualitative tool frequently used in the geotechnical engineering field to assess permanent displacement of soil slopes under

seismic loading. The prevalent tool for sliding block analyses, “SLAMMER” (Seismic Landslide Movement Modeling using Earthquake Records), is a legacy Java GUI program with limited flexibility. In this study, we developed and published pySLAMMER, an open-source Python package that modernizes sliding block analysis and will easily fit into a number of industry-standard workflows. Relative to the legacy program, pySLAMMER provides increased data access, improved plotting capabilities, and the ability to easily run multiple analyses with varying input parameters in a Python workflow. Additionally, pySLAMMER provides a template for users to incorporate their own sliding block models suiting their needs and adding additional capabilities as further research in this field is performed. Although the legacy program is out-of-date, its results have been used as an index parameter in practice for decades. Therefore, we rigorously compared pySLAMMER’s analysis results and performance with the legacy program. The comparison results show good agreement, allowing us to present pySLAMMER to the geotechnical engineering community as a reliable tool for modern seismic landslide analysis.

Poster #15: Automated Detector Comparison for the North Pacific Fin Whale using Low-Frequency Hydrophone Data
Authors: Carla L. Peterson, Dr. Heather Dillon, Dr. Ben Tribelhorn, and Dr. Juhua Hu
Abstract: Increasing global shipping has led to rising levels of low-frequency (LF) sound in the ocean, potentially affecting marine mammals such as fin whales. Large passive acoustic monitoring (PAM) datasets containing LF sound offer valuable opportunities to assess these impacts. However, a review of existing automated detection tools reveals that they are not well-suited for large PAM datasets, particularly due to difficulties in distinguishing fin whale calls from overlapping anthropogenic noise. Using data from an LF hydrophone, we identify opportunities to improve automatic detection methods, with a focus on reducing the high rate of missed detections through unsupervised machine learning algorithms (e.g. clustering). By refining peak detection techniques, we demonstrate promising solutions for enhancing fin whale call detection in large-scale PAM datasets. Implementing these advanced methods will enable more accurate detection of overlapping sounds with fin whale calls and their impact on fin whale behavior, ultimately contributing to better-informed conservation strategies.

Poster #16: AI-based Conversational Agents to Augment Tuberculosis Care
Authors: Daniil Filienko, Mahek Nizar, Javier Roberti, Denise Galdamez, Haroon Jakher, Sarah Iribarren, Weichao Yuwen, Martine De Cock
Abstract: Tuberculosis (TB) remains the world’s deadliest infectious disease, despite being preventable and curable. The burden is disproportionately high in low- and middle-income countries, where healthcare systems face significant challenges. Effective patient-provider communication and support during the demanding 6- to 9-month treatment period is critical to improving outcomes but is often limited in these settings, contributing to increased treatment non-adherence. Novel AI based on large language models (LLMs) holds transformative potential to assist providers and scale up care where healthcare providers are stretched thin. Building on data from an existing trial in Argentina, we developed and evaluated a series of LLM-based conversational agents to augment interactive communication between patients and treatment supporters. This AI-powered approach, operating within a human-in-the-loop

framework, aims to enhance patient engagement, reduce communication delay between the patient and provider, and improve TB treatment outcomes. Our models, which employ few-shot learning, Retrieval Augmented Generation (RAG), and perturbations of embeddings to provide patient privacy, were evaluated by Spanish speaking experts for medical accuracy, empathy, and linguistic appropriateness. The process of iterative building, refining and evaluation by experts revealed the strengths of LLMs when augmenting human professionals as well as areas for further improvement.

Poster #17: Advancing Privacy-Preserving AI: UW Tacoma as a NAIRR Pioneer
Authors: Sikha Pentyala, Shane Menzies, Jineta Banerjee, Paulo Barreto, Daniil Filienko, Luca Foschini, Steven Golob, Geetha Sitaraman, Martine De Cock
Abstract: The National Artificial Intelligence Research Resource (NAIRR) Pilot is an initiative led by the National Science Foundation (NSF) in collaboration with other federal agencies and private sector partners. This pilot serves as a proof-of-concept for a comprehensive national infrastructure for AI research and development. SET received one of the 35 first round access projects to the NAIRR when it was launched in 2024, and has since also been awarded a NAIRR Pilot demonstration project for privacy-preserving synthetic data generation. Our research is motivated by the realization that much of the most valuable data in the nation is siloed in research centers, hospitals, banks, etc. The long and onerous processes that researchers must go through to access each silo is causing a substantial underutilization of AI in many of the most important domains, including healthcare and genomics. Synthetic data generation (SDG) offers an appealing solution to make data more broadly available for AI research while mitigating privacy concerns. Current SDG algorithms lack provisions for protection of input privacy. We leverage the NAIRR infrastructure (TACC Frontera) and build solutions to make it possible for data holders to contribute their data to an SDG process without disclosing that data in an unencrypted manner.

Poster #18: withdrawn

Poster #19: PartFlow: A Visualization Tool for Application Partitioning and Workload Offloading in Mobile Edge Computing
Authors: Boda Li, Minghao Li, Jian Zhao, Wei Cai
Abstract: We present PartFlow, a novel visualization system for mobile edge computing that facilitates dynamic partitioning and workload offloading through detailed analysis of user-driven execution patterns. PartFlow collects real-time data via binary instrumentation and employs interactive visualizations—including flame graphs, sunburst diagrams, and Sankey-based decision trees—to reveal intricate component performance and state transition patterns. A key innovation is our integration of an LSTM-based deep learning module for multi-step forecasting, which predicts component states and guides optimization of offloading strategies to reduce energy consumption and latency. Case studies and extensive user evaluations confirm that PartFlow not only improves the accuracy of partitioning decisions but also enhances overall application performance in heterogeneous environments. Recently accepted for presentation at PacificVis 25, this work has been recognized for its innovative approach and significant impact on visual analytics in mobile computing. PartFlow offers researchers and practitioners a robust

tool to bridge the gap between static analysis and dynamic user behavior, paving the way for future advancements in mobile edge computing.

Poster #20: From the Benchtop to the Bedside: Revealing objective targets for management of Post-Acute Sequelae of COVID-19 (PASC)
Authors: Andrew Cole, Thomas Dahlstrom, Jesse Flores, Bryce Fukuda, Ling-Hong Hung, Ka Yee Yeung
Abstract: Despite advances in the multidisciplinary management of Long-Covid (LC), access to direct objective diagnostic and monitoring markers of LC remains elusive. This study reveals actionable targets using a compendium analytical pathway to objective vital endpoints. We aimed to uniformly process diverse COVID-19 and LC datasets by horizontally integrating inputs using our BioDepot-workflow-builder (Bwb) platform to perform data preparation and analysis for identification of actionable insights. Using a custom-built, containerized widget-based software package, we harmonized publicly available datasets from globally diverse study sites subsequently performing data preparation, analysis, and visualization to reveal measurable targets for managing LC, whose current management is subjective. Our results show a dichotomy of molecular pathways prevalent in LC patients versus acute severe COVID-19 patients which can be applied to the diagnosis, classification, follow-up, and prognosis related to infection and post-infection complications evident in LC. These findings suggest our targets could help manage LC easily and measurably, potentially revolutionizing the current subjective approach that heavily relies on the process of elimination and clinical features to manage LC patients.

Poster #21: Clustering Multimodal Spatial Transcriptomics Data
Authors: Ruize Jia, Ling-Hong Hung, Ka Yee Yeung
Abstract: Spatial transcriptomics (ST) provides a spatially resolved, high-dimensional assessment of gene transcription. Spatial domain identification (SDI) is critical in ST to understand tissue microenvironments and biological functions. Existing statistical or deep learning SDI methods incorporate a clustering step to infer spatial domains. However, those methods face two significant limitations in the clustering process. First, they often rely on a hardcoded number of clusters and/or model types. In practice, ground truth annotations, such as the number of spatial domains, are generally unavailable. Second, principal component analysis (PCA) is commonly used for dimension reduction of the gene expression matrix. However, PCA primarily captures variability that may not align with clustering features, potentially hindering accurate domain identification. To tackle these limitations, we applied model-based clustering with various dimension reduction techniques. Specifically, we experimented with mclust, leveraging the Bayesian Information Criterion (BIC) to select the best model and determine the optimal number of clusters. Additionally, we substituted PCA with autoencoders and foundation models for dimension reduction. Finally, clustering is performed on the spatial embeddings and the spatially enhanced gene expression matrix derived from the dorsolateral prefrontal cortex reference dataset, with results compared to external knowledge using the Adjusted Rand Index (ARI).

Poster #22: Single Cell RNA/Perturb Sequencing and gRNA Enrichment Data Processing Pipelines

Authors: Ling-Hong Hung, Bryce Fukuda, Thomas Dahlstrom, Ka Yee Yeung

Abstract: Graphical and containerized workflows are developed to uniformly process different data types generated in the NIH MorPhiC program. We developed a generalized open-source workflow that assigns feature barcodes, aligns and assigns cell barcodes for single cell RNA sequencing (scRNA-seq) data, performs post-processing steps such as empty cell detection, doublet removal, noise reduction, and provides visualizations for quality control. Feature barcode assignment is accomplished using our new software package that can take advantage of targeted sequencing of feature barcodes or detect from expression data. 6 different open-source aligners are supported by the workflow and the output format is the widely used h5ad scanpy Anndata objects. Our gRNA workflow utilizes the Model-based Analysis of Genome-wide CRISPR/Cas9 Knockout (MAGeCK) computational tool to process gRNA samples. The workflow first quantifies gRNA read counts from sequencing files using MAGeCK, then reformats the count data into a unified count table, and finally performs comparative analysis between control and treatment samples to identify and rank positively and negatively selected genes and gRNAs. Both workflows were tested and validated using data from the Huangfu Lab at Memorial Sloan Kettering Cancer Center.

Poster #23: Graphical and Containerized Spatial Proteomics Image Analysis Workflow

Authors: Pritpal Singh, Bryce Fukuda, Jocelyn H. Wright, Kimberly S. Smythe, Ling-Hong Hung, Cecilia CS Yeung, Ka Yee Yeung

Abstract: The advent of high-plex spatial proteomics platforms allow interrogation of patient tissue samples with over 60 antibody protein markers simultaneously for identification of novel spatial biomarkers that could identify disease, assess immune microenvironment, and predict drug response. We present a modular and graphical workflow that allows execution of complex spatial proteomic analysis in an automated, end-to-end workflow using the BioDepot-workflow-builder (Bwb) desktop platform that readily integrates with image analysis software through containerization. This workflow supports graphical output with the full functionalities of QuPath to allow biomarker visualization and validation on the image, cell segmentation, and export of cell data for unsupervised clustering. Viewing of the cell type clusters as biomarker expression heatmaps and UMAPs is available using Jupyter Notebooks and python libraries. Clustered results can be imported back into QuPath images as color maps for validation The whole process can be performed automatically or as individual, interactive steps allowing the user to adjust parameters. To demonstrate the performance of this workflow, we evaluated the analysis of a six multi-cancer + tonsil tissue microarray that was stained with a 55-antibody marker PhenoCycler-Fusion assay. Results were comparable to that with a commercially available platform that requires sharing of data rights.

Poster #24: Scaling complex bioinformatics workflows using asynchronous execution and a hybrid HPC/cloud architecture

Authors: Patrick McKeever, Varun Mittal, Ka Yee Yeung, Ling Hong Hung

Abstract: With the rapidly increasing size and scale of genomic data, it is essential to develop scalable computational methods and infrastructure to process these big biomedical datasets.

Cloud computing platforms have been gaining popularity due to their pay-as-you-go on-demand pricing structure. However, for tightly-coupled or communications-intensive parallel workloads, supercomputers (or high-performance computing [HPC]) can deliver significantly shorter makespans relative to cloud computing. Most importantly, academic researchers can request credits and/or allocations from NSF funded supercomputers, while the costs of commercial cloud platforms could pose financial obstacles to academic researchers.
Our key idea is to develop computational methods and tools to enable biomedical scientists to effectively leverage both commercial cloud and HPC for big data analysis. A major obstacle is that effectively leveraging HPC and cloud computing requires significant technical knowledge. Users may wish to deploy the entirety of a bioinformatics workflow to a particular platform or may instead deploy different stages across different platforms so as to minimize cost or enhance parallelism. Here, we present a user accessible workflow scheduler based on Temporal, allowing for durable execution of scientific workflows on both cloud and HPC infrastructure. As a test case, we execute a bulk RNA sequencing workflow on NSF supercomputers.

Poster #25: Disaster Ready Cybersecurity Guidelines: Building resilient support systems for domestic violence survivors
Authors: Naomi Meyer, Dea Angeles Quiroz, Alex Worsham, Jessie Lowell, PhD, Andrew Wolfe
Abstract: Safety Net Project, the tech safety team at the National Network to End Domestic Violence (NNEDV) has seen a significant uptick in recent years with local victim service providers requiring additional aid to support survivors and their families, in the face of natural disaster events like fires, hurricanes, and flooding. This project was born out of a direct response to this need - literal natural disasters where technical infrastructure and physical buildings are often not usable and alternatives are required. Research on this critical topic of cybersecurity best practices and guidelines for local organizations in the context of disaster preparedness and response has a wide impact. NNEDV supports 56 state and territorial coalitions against domestic violence, which in turn support nearly 2,000 local programs and millions of survivors every year in the US as well as consultation work with sister projects in Canada and Australia.
Some key topics covered include: emergency response communication plans, privacy and digital protection during disasters, as well as location tracking detection and prevention. Researchers plan to publish and have been selected to present findings at the upcoming BSides Seattle industry conference in April 2025. Overall this project offers actionable recommendations to help local victim service providers continue critical communication and safeguard survivors during and after natural disasters.

Poster #26: Maximum Information Correlated Differential Privacy: Enhancing Utility in Privacy-Preserving Data Analysis
Authors: Wenjun Yang, Eyhab Al-masri, Olivera Kotevska
Abstract: Preserving privacy in distributed data analysis is challenging when datasets exhibit inherent correlations, as conventional differential privacy (DP) mechanisms assume record independence. This paper introduces Maximum Information Correlated Differential Privacy

(MIC-DP), a novel framework that dynamically adjusts privacy guarantees based on structured dependencies within correlated data. Unlike existing methods, MIC-DP leverages the Maximum Information Coefficient (MIC) to automatically detect and quantify nonlinear correlations without explicit modeling, enabling adaptive privacy protection. By dynamically calibrating noise injection based on MIC-measured correlation strength, MIC-DP optimizes the privacy-utility tradeoff while ensuring formal DP guarantees and mitigating correlation-based inference risks. Extensive evaluations on real-world datasets—including healthcare (MIMIC), demographic (ACI), and energy demand (HED)—demonstrate MIC-DP's superiority over state-of-the-art methods. The framework consistently adapts to heterogeneous correlation structures across domains, proving its scalability and effectiveness. For instance, in healthcare data with complex interdependencies, MIC-DP achieves robust privacy without sacrificing analytical accuracy. These results highlight MIC-DP's potential as a versatile solution for privacy-preserving analysis of correlated data, addressing a critical gap in DP frameworks for real-world, interconnected datasets. MIC-DP's dynamic, correlation-aware approach sets a new standard for balancing utility and privacy in distributed systems.

Poster #27: Toward Comprehensive Computer Vision based Sign Language Research
Authors: Yiming Ni, Jiayu Li, Zhiqi Cheng, Wei Cheng
Abstract: Sign language is a vital means of communication for the Deaf community. However, effective interaction with hearing individuals remains challenging due to the inherent complexity of sign language. To overcome this barrier, significant efforts have been made in sign language translation, yielding promising results. Nevertheless, the quality of translation remains insufficient for practical, real-world applications. While numerous studies have identified the limitations of existing sign language datasets as a key obstacle, no comprehensive collection or systematic analysis of these datasets has been conducted. To address this gap, we have compiled the most comprehensive table of sign language datasets to date and conducted an in-depth analysis of commonly used datasets. Additionally, we provide recommendations for future sign language dataset construction. Furthermore, we have reviewed research papers covering deep learning-based methods for Sign Language tasks, including Recognition, Translation, and Production, and have established leaderboards to benchmark progress across these areas. Comprehensive work and Sign Language Dataset information are available at https://github.com/Ginqwerty/Open-Sign-Language.

Poster #28: Distributed FaaSRunner: Enabling Reproducible Temporal and Spatial Function-as-a-Service Endpoint Testing
Authors: Tomoki Kondo, Austin Bomhold, Robert Cordingly, Wes Lloyd
Abstract: Today's cloud native applications are often built using a service-oriented architecture, integrating many microservices supported by serverless Function-as-a-Service (FaaS) platforms. The majority of serverless function benchmarking and testing is performed using a single-client node generating a sequential or parallel load against a highly scalable serverless backend. Single-client test engines, however, lack the computational resources and network bandwidth to stress them. Load testing tools such as Apache JMeter support generating tests using multiple nodes, but they lack the ability to coordinate sophisticated tests that reproduce distinct distributed workload patterns or serverless workloads observed "in the wild".

In this study, we introduce Distributed FaaSRunner, a distributed test tool, along with SETGen, a trace generation tool. SETGen generates workload traces based on probability distributions or by processing serverless function logs. Distributed FaaSRunner reproduces multi-node workloads generated with SETGen. We test our ability to precisely reproduce serverless function request timings using test clusters with nodes distributed across cloud regions or localized to a single region or availability zone. By supporting workload traces that replicate the timing of requests using distributed clients, we can reproduce temporal and spatial characteristics of workloads, enabling a new capability to assess performance of FaaS platforms beyond traditional load testing.

Poster #29: Sky Computing for Serverless: Towards Infrastructure Prediction and Performance Enhancement

Authors: Robert Cordingly, Wes Lloyd

Abstract: Serverless cloud computing platforms enable developers to deploy applications that automatically scale and manage computing infrastructure. The ""serverless"" nature of these platforms leads to infrastructure obfuscation, unpredictable performance, and inconsistent costs. This unpredictability is caused by a diverse, constantly shifting pool of available hardware provided by Infrastructure-as-a-Service cloud resource pools used to host the serverless platform. Available resources constantly change resulting in varying sets of CPU generations, CPU clock speeds, memory types, and server capacity. When applications run on serverless platforms, function instances can end up on any of these heterogeneous hardware configurations, causing variability in performance.

To address this challenge and take advantage of the hardware heterogeneity of serverless platforms, this research develops a novel methodology for inferring key hardware characteristics (e.g., CPU model, CPU clock speed, number of allocated hosts) in distinct serverless availability zones. Using these observations, our serverless Sky Computing system can aggregate resources from many availability zones to route requests to the highest-performance infrastructure that is available. Leveraging our approach can unlock significant performance gains by capitalizing on hidden hardware heterogeneity in the cloud.

Poster #30: Large language models for Serverless Function Generation: An Investigation on Performance and Code Quality

Authors: Xinghan Chen, Vishnu Priya Rajendran, Robert Cordingly, Wes Lloyd

Abstract: The rapidly expanding use of large language model (LLM) code generation opens up new possibilities for cloud computing, while also introducing unique performance and reliability challenges. Existing research on LLMs for automatic code generation has primarily focused on general-purpose computing environments and the latest, most powerful and resource hungry models that require expensive environments to run on, while neglecting mid-range model sizes (i.e. 1.5-8 billion or 32-70 billion parameters) that are capable of running on readily available consumer GPUs. In this work, we address this gap by investigating both publicly available large-scale APIs and smaller, locally hosted models (e.g. UW Hyak clusters or slower local machines) for serverless function generation.

In this research, we explore correctness, code quality, and performance, investigating to what extent smaller LLMs match the accuracy and efficiency of their larger counterparts for

generating complex functions. We compare code generation outcomes where models must generate custom code from scratch versus leveraging existing well-known libraries to perform the heavy lifting. Preliminary findings reveal tradeoffs between generation cost, code correctness, code quality, and runtime performance, shedding light on how developers and researchers can better leverage LLMs to accelerate serverless function creation without sacrificing reliability or speed.

Poster #31: GraphQL vs. REST interfaces - Performance and Cost Investigation for microservice and database APIs
Authors: Runjie Jin, Robert Cordingly, Dongfang Zhao, Wes Lloyd
Abstract: Serverless computing removes infrastructure management complexities, with RESTful APIs traditionally serving as the primary interface. However, REST often results in inefficiencies such as data over-fetching and under-fetching, impacting both performance and cost. This research explores GraphQL as an alternative, particularly for serverless applications and database-backed systems. GraphQL provides a data query and manipulation language that allows specifying operations over data (e.g. reads, writes, updates). GraphQL supports creating APIs that leverage an execution engine to evaluate queries. By using GraphQL's ability to aggregate queries and optimize data transfer, we analyze its impact on roundtrip time (RTT), scalability, and cost compared to REST.
Starting with a serverless image processing pipeline, we investigate both managed (AWS AppSync) and unmanaged (Apollo Server) GraphQL hosting solutions. Our results suggest that GraphQL outperforms REST in scenarios with high network latency by reducing redundant data transfers and request overhead. Additionally, we investigate and report on GraphQL's role in database applications, assessing its impact on query performance with modern cloud-based storage solutions in comparison to REST. As GraphQL adoption grows in cloud environments, this study provides insights into its trade-offs and potential as a primary interface for modern serverless and database applications.

Poster #32: VecLSTM: A Vectorized Deep Learning Framework for Scalable Trajectory Prediction and Activity Recognition
Authors: Solmaz Seyed Monir, Dongfang Zhao
Abstract: Trajectory prediction and activity recognition are crucial for understanding dynamic systems, particularly in transportation and urban mobility. However, existing methods face scalability and computational efficiency limitations when processing large-scale, high-dimensional trajectory data. In this paper, we introduce VecLSTM, a novel deep learning framework that enhances both accuracy and efficiency in trajectory modeling. The framework integrates a Vectorization layer that preprocesses raw GPS data, converting it into structured and efficient vector representations. This approach optimizes data storage and retrieval, significantly reducing training time. Additionally, VecLSTM utilizes convolutional layers for spatial feature extraction and an LSTM network for temporal modeling. To further enhance efficiency, we introduce a structured metadata storage system that associates each trajectory with time, spatial coordinates, activity labels, and user information, facilitating efficient data retrieval and streamlined preprocessing. We evaluate VecLSTM on two large-scale real-world datasets, GeoLife and HighD, achieving a 74.2\% reduction in training time and state-of-the-art

performance, with an RMSE of 0.468 and a weighted F1-score of 0.86. These results establish VecLSTM as an innovative and scalable solution for trajectory prediction and activity recognition tasks.

Poster #33: A Point-Based Algorithm for Distributional Reinforcement Learning in Partially Observable Domains
Authors: Larry D. Preuett
Abstract: In many real-world planning tasks, agents must tackle uncertainty about the environment's state and variability in the outcomes of any chosen policy. We address both forms of uncertainty as a first step toward safer algorithms in partially observable settings. Specifically, we extend Distributional Reinforcement Learning (DistRL)—which models the entire return distribution for fully observable domains—to Partially Observable Markov Decision Processes (POMDPs), allowing an agent to learn the distribution of returns for each conditional plan. Concretely, we introduce new distributional Bellman operators for partial observability and prove their convergence under the supremum p-Wasserstein metric. We also propose a finite representation of these return distributions via _-vectors, generalizing the classical _-vectors in POMDP solvers. Building on this, we develop Distributional Point-Based Value Iteration (DPBVI), which integrates _-vectors into a standard point-based backup procedure—bridging DistRL and POMDP planning. By tracking return distributions, DPBVI naturally enables risk-sensitive control in domains where rare, high-impact events must be carefully managed. We provide source code to foster further research in robust decision-making under partial observability.

Poster #34: A Markov Decision Process for Trauma Patient Resuscitation
Authors: Larry D. Preuett, Catherine Beni, Qian Qui, Blake Murphy, Grant O'Keefe, Ankur M. Teredesai
Abstract: Post-hemorrhage resuscitation strategies in the ICU vary widely, with limited consensus on optimal treatment. We hypothesize that machine learning can retrospectively derive effective resuscitation strategies to support clinical decision-making. We framed ICU resuscitation as a sequential decision-making problem and developed a Markov Decision Process (MDP) for treatment planning. Using Dueling Double Deep Q-Networks (D3QN) and batch reinforcement learning, we learned vasopressor and intravenous crystalloid (IVF) treatment policies from a cohort of 4,305 trauma patients admitted to a level I trauma center (2012–2019) with lactate ≥2 mmol/L at ICU admission. We compared the learned dosing policy to observed clinical practice using McNemar's test.
D3QN's learned strategy closely aligned with clinical practice but differed in drug administration. It recommended ≥250 ml IVF in 19% ± 12% of decisions versus 13% in observed practice ($p < 0.001$). It suggested norepinephrine in 4% ± 6% of cases versus 12% ± 1% in observed practice ($p < 0.001$) but increased vasopressin use (13% ± 12% vs. 4%, $p < 0.001$).
Our findings highlight key differences between AI-derived and observed strategies, suggesting reinforcement learning may help standardize ICU resuscitation protocols and reduce physician variability.

Poster #35: RAGE: RAG Enhanced LLM Explainer for Heterogeneous Graphs

Authors: Raghvi Baloni, Yihui Chong, Ankur Teredesai
Abstract: Generating accurate and interpretable explanations for predictions on heterogeneous graphs remains a significant challenge due to their multi-typed structures and complex relational dependencies. While Large Language Models (LLMs) have demonstrated strong performance in natural language tasks, their ability to provide grounded explanations for heterogeneous graphs is still underexplored. In this work, we introduce RAGE (Retrieval-Augmented Graph Explainer), a novel framework that enhances explanation quality by integrating Retrieval-Augmented Generation (RAG) with structured graph retrieval. RAGE retrieves subgraphs directly relevant to a given query, ensuring that explanations remain closely aligned with the dataset's inherent structure. We evaluate RAGE on two heterogeneous graph datasets, DBLP and Goodreads, across multiple LLMs. Through comprehensive experiments, we demonstrate that RAGE achieves comparable or superior predictive performance to metapath-based approach, while improving scalability. Furthermore, our qualitative evaluation highlights that RAGE produces more coherent and contextually accurate explanations, reducing the hallucination risks associated with indirect explanation approaches. By offering a directly interpretable alternative to metapath-based explanation, RAGE provides a compelling framework for enhancing LLM-based explanation over heterogeneous graphs.

Poster #36: MIRAGE: Medical Image Retrieval Augmented Generation for Enhanced Pneumonia Diagnosis
Authors: Nicole Guobadia, Jay Estacio, Grant O'Keefe, Juhua Hu
Abstract: Pneumonia is a common infection in one or both lungs and is caused by several things such as Flu vaccinations, exposure to certain kinds of animals, or even from person-to-person transmission. Pneumonia diagnosis is difficult, as its radiological presentation can closely resemble other chest abnormalities such as consolidation and lung opacities. A potential improvement for pneumonia diagnosis involves using large language models (LLMs) due to their reasoning capabilities. However, they often hallucinate, which limits their reliability in healthcare applications. Additionally, LLMs only use text as input, which is unrealistic as diagnosis rarely relies on text alone but also incorporates medical imaging data and comparative case analysis. Large vision-language models (LVLMs) offer an attractive solution: they can interpret visual and text data and use multiple images in a given query. To this end, we introduce MIRAGE (Medical Image Retrieval Augmented Generation), a novel approach that enhances LVLM performance in pneumonia prediction through image-based retrieval-augmented generation (RAG) to address these challenges. Experimental results demonstrate that MIRAGE achieves performance comparable to specialized fine-tuned Med-LVLMs. This work presents a promising direction for reducing radiologists' workload while preserving diagnostic accuracy.

Poster #37: Customized Multiple Clustering via Multi-Modal Subspace Proxy Learning
Authors: Jiawei Yao, Qi Qian, Juhua Hu
Abstract: Multiple clustering aims to discover various latent structures of data from different aspects. Deep multiple clustering methods have achieved remarkable performance by exploiting complex patterns and relationships in data. However, existing works struggle to flexibly adapt to diverse user-specific needs in data grouping, which may require manual understanding of each

clustering. To address these limitations, we introduce Multi-Sub, a novel end-to-end multiple clustering approach that incorporates a multi-modal subspace proxy learning framework in this work. Utilizing the synergistic capabilities of CLIP and GPT-4, Multi-Sub aligns textual prompts expressing user preferences with their corresponding visual representations. This is achieved by automatically generating proxy words from large language models that act as subspace bases, thus allowing for the customized representation of data in terms specific to the user's interests. Our method consistently outperforms existing baselines across a broad set of datasets in visual multiple clustering tasks.

Poster #38: Older Adults and Comfort in Sharing the Road Alongside Autonomous Vehicles: An Examination of Travel Stress, Labeling, and Dedicated Lanes

Authors: Panick Kalambay and Angela Kitali

Abstract: As we transition to the era of autonomous passenger vehicles (APVs) alongside the growth of the United States' aging population (+65 years), ensuring safe and convenient mobility for older adults becomes increasingly critical. This study examines the influence of travel stress, dedicated lanes, and labeling on older adults' comfort sharing roads with APVs and support for their widespread adoption. Data from a nationwide U.S. survey analyzed using Pearson's Chi-squared tests and mediation models with bootstrap sampling revealed key factors shaping older adults' perceptions and willingness to adopt APVs. Older adults who are women, have a high school education or less, or belong to middle- or lower-income groups report greater discomfort sharing the road alongside APVs and skepticism about their potential to reduce travel-related stress. Our analysis reveals several additional findings. Among them, reduced travel stress emerges as a key driver of APV support. Travel comfort is a critical mediator, reinforcing the association between lower stress and APV acceptance. Findings emphasize the importance of prioritizing stress-free mobility and travel comfort to build trust in APVs. Policymakers should carefully implement infrastructure strategies and conduct real-world trials to address older adults' concerns, fostering greater acceptance of autonomous transportation solutions.

Poster #39: Low-Temperature Alkaline Treatment of PFAS Precursors

Authors: Ansaf V. Karim (presenter), Faculty Advisors: Emese Hadnagy, Joel Baker, Industry Mentors: Brian Pinkard, Annie Heble, Conrad Austin

Abstract: The widespread presence of per- and poly-fluoroalkyl substances (PFAS) in aquatic environments is a growing environmental concern. Fluorotelomers, such as 6:2 fluorotelomer sulfonate (6:2 FTS), are significant PFAS precursors that can degrade into more stable and toxic compounds, contributing to their persistence in the wastewater treatment process and ultimately in receiving surface waters. Existing wastewater treatment technologies, such as biological processes, advanced oxidation, membrane filtration, adsorption, etc., are insufficient for complete defluorination. Hydrothermal Alkaline Treatment (HALT) has strong potential as an efficient destructive treatment approach for the complete mineralization of PFAS. The current study focuses on investigating a low-energy, chemical intensive HALT technology for the degradation of 6:2 FTS. This study hypothesizes that alkaline conditions facilitate nucleophilic substitution and decarboxylation reactions, promoting PFAS degradation under mild experimental conditions. Experiments were conducted in a high pressure/temperature Parr

reactor to optimize key operational parameters such as reaction temperature, reaction time and chemical dosage to obtain maximum degradation of 6:2 FTS. Experiments conducted at 250°C and 2M NaOH showed 97 ± 1.5% degradation of 6:2 FTS in 30 min, highlighting the outstanding effectiveness of this process. Further detailed studies are ongoing (results of which will be presented) to optimize operational parameters, identify degradation byproducts, and explain the underlying mechanism, striving for a more energy- and chemical-efficient PFAS destruction approach.

Poster #40: Identifying key drivers of habitability loss reveals pathways for climate change adaptation in the Pacific
Authors: Emily Nabong, Jeff Walters, Aaron Opdyke
Abstract: Pacific islands and atolls face heightened climate risk due to low elevations and limited resources. The question of (unin)habitability in these locations is often simplified to characteristics of hazard exposure, reinforcing assumptions of inevitable mass migration. Here we use a multi-dimensional conceptualisation of habitability, built from local knowledge, to simulate habitability trends in the Pacific Island nation of Kiribati over the coming century. We find that water insecurity will be a driving factor in habitability loss, intensifying under extreme climate scenarios, while population pressures will further constrain resources. We show that regional disparities will lead to high internal migration rates, with movement to national urban centres preferred over movement abroad. Our work answers calls for a holistic and locally grounded understanding of habitability. By identifying how drivers of habitability change over time, we offer insights for targeted and timely climate adaptation.

Poster #41: Bioinspired Design from Fish Armor: Mechanics, Hydrodynamics, and Engineering Applications
Authors: Cassandra M. Donatelli, Karly E. Cohen, Jonah W Armendariz, Inaya Kamal, James A Kimpel, Bryan Lemus, Ellen Pak, Cody T Peradotto, Megan L. Vandenberg
Abstract: Nature has long served as a blueprint for engineering, with biological structures offering innovative solutions to challenges in materials science, fluid dynamics, and robotics. Fish armor provides an ideal model for multifunctional systems that balance protection, flexibility, and hydrodynamic performance. From overlapping bony plates to intricate surface textures and self-healing properties, these systems inspire novel designs for drag-resistant surfaces, adaptive materials, and filtration technologies. In our lab, we use an interdisciplinary approach to study the mechanics and hydrodynamics of fish armor. By integrating CT-based reconstructions of biological structures with idealized parametric models, we analyze how structural arrangements influence mechanical performance and flow interactions. We use UTMs to test bioinspired, composite tiled surfaces to explore their potential for robotic and biomedical applications. We use particle image velocimetry (PIV) and computational fluid dynamics (CFD) simulations to investigate how armor-inspired structures influence hydrodynamics. By translating biological principles into engineered solutions, fish armor offers pathways for improving materials in aerospace, biomechanics, and soft robotics.

Poster #42: Assessment of end-of-life Design in Consumer Coffee Makers
Authors: Ryan Lindbom, Kara Nichols, Dennis Tanner, Seung-Jin Lee, and Heather E. Dillon

Abstract: In the United States, many small appliances and products are single use or un-repairable when a component fails. This leads to an increased frequency of new product purchasing and a high rate of waste production. To solve this, product design should shift to allow for easy repair, replacement, or reuse of failed components by the consumer. A research study was conducted to evaluate the sustainability and reuse potential of a pair of popular coffee makers. The coffee maker pair was disassembled and evaluated on nine parameters to quantify the product design for disassembly. The analysis indicated that the full disassembly of the pod coffee maker components would take approximately 97 minutes and require 8 tools. During the disassembly phase, the essential components of the coffee maker were discovered to be significantly interconnected making repair at home very difficult. The disassembly of a drip coffee maker was 21 minutes with lower levels of complexity in most parts. The difficulty of repairing these products supports the theory that sustainable design within modern products is rarely a priority. As sustainability and waste reduction becomes a higher priority in society, consumers should demand product designs with easy to repair, replace, or reuse components.

Poster #43: The Importance of “Place” in the Building and Establishment of a New Engineering Program

Authors: Mark Pagano and Michael Sullivan

Abstract: In today’s world, “place” is an ever-increasing element of almost every known culture and geographic region. We therefore believe that it should be a critically important factor in the building and establishment of any new engineering program. Place was definitely an important factor in 1989 when the State of Washington committed itself to establishing new regional higher education institutions in an effort to serve place-bound students and their surrounding communities. The University of Washington Tacoma (UWT) campus was quickly established by the local Tacoma community as a result of this state initiative in 1990 and thus, the campus carefully considered the importance of place again as it proposed, designed and implemented two new engineering programs including a new facility to house them over the course of the past six years. Tacoma has long been associated with the rise (and fall) of the timber industry in the Pacific Northwest as well as a turbulent relationship with the local Salish Tribes. A partnership was formed with the local Puyallup Tribe whose first people have been “educating” and “engineering” on essentially the exact location of UWT since time immemorial. The Tribe was instrumental in helping tell the story of “place” as we integrated it into the fabric of the building design so that all future students see it every day of their educational career. A second significant example of place is the focus on the history of the Tacoma Narrows Bridge on the walls outside the civil engineering (CE) Senior Capstone Design Lab on the third floor of the facility. UWT has the distinction of being the closest four-year program in the world to this famous CE landmark with it being located just six miles directly west of the campus. Both of these two historical exhibits along with the rich stories of what happened here are being integrated further into the curriculum of the new civil and mechanical engineering programs as they are rolled out. A new study abroad” program is also being developed and proposed around “Place” in partnership with faculty members from these two programs and UWT’s Office of Global Affairs. This abstract has been accepted by the American Society of Engineering Education (ASEE) for inclusion in its June 2025 Annual Conference in Montreal Canada. This poster will highlight the two exhibits and how they are being integrated into the Engineering

Curricula as well as the plans for the new study abroad program under development.

Poster #44: Time Series Analysis and Clustering for Cybersecurity
Authors: Hongtai Yang, Shiva Kumara, Raed Alashor, DC Grant, Greg Dalcher
Abstract: Cybersecurity anomaly detection remains a complex challenge due to the dynamic nature of security threats and the high-dimensional structure of log data. This research-driven project explores the application of time-series clustering techniques to detect anomalies, focusing on experimentation rather than predefined outcomes. This project is a joint effort between UW Tacoma MCL students and Greg Dalcher from CrowdStrike as advisor. D.C. grant is the UW faculty advisor for the students. Using Python and Scikit-learn, we will apply clustering algorithms such as K-Means, DBSCAN, and HDBSCAN to cybersecurity log data containing both temporal and categorical features. Through iterative testing and evaluation, we will analyze how different methods identify patterns and outliers. Cloud technologies such as AWS SageMaker may also be utilized to enhance scalability and computational efficiency.
Rather than optimizing for a single best solution, this project emphasizes exploration, highlighting the strengths, limitations, and trade-offs of various clustering techniques. The findings will be documented in a research report and summarized in a presentation, offering insights into the practical considerations of using time-series clustering for cybersecurity anomaly detection. By focusing on experimentation and analysis, this work aims to contribute to a deeper understanding of how clustering techniques can be leveraged in cybersecurity, providing valuable takeaways for researchers and industry professionals alike.

Poster #45: Small Business Data Breaches: How does poor data quality impact data governance?
Authors: Deveeshree Nayak, Andres Gamboa
Abstract: This research delves into the data breaches of small businesses, revealing the state of their data management practices. The study is guided by a crucial question: How does poor data quality impact data governance for small businesses with less than 200 employees? To answer this, we analyzed 50 data breach notifications in the healthcare, finance, insurance, and education sectors. The focus was on how organizations incorporate key data quality dimensions (accuracy, completeness, consistency, validity, timeliness, and uniqueness) into their incident response strategies. The study uncovers that most companies promptly investigate threats, accurately notify affected individuals, and offer credit monitoring or identity protection services. Some prioritize internal audits and employee training, while others nearly meet the minimum legal notification requirements. These findings underscore the pressing need for a more standardized system for data governance that transcends industry boundaries. Such standardized governance processes are crucial for our ability to respond to breaches and for bolstering public confidence in data handling by organizations. The aim is to spark a conversation on establishing standard data governance protocols that support practical, comprehensive, and ethical incident management, thereby safeguarding customer trust and organizational integrity.

Poster #46: Small Business Data Breaches: The Role of Data Quality Dimensions
Authors: Deveeshree Nayak, Kush Juneja

Abstract: Small businesses are more vulnerable to data breaches due to limited resources and knowledge in maintaining data quality. In this research, we analyzed 50 small businesses with less than 200 employees who faced data breaches to check if the data quality (DQ) dimensions of data management associations (DAMA), UK, impact their data breaches. Each business was assessed using DAMA's DQ dimensions—Accuracy, Timeliness, Completeness, Consistency, Uniqueness, and Validity—along with other security and privacy breaches, such as Unauthorized Disclosure and Falsification. The findings reveal key weaknesses, including delayed breach reporting, lack of access controls, and incomplete remediation efforts. Timeliness and Confidentiality violations were the most frequent, highlighting poor security frameworks and slow responses to breaches. This study provides insight into the challenges small businesses face in protecting sensitive data and complying with regulations.