

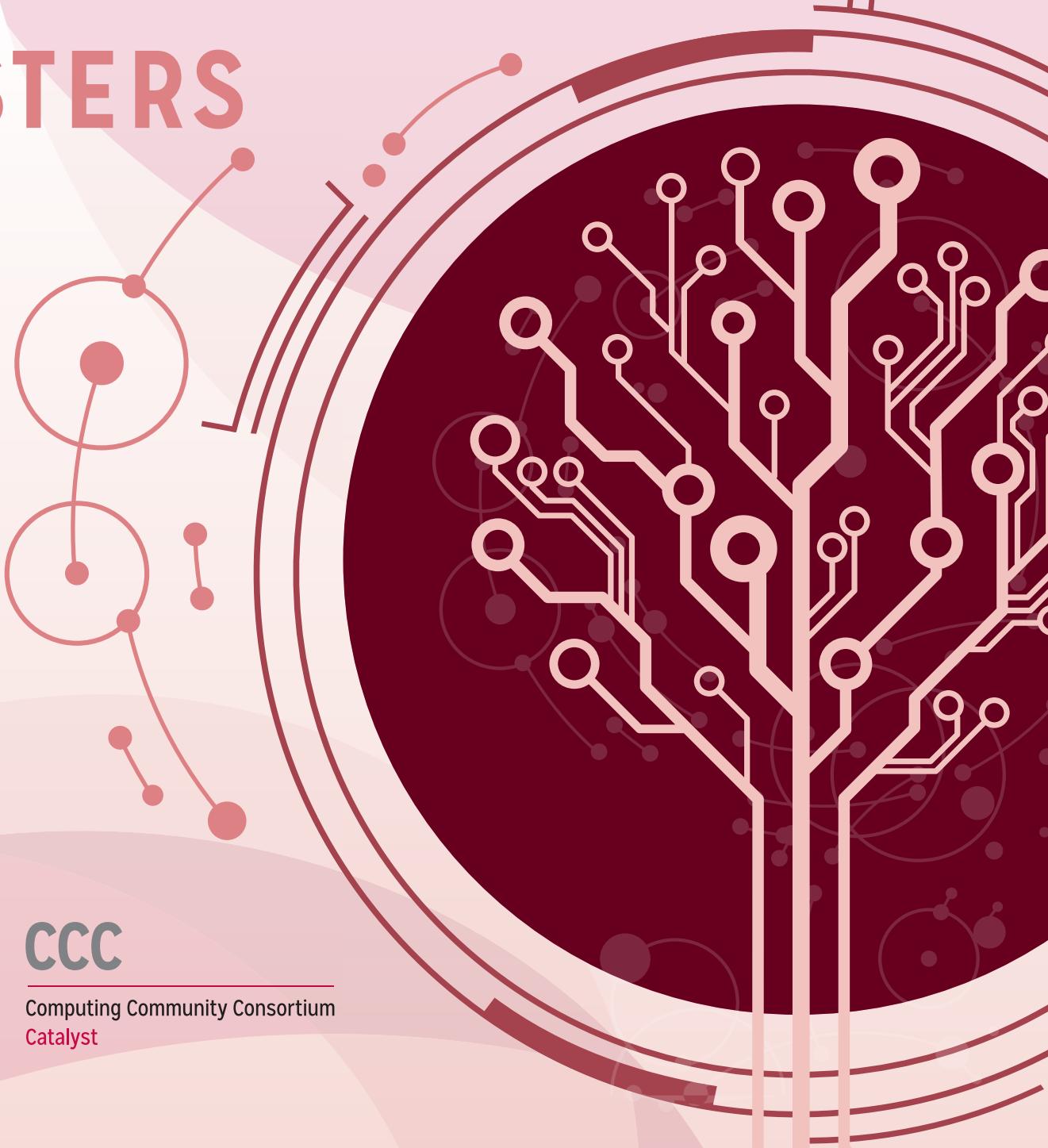
# POSTERS



**CCC**

Computing Community Consortium  
Catalyst

# Early Career **RESEARCHER** SYMPOSIUM



# POSTERS BEING PRESENTED

	NAME	AFFILIATION	POSTER TITLE
1	<b>Nigini A. Oliveira</b>	University of Washington	Promoting diversity in online collaboration
2	<b>Jae-wook Ahn</b>	IBM Research	Wizard's Apprentice: Cognitive Suggestion Support for Wizard-of-Oz Question Answering
3	<b>Bita Analui</b>	University of California Irvine	Analysis of Model Uncertainty and Inaccuracies in Power System Planning
4	<b>Matt Anderson</b>	Union College	Computer-Aided Search for Matrix Multiplication Algorithms
5	<b>Aruna Balasubramanian</b>	Stony Brook	NetSys at Stony Brook
6	<b>Andrea Barbarin</b>	IBM Watson Health	Cognitive Design for Health
7	<b>Roghayeh Barmaki</b>	Johns Hopkins University	Immersive Technologies for Medical Education
8	<b>Christine Bassem</b>	Wellesley College	Temporal Weighted Graphs; Routing, Reachability, and their Application to Mobile Crowd Sensing
9	<b>Matthew Berger</b>	Vanderbilt University	The Role of Machine Learning for Visualizing Data
10	<b>Cindy Bethel</b>	Mississippi State University	Human-Robot Interaction for Law Enforcement Applications
11	<b>Matthew Bietz</b>	University of California, Irvine	Pervasive Data Ethics for Computational Research
12	<b>Eleanor Birrell</b>	Pomona College	A Reactive Approach for Use-Based Privacy
13	<b>Yonatan Bisk</b>	University of Washington	From Language to Action: Understanding Abstraction
14	<b>Eduardo Blanco</b>	University of North Texas	Making Computers Understand Human Language
15	<b>Gedare Bloom</b>	Howard University	Resilient Cyber Infrastructure with Distributed Trust
16	<b>Lydia Chiton</b>	Columbia University	Creating Visual Blends with Crowds and Machines
17	<b>Omar Chowdhury</b>	The University of Iowa	LTEInspector: A Systematic Approach for Adversarial Testing of 4G LTE

	<b>NAME</b>	<b>AFFILIATION</b>	<b>POSTER TITLE</b>
18	<b>Sauvik Das</b>	Georgia Institute of Technology	Social Cybersecurity: Reshaping Security Through An Empirical Understanding of Human Social Behavior
19	<b>Lorenzo De Carli</b>	Worcester Polytechnic Institute	Automatic Inference of Malware Protocol Specifications
20	<b>Tawanna Dillahunt</b>	University of Michigan	Designing for Employability: Envisioning Tools for Low-resource Job Seekers
21	<b>Kenneth Fletcher</b>	University of Massachusetts Boston	Collaborative Learning using LSTM-RNN for Personalized Recommendation
22	<b>Pedro Fonseca</b>	University of Washington	MultiNyx: A Multi-level Abstraction Framework for Systematic Analysis of Hypervisors
23	<b>Davide Fossati</b>	Emory University	Peer Evaluations: Data Driven Learning of Debugging Skills
24	<b>Deepak Gangadharan</b>	University of Pennsylvania	Bandwidth Optimal Data/Service Delivery to Connected Vehicles via Edges
25	<b>Vivian Genaro Motti</b>	George Mason University	Assisting Students with Intellectual Disabilities in Inclusive Education with a Smartwatch Application
26	<b>Michael Hay</b>	Colgate University	Towards Systems for Data Science with Formal Privacy Guarantees
27	<b>Jeffrey Hemmes</b>	Regis University	Trust Models for Heterogeneity in the Internet of Things
28	<b>Ehsan Hoque</b>	University of Rochester	Building up Speaking Skills in an online learning community: a network-analytics exploration
29	<b>Faraz Hussain</b>	Clarkson University	Parameter Synthesis in Probabilistic Models using Statistical Model Checking
30	<b>Sarah Iribarren</b>	University of Washington	What do patients and experts want in a smartphone-based application to support tuberculosis treatment completion in Argentina?
31	<b>Eakta Jain</b>	University of Florida	Empathetic AI: Assessing Users' Engagement by Looking at their Eyes
32	<b>Yangfeng Ji</b>	University of Virginia	Neural Text Generation in Stories Using Entity Representations as Context
33	<b>Samantha Kleinberg</b>	Stevens Institute of Technology	Causal Inference from Complex and Uncertain Data to Improve Human Health

	NAME	AFFILIATION	POSTER TITLE
34	<b>Olivera Kotevska</b>	National Institute of Standards and Technology	AI and statistical based analysis of IoT network traffic
35	<b>Aron Laszka</b>	University of Houston	SolidWorx: A Resilient and Trustworthy Transactive Platform for Smart and Connected Communities
36	<b>Amanda Lazar</b>	University of Maryland, College Park	The Role of Technology in Understanding Perspectives on Aging and Health
37	<b>Damon McCoy</b>	New York University	Evidence-based Security
38	<b>Nathan McNeese</b>	Clemson University	Current and Future Trajectories of Team Cognition and Technology
39	<b>Andrew Miller</b>	Indiana University: IUPUI	Health Coordination and Social Support Technologies for Youth
40	<b>Antonina Mitrofanova</b>	Rutgers, The State University of New Jersey	Integrative (epi) genomic analysis to predict response to androgen-deprivation therapy in prostate cancer
41	<b>Jamie Morgenstern</b>	Georgia Institute of Technology	Directions in Fairness in the face of limited data
42	<b>Hein Nguyen</b>	University of Houston	Fast Capsule Networks for Lung Cancer Screening
43	<b>Ifeoma Nwogu</b>	Rochester Institute of Technology	Computational Social Dynamics: Analyzing the Face-level Interactions in a Group
44	<b>Joseph Osborn</b>	Pomona College	Artificial Intelligence in the Software Development Process
45	<b>Andrea Parker</b>	Northeastern University	Community Wellness Informatics
46	<b>Masood Parvania</b>	University of Utah	Coordinate Operation of Interdependent Infrastructure in Smart Cities
47	<b>Richard Phillips</b>	Cornell University	Applying Interpretability Methods for Accountable Data Pipelines
48	<b>Jorge Poco</b>	San Pablo Catholic University	Towards Automatic Chart Interpretation
49	<b>Lev Reyzin</b>	University of Illinois Chicago	Sublinear-Time Adaptive Data Analysis
50	<b>Jack Sampson</b>	Penn State	Nonvolatile Processors
51	<b>Catherine Schuman</b>	Oak Ridge National Laboratory	Neuromorphic Computing: Where Machine Learning Meets Hardware

	<b>NAME</b>	<b>AFFILIATION</b>	<b>POSTER TITLE</b>
52	<b>Roy Schwartz</b>	University of Washington Seattle and Allen Institute for Artificial Intelligence	Teaching Machine how to Read
53	<b>Linda Sellie</b>	NYU Tandon School of Engineering	Observations on Empowering Students
54	<b>Bijan Seyednasrollah</b>	Harvard University / Northern Arizona University	Tackling challenges of extracting time-series data from digital repeat photography
55	<b>Wei (Wilbur) Shi</b>	Princeton University	Decentralized Optimization over Networks with Geometric Convergence
56	<b>Igor Steinmacher</b>	Northern Arizona University	Supporting the Next Generation of Software Engineers
57	<b>Chenhao Tan</b>	University of Colorado Boulder	Friendships, Rivalries, and Trysts: Characterizing Relations between Ideas in Texts
58	<b>Wesley Tansey</b>	Columbia University	Interpreting deep neural networks with false discovery rate control
59	<b>Cui Tao</b>	University of Texas Health Science Center at Houston	Biomedical Data &Knowledge Management
60	<b>Mohit Tiwari</b>	University of Texas at Austin	Abstractions for a Security-plane for Computer Systems
61	<b>Hanghang Tong</b>	Arizona State University	Network Science of Teams: Characterization, Prediction, and Optimization
62	<b>Tammy Toscos</b>	Parkview Health	"Give Me More Consumer Health Technology": A Multi-Platform Intervention to Support Medication Adherence
63	<b>David Van Horn</b>	University of Maryland	
64	<b>Lei Wang</b>	Union College	Improves localization accuracy and robustness: ARPAP and UMTS
65	<b>Tim Weninger</b>	University of Notre Dame	A Formal Language Theory for Graphs
66	<b>Lauren Wilcox</b>	Georgia Institute of Technology	Promoting Engagement with Personal Health through Interactive Technology
67	<b>Pamela Wisniewski</b>	University of Central Florida	Safety by Design: Sociotechnical Interventions for Adolescent Online Safety
68	<b>Lirong Xia</b>	Rensselaer Polytechnic Institute	Improving Group Decision-Making by Artificial Intelligence

	NAME	AFFILIATION	POSTER TITLE
69	<b>Da Yan</b>	The University of Alabama at Birmingham	T-thinker: A Task-Centric Framework to Revolutionize Big Data Systems Research
70	<b>Yezhou Yang</b>	Active Perception Group, Arizona State University	Visual Recognition with Knowledge: From an Active Agent's Perspective
71	<b>Lana Yarosh</b>	University of Minnesota	Technology for Empowering Social Connections in Critical Contexts
72	<b>Fateme Yousefi</b>	Arizona State University	Spatiotemporal multidimensional modeling of land and ocean interactions at large scales
73	<b>Yunpeng Zhang</b>	University of Houston	Interactive Based Access Control Framework for Connected Vehicle Communication

# POSTER DESCRIPTIONS

**NIGINI A. OLIVEIRA** • University of Washington

## Promoting diversity in online collaboration

Many communities use online environments to achieve their goals. Two examples are Wikipedia editors and Stack Overflow participants who generate valuable content for all Web users. Still, we have identified a lack of diversity among contributors of Stack Overflow and other Question & Answer sites that can risk content quality and community health. My research studies collaboration settings and its stakeholders' cultural background to design environments that can leverage participation equity.

**JAE-WOOK AHN** • IBM Research

## Wizard's Apprentice: Cognitive Suggestion Support for Wizard-of-Oz Question Answering

Recent advances in artificial intelligence and natural language processing greatly enhance the capabilities of intelligent tutoring systems. However, gathering a subject-appropriate corpus of training data remains challenging. In order to address this issue, we present a system based on a hybrid Wizard-of-Oz technique, which enables cognitive systems to work in tandem with a human operator (the "wizard"), to enhance collection of dialog variants.

**BITA ANALUI** • University of California Irvine

## Analysis of Model Uncertainty and Inaccuracies in Power System Planning

Planning the operations of power system introduces a number of optimization problems that need to be solved in different time resolutions, under various sources of uncertainty (e.g., natural stochastic processes, price processes, demands) and also sequentially. In addition, uncertainty is not only in the parameters, but also in probability models. Also indicating that, in presence of parameter uncertainty, approximation algorithms results in loss of information.

**MATT ANDERSON** • Union College

## Computer-Aided Search for Matrix Multiplication Algorithms

Cohn and Umans proposed a framework for developing matrix multiplication algorithms that could surpass the  $O(n^{2.375})$  run time of Coppersmith and Winograd's algorithm. The Cohn et al showed that the existence of sufficiently large algebraic structures, called strong uniquely-solvable puzzles, imply faster algorithms for matrix multiplication. We design and implement a number of greedy, dynamic programming, satisfiability, integer programming, 3D matching, search, and parallel algorithms that attempt to construct large strong uniquely-solvable puzzles that imply faster matrix multiplication algorithms.

**ARUNA BALASUBRAMANIAN** • Stony Brook

## NetSys at Stony Brook

Research work done by the NetSys lab at Stony Brook.

**ANDREA BARBARIN • IBM Watson Health**

**Cognitive Design for Health**

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As a Design Research Lead at IBM Watson Health, I use mixed methods (i.e., collect and analyze qualitative and quantitative data) to understand how information technology incorporating AI can support health care providers as they work with patients and caregivers to manage chronic illness. My research interests span human-computer interaction, computer-supported cooperative work, and behavior change. I am currently working on how to leverage social determinants of health (SDOH) data for use in a clinical decision support system.

**ROGHAYEH BARMAKI • Johns Hopkins University**

**Immersive Technologies for Medical Education**

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In this project, a paradigm-shifting anatomy learning system based on screen-based augmented reality techniques (REFLECT or Magic Mirror) is proposed and validated with a large-scale study among premedical students ( $n=288$ ) at Johns Hopkins University. The results indicated that using REFLECT enhanced students' engagement, and knowledge retention in the human anatomy with elevated performance in evaluation tests, high level of engagement and increased time to focus on the painting task.

**CHRISTINE BASSEM • Wellesley College**

**Temporal Weighted Graphs; Routing, Reachability, and their Application to Mobile Crowd Sensing**

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With the emergence of mobile crowd sensing platforms, a different model of temporal graphs needs to be considered, namely temporal weighted graphs, in which node scores evolve over time. In this work, the model of temporal weighted graphs is defined and formalized, associated with its corresponding routing algorithms and centrality metrics, and their role in optimizing task allocation in mobile crowd sensing platforms.

**MATTHEW BERGER • Vanderbilt University**

**The Role of Machine Learning for Visualizing Data**

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My research is centered on using machine learning to enhance visualization techniques, in order to help people make sense of data. In particular, I focus on how to build machine learning models when visual exploration is the primary downstream task. I will show examples of how to leverage learning models for improving visual encodings and user interactions across a diverse set of domains.

**CINDY BETHEL • Mississippi State University**

**Human-Robot Interaction for Law Enforcement Applications**

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This poster outlines three primary research project that I have been focused on that are related to different uses of robots for law enforcement applications. The first project is Therabot - A Robot Therapeutic Support System. Therabot, designed as a stuffed robotic dog, has been developed as an assistive robot to provide therapeutic support at home and in the counseling setting. The second project involves the use of robots for gathering sensitive information from children related to eyewitness memory and bullying victimization. The third project is the use of robots integrated with tactical teams to improve performance, scene understanding, and situation awareness for better decisions and safety of officers and civilians.

**MATTHEW BIETZ • University of California, Irvine**

**Pervasive Data Ethics for Computational Research**

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Networked information technologies, such as the internet of things, wearable devices, ubiquitous sensing, and social sharing platforms increase the flow of rich, but often personal, information available for computing research. The growth in the scale, scope, speed, and depth of human data research requires reconsideration of ethical assumptions. This poster introduces PERVADE, an NSF-funded multi-institution project conducting empirical research on Pervasive Data Ethics.

**ELEANOR BIRRELL** • Pomona College  
**A Reactive Approach for Use-Based Privacy**

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Use-based privacy posits that privacy can be provided by preventing harmful uses of sensitive information, an attractive approach to enhancing privacy in networked information systems. This poster explores the feasibility of expressing and enforcing use-based privacy. We identify key properties of any use-based policy language and describe the Avenance language. We also explore how Intel's SGX might be used as a root of trust for enforcing use-based privacy in networked information systems.

**YONATAN BISK** • University of Washington  
**From Language to Action: Understanding Abstraction**

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Natural Language is abstract and assumes a rich model of the listener. When giving instructions or asking for help, we assume the person we are talking to understands and can navigate the world. These assumptions do not hold for robotic systems. What information is missing to bridge this gap and how do we encode this knowledge into our AI systems?

**EDUARDO BLANCO** • University of North Texas  
**Making Computers Understand Human Language**

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I am interested in building computational models to make computers understand human language. My research targets implicit meanings that are intuitive to humans when interpreting language, and incorporates temporal inference and uncertainty to create semantic representations. More specifically, my work targets nuances in meaning such as intentions, implications and other forms of implicit meaning. In this poster, I will present two ongoing projects in my lab: revealing positive interpretations from negation and extracting spatial timelines.

**GEDARE BLOOM** • Howard University  
**Resilient Cyber Infrastructure with Distributed Trust**

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Increasing reliance on distributed sensing, sensor fusion, aggregation, and analytics throughout the computing and information technology landscape introduces problems with data trustworthiness and the resilience of data processing. This poster describes methods and frameworks for increasing trust and resilience in cyber infrastructure.

**LYDIA CHITON** • Columbia University  
**Creating Visual Blends with Crowds and Machines**

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Visual Blends are a communication technique in journalism, ads and PSAs. We show that this difficult and creative task can be decomposed and distributed to both crowds of people and machines to collaboratively create images to communicate important messages.

**OMAR CHOWDHURY • The University of Iowa**

**LTEInspector: A Systematic Approach for Adversarial Testing of 4G LTE**

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In this poster, we present our findings of analyzing the security and privacy of the three critical procedures of the 4G LTE protocol (i.e., attach, detach, and paging). Our findings include potential design flaws of the protocol and unsafe practices employed by the stakeholders. For exposing vulnerabilities, we propose a model-based testing approach, dubbed LTEInspector, which lazily combines a symbolic model checker and a cryptographic protocol verifier. Using LTEInspector, we have uncovered 10 new attacks along with 9 prior attacks, categorized into three abstract classes (i.e., security, user privacy, and disruption of service), in the three procedures of 4G LTE. Notable among our findings is the authentication relay attack that enables an adversary to spoof the location of a legitimate user to the core network without possessing appropriate credentials. To ensure that the exposed attacks pose real threats and are indeed realizable in practice, we have validated 8 of the 10 new attacks and their accompanying adversarial assumptions through experimentation in a real testbed.

**SAUVIK DAS • Georgia Institute of Technology**

**Social Cybersecurity: Reshaping Security Through An Empirical Understanding of Human Social Behavior**

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In my poster, I discuss three quantitative papers that empirically illustrate how social influence is pivotal in affecting end-user security and privacy behaviors.

**LORENZO DE CARLI • Worcester Polytechnic Institute**

**Automatic Inference of Malware Protocol Specifications**

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Devising a successful detector for a given malware family requires painstaking reverse-engineering of malware binaries and communications. The rate at which new malware families are released makes it unfeasible to perform this analysis manually. My work proposes a novel protocol inference algorithm which automatically generates (i) a formal specification of the application-level protocol used by malware, and (ii) detection procedures which can identify the protocol within network traffic.

**TAWANNA DILLAHUNT • University of Michigan**

**Designing for Employability: Envisioning Tools for Low-resource Job Seekers**

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Today's Information and Communication Technologies (ICTs) are designed to address one of society's most pressing problems--unemployment. These technologies support job seekers' ability to search for jobs, create resumes, highlight skills, and share employment opportunities. However, the benefits of employment tools and technologies are unequally distributed and provide limited advantages for certain populations in our society. Like other valuable resources, ICTs have done little to support individuals with limited knowledge, skills, or experience to leverage them. Without an understanding of how people from low-resource settings use ICTs for job seeking, the same employment inequalities that occur offline will be repeated in online contexts. This poster reveals the results of several studies that investigate how ICTs could lead to employment, particularly among job seekers with limited digital skills, education, and income.

**KENNETH FLETCHER • University of Massachusetts Boston**

**Collaborative Learning using LSTM-RNN for Personalized Recommendation**

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Today, the ability to track users' sequence of online activities, makes identifying their evolving preferences for recommendation practicable. Despite the availability of such information, most existing time-based recommender systems focus on predicting some user rating. This work considers the rich, user activity sequence, and combine the concept of collaborative filtering with long short-term recurrent neural network (LSTM-RNN), to make personalized recommendations. Specifically, the encoder-decoder LSTM-RNN is employed to make sequence-to-sequence recommendations.

**PEDRO FONSECA** • University of Washington

**MultiNyx: A Multi-level Abstraction Framework for Systematic Analysis of Hypervisors**

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MultiNyx is a new framework designed to systematically analyze modern virtual machine monitors (VMMs), which rely on complex processor extensions to enhance their efficiency. Our experiments demonstrate that MultiNyx is practical and effective at analyzing VMMs. By applying MultiNyx to KVM, we automatically generated 206,628 test cases, which revealed critical inconsistencies with security implications.

**DAVIDE FOSSATI** • Emory University

**Peer Evaluations: Data Driven Learning of Debugging Skills**

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Detecting and correcting errors in computer code, also known as debugging, is a fundamental skill for computer programmers. However, explicit and deliberate teaching of this skill is often overlooked in introductory programming courses. Peer Evaluations is an activity designed to help students practice their debugging skills by exposing them to hundreds of faulty programs written by their peers. This activity was implemented in a large introductory programming course with promising results.

**DEEPAK GANGADHARAN** • University of Pennsylvania

**Bandwidth Optimal Data/Service Delivery to Connected Vehicles via Edges**

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The poster presents an optimization framework for bandwidth optimal delivery of data/service to connected vehicles via edge devices.

**VIVIAN GENARO MOTTI** • George Mason University

**Assisting Students with Intellectual Disabilities in Inclusive Education with a Smartwatch Application**

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Smartwatches have a large potential to assist students with disabilities in their everyday activities. However, their potential as assistive technologies in inclusive academic environments is unclear. To investigate how smartwatches can support students with intellectual and developmental disabilities (IDDs) to perform activities that require emotional and behavioral skills and involve communication, collaboration and planning, we implemented WELI. WELI (Wearable Life) is a wearable application designed to assist young adults with IDDs attending a postsecondary education program. Through a user-centric design process, this project investigates how smartwatches can effectively assist students with IDDs in special education. The results reported are drawn from 8 user studies with 58 participants in total. WELI features include behavioral intervention, mood regulation, reminders, checklists, surveys and rewards. Results indicate that several considerations must be taken into account when designing for students with IDDs. Overall, the study participants were enthusiastic with an innovative smartwatch application to be used in class, and reacted positively about the technology and features provided.

**MICHAEL HAY** • Colgate University

**Towards Systems for Data Science with Formal Privacy Guarantees**

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There are many settings where there is a desire to disseminate sensitive data as long as privacy is protected. Differential privacy (DP) has emerged as an important standard for privacy-preserving computation, offering rigorous protection while still enabling accurate data analysis. However, deploying DP currently requires a team of privacy experts. This poster describes barriers to real-world deployment and new systems that will make it easier for non-experts to use and deploy DP technology.

**JEFFREY HEMMES** • Regis University

**Trust Models for Heterogeneity in the Internet of Things**

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The massively heterogeneous nature of the Internet of Things (IoT) poses unique and significant security challenges. Devices can join different network enclaves or from multiple access points, and can have varying capabilities in terms of computing power. Although these characteristics allow for great opportunities in terms of functionality, designing an effective security architecture for such systems is quite difficult. Any node could send malicious information and cause disruption in the overall system, with real-world consequences. In this work, the use of trust models for a heterogeneous collection of IoT devices is explored and evaluated. Such trust models could be incorporated into the design of IoT middleware or a gateway security policy, and are based on both the capabilities of connected devices as well as their demonstrated behavior.

**EHSAN HOQUE** • University of Rochester

**Building up Speaking Skills in an online learning community: a network-analytics exploration**

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We present an evidence for gradual buildup of speaking skills in a small-group. We ask (i) whether the participants' ratings are affected by their peers, and (ii) whether there is any gradual buildup of speaking skills in the communities towards homogeneity. We study the performance ratings of the participants as graph signals atop underlying interaction topologies. We anticipate peer-influenced skill development mechanisms and help design interventions in small-groups to maximize peer-effects.

**FARAZ HUSSAIN** • Clarkson University

**Parameter Synthesis in Probabilistic Models using Statistical Model Checking**

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We describe a new algorithmic technique for automatically synthesizing parameters in stochastic models that uses statistical hypothesis testing, mathematical optimization, and probabilistic model checking to explore a model's parameter space by continually checking if its instantiations at different parameter points meet user-defined properties. We discuss an application of this technique by synthesizing parameters in a complex physiological agent-based model of acute inflammation.

**SARAH IRIBARREN** • University of Washington

**What do patients and experts want in a smartphone-based application to support tuberculosis treatment completion in Argentina?**

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A mobile phone application to support individuals receiving treatment for active tuberculosis (TB) by self-administration is being developed with TB experts and patients in active TB treatment using agile development methods to meet the needs of endusers.

**EAKTA JAIN** • University of Florida

**Empathetic AI: Assessing Users' Engagement by Looking at their Eyes**

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How do we build AI that understand what their user is feeling and react empathetically? Researchers are studying a variety of techniques to understand a user's motivational/emotional state: ubiquitous sensors, behavioral measurements, physiological sensors, etc. Multi-modal sensing is indeed quite good at predicting emotional state/valence-arousal. However, it is burdensome for a user to wear a multitude of sensors. My research leverages eye-tracking to understand a user's attention and engagement.

**YANGFENG JI** • University of Virginia

**Neural Text Generation in Stories Using Entity Representations as Context**

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We introduce an approach to neural text generation that explicitly represents entities mentioned in the text. Entity representations are vectors that are updated as the text proceeds; they are designed specifically for narrative text like fiction or news stories. Our experiments demonstrate that modeling entities offers a benefit in two automatic evaluations: mention generation (in which a model chooses which entity to mention next and which words to use in the mention) and selection between a correct next sentence and a distractor from later in the same story. We also conduct a human evaluation on automatically generated text in story contexts; this study supports our emphasis on entities and suggests directions for further research.

**SAMANTHA KLEINBERG** • Stevens Institute of Technology

**Causal Inference from Complex and Uncertain Data to Improve Human Health**

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Massive amounts of medical data such as from electronic health records and body-worn sensors are being collected and mined by researchers, but translating findings into actionable knowledge remains difficult. The first challenge is finding causes, rather than correlations, when the data are highly noisy and often missing. The second is using these to explain specific cases, such as why an individual's blood glucose is raised. We develop new methods for both causal inference and explanation from complex and uncertain data, and show how they can be used to make better decisions and provide individualized feedback.

**OLIVERA KOTEVSKA** • National Institute of Standards and Technology

**AI and statistical based analysis of IoT network traffic**

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IoT (Internet of Things) products are loaded with possibilities to make our lives easier and more convenient. However, the benefits the IoT products bring may be overshadowed by their security flaws and potential malicious misuse in carrying out massive distributed denial of service (DDoS) attacks against our critical infrastructure. The series of DDoS attacks against Dyn LLC in fall of 2016 - the first incidents that revealed the catastrophic effect of such cascading events - was the largest of this kind in history, with attack strength of 1.2Tbps, that brought down sites like Twitter, the Guardian, Netflix, Reddit, CNN and many others in Europe and the US. About 100,000 IoT devices (Internet-connected IP cameras) compromised by Mirai and Mirai-variants malware was involved in these DDoS attacks against Dyn's servers that control much of the internet's Domain Name System (DNS) infrastructure. As one of the feasible endeavors to prevent or mitigate such cyber attacks, we investigate characteristic IoT devices on the network level and measuring their behavior. This poster presents the established IoT lab for collecting network traffic data, which includes mobile phones and tablets with different platforms, virtual assistants such as Google Home, Alexa, and Google Voice based on Raspberry Pi, and TJBots that use IBM Watson to simulate human interaction with devices. The main focus is on the preliminary research of understanding the characteristics of network traffic flow generated by the target IoT devices, differentiating primitive IoT devices from other devices using various artificial and statistical approaches such as machine-learning, graphlets decomposition, and similarity pattern matching.

**ARON LASZKA** • University of Houston

**SolidWorx: A Resilient and Trustworthy Transactive Platform for Smart and Connected Communities**

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Recent technological advancements are fueling the development of innovative applications for Smart and Connected Communities (SCC). These applications often provide participants with the capability to exchange resources, which raises the need for fair and efficient resource allocation. However, since stakeholders may have limited trust in each other, collaboratively reaching consensus on allocations becomes problematic. We present SolidWorx, a blockchain-based platform that provides key mechanisms for arbitrating resource exchange in a domain-agnostic manner.

**AMANDA LAZAR** • University of Maryland, College Park

**The Role of Technology in Understanding Perspectives on Aging and Health**

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Human-Computer Interaction researchers and designers are moving away from a view of aging that focuses exclusively on physical changes in the body and brain. Instead, aging is increasingly seen as a process that is affected by a diverse array of factors, including one's life history, environment, relationships, and resources. I describe my research that examines how the material, social, and societal context can be taken into account when designing technologies with and for older people and people with dementia. I argue for a view of aging that takes into account the ways that technologies position older individuals and, in turn, the way that this view can inform the design of new technologies to enrich the experience of growing older.

**DAMON MCCOY** • New York University

**Evidence-based Security**

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Traditionally, engineers have focused on improving the security and privacy of systems by mitigating unintended design or implementation vulnerabilities. However, history has shown us that attempting to solve security issues with purely technical approaches often results in adversarial arms-races where the defender is reactive. This approach to security also misses a fundamental insight: we care about security only because adversaries are motivated to attack us and that these attacks cause actual harm. These insights have motivated my work to study security and privacy using both engineering and empirically-based experimental science approaches. Using these approaches my studies have illuminated the economic, sociological, and technical ecosystem and harms of large-scale security and privacy issues. The core tenant of this evidence-based security and privacy field is that more effective mitigations can be identified when security and privacy problems are studied using rigorous experimental methodologies. My work has contributed to fundamental methodologies and helped to broaden the field of evidence-based security and privacy by investigating issues that disproportionately harm vulnerable people such as domestic violence, harassment, and human trafficking.

**NATHAN MCNEESE** • Clemson University

**Current and Future Trajectories of Team Cognition and Technology**

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Team cognition is a long studied aspect of teamwork, often being recognized as one of the most important and influential concepts impacting team performance. Although team cognition is widely studied, there is a lack of literature that considers the role of technology in relation to team cognition. Specifically, there is a lack of work focused on team cognition in: 1) human-machine teams and artificial intelligence, 2) collaborative technology design and development, and 3) the healthcare domain. This poster highlights my research group's work to better understand the relationship between team cognition and technology. We will outline multiple research initiatives.

**ANDREW MILLER** • Indiana University: IUPUI

**Health Coordination and Social Support Technologies for Youth**

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I study how social computing technology can empower young people and their families to help each other with their health and wellness. Through qualitative observational and interview research, I examine the current and potential role for patient-centered collaborative health technologies for families and youth. I then co-design prototypes with youth, families, and clinicians. In this poster, I highlight recent and ongoing research engagements in hospitals, primary care clinics, and schools.

**ANTONINA MITROFANOVA** • Rutgers, The State University of New Jersey

**Integrative (epi) genomic analysis to predict response to androgen-deprivation therapy in prostate cancer**

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Therapeutic resistance is an emerging clinical problem, with detrimental implications in oncology. Here, we propose a computational approach that integrates genomic and epigenomic data to prioritize patients at risk of treatment resistance. We have integrated DNA methylation and mRNA expression patient profiles, which defined a comprehensive panel of markers of therapeutic response. We have demonstrated that this panel predicts patients with predisposition to resistance and those

who would benefit from the therapy. Even though driven by a critical need to investigate resistance to androgen-deprivation therapy in prostate cancer, our approach is applicable to a wide range of therapeutic regimens.

**JAMIE MORGNSTERN** • Georgia Institute of Technology

**Directions in Fairness in the face of limited data**

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This poster outlines some of the holes in current work on fairness in machine learning stemming primarily from limited amounts of training data. Many of the contexts in which ML researchers work have less data than would be necessary to employ the interventions suggested in prior work on fairness in ML. We propose several new definitions and techniques for achieving fairness in a data-scarce setting.

**HEIN NGUYEN** • University of Houston

**Fast Capsule Networks for Lung Cancer Screening**

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Lung cancer is the leading cause of cancer-related deaths in the past several years. A major challenge in lung cancer screening is the detection of lung nodules from computed tomography (CT) scans. State-of-the-art approaches in automated lung nodule classification use deep convolutional neural networks (CNNs). However, these networks require a large number of training samples to generalize well. This paper investigates the use of capsule networks (CapsNets) as an alternative to CNNs. We show that CapsNets significantly outperforms CNNs when the number of training samples is small. To increase the computational efficiency, our paper proposes a consistent dynamic routing mechanism that results in 3 times speedup of CapsNet. Finally, we show that the original image reconstruction method of CapNets performs poorly on lung nodule data. We propose an efficient alternative, called convolutional decoder, that yields lower reconstruction error and higher classification accuracy.

**IFEOMA NWOGU** • Rochester Institute of Technology

**Computational Social Dynamics: Analyzing the Face-level Interactions in a Group**

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We present a model to measure interactional synchrony (IS) based on facial action units. IS refers to how the speech or behavior of people in a conversation becomes more synchronized, and they can appear almost to mimic one another. The model is composed of intermediary long short-term memory networks, useful for learning the extent of IS between two or more dynamic signals. On a real-life dataset the model successfully estimated the extent of IS, with an overall prediction mean of 2.96% error, as compared to 26.1% random permutations serving as the control baseline.

**JOSEPH OSBORN** • Pomona College

**Artificial Intelligence in the Software Development Process**

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My work explores roles AI can play in the videogame development process: e.g., visualizing the possibility space of play, verifying that game levels can be beaten, and understanding interactive software in ways legible to humans. As an example, I show how leveraging connections between action games and cyber-physical systems can lead to new insights for hybrid systems identification, general game playing, modeling languages and verification, and interactive software development workflows.

**ANDREA PARKER** • Northeastern University

**Community Wellness Informatics**

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The Wellness Technology lab examines how novel software tools can empower communities to overcome barriers to wellness. We build and evaluate software that helps families learn from personal health data, systems that help people to advocate for and enact change that makes wellness more achievable in their neighborhoods, and tools that help people overcome wellness barriers faced in particular life stages, such as caring for a sick loved one.

**MASOOD PARVANIA** • University of Utah

**Coordinate Operation of Interdependent Infrastructure in Smart Cities**

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Critical power, water and transportation infrastructure have been traditionally designed and operated as independent infrastructures. However, proliferation of distributed power and water technologies, along with the electrification of transportation systems, is increasing the interdependency and exposing the inefficiencies of current uncoordinated operation practices of these infrastructure. This poster will present a novel approach for coordinated operation of power, water and electrified transportation infrastructure.

**RICHARD PHILLIPS** • Cornell University

**Applying Interpretability Methods for Accountable Data Pipelines**

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Much of the work left to be done in model interpretability involves finding ways to provide actionable explanations for existing data pipelines. This poster explores ways recent work has attempted to use model interpretability and accountability techniques towards real-world data pipelines. This includes applying interpretability techniques towards active learning strategies in an exploratory chemistry pipeline and interpretability and algorithmic fairness techniques on recidivism data.

**JORGE POCO** • San Pablo Catholic University

**Towards Automatic Chart Interpretation**

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We investigate how to automatically recover visual encodings from a chart image. Given a bitmap image as input, we return a visual encoding specification as output. We evaluate our techniques on three chart corpora and demonstrate accurate automatic inference across a variety of chart types. In addition, we present three applications of our method: automatic recoloring to improve perceptual effectiveness, map reprojection, and interactive overlays to enable improved reading of static visualizations.

**LEV REYZIN** • University of Illinois Chicago

**Sublinear-Time Adaptive Data Analysis**

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The topic of this talk lies in the area of adaptive data analysis, where the goal is to design mechanisms that can give statistically valid answers to adaptively generated queries. My poster presents fast mechanisms for answering adaptive queries into datasets. These mechanisms provide exponential speed-ups per query without increasing sample complexity. These techniques also yield improved bounds for adaptively optimizing convex and strongly convex functions over a dataset.

**JACK SAMPSON** • Penn State

**Nonvolatile Processors**

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Developments in both SW and HW techniques to leverage on-chip integration of nonvolatile storage elements to provide continuity in the face of frequent power interruptions have rapidly expanded the research area of intermittent computing. Nonvolatile processors, wherein the hardware can provide software-transparent support for intermittency, are a promising design paradigm that strongly synergizes with energy-harvesting and enable novel optimizations from microarchitectural to system levels.

**CATHERINE SCHUMAN** • Oak Ridge National Laboratory

**Neuromorphic Computing: Where Machine Learning Meets Hardware**

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The end of Moore's law and Dennard scaling have inspired the computing community to explore alternative computer architectures. One of the most compelling non-von Neumann architectures are neuromorphic systems. This poster will show example neuromorphic hardware implementations, introduce one way that neuromorphic systems are programmed (using evolutionary algorithms), and show how neuromorphic systems are used to solve real-world applications (scientific data analysis and robot navigation).

**ROY SCHWARTZ** • University of Washington Seattle and Allen Institute for Artificial Intelligence  
**Teaching Machine how to Read**

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Natural language processing (NLP) is a major part in many AI systems. State-of-the-art NLP systems largely rely on deep learning methods. These methods are often used as black boxes, making them hard to understand, analyze and extend. My research combines linguistic knowledge as well as insights from the theory of computer science into the design of deep learning models. In particular, I incorporate language patterns ("what a great X", where X can be replaced with words like "movie" or "book") into deep models for NLP. I also study the connection between state-of-the-art deep models and weighted finite-state automata, showing that this connection can lead to the design of new models. My results show that incorporating these types of knowledge into deep models improves their performance on a range of NLP tasks.

**LINDA SELLIE** • NYU Tandon School of Engineering  
**Observations on Empowering Students**

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I discuss some of the techniques that have helped make active learners out of my computer science students.

**BIJAN SEYEDNASROLLAH** • Harvard University / Northern Arizona University  
**Tackling challenges of extracting time-series data from digital repeat photography**

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Near-surface remote sensing and in situ photography are powerful tools to study how climate change and climate variability influence vegetation phenology and the associated seasonal rhythms of green-up and senescence. The rapidly-growing PhenoCam network has been using in situ digital repeat photography to study phenology in almost 500 locations around the world, with an emphasis on North America. However, extracting time series data from multiple years of half-hourly imagery - while each set of images may contain several regions of interest (ROI's), corresponding to different species or vegetation types - is not always straightforward. Large volumes of data require substantial processing time, and changes (either intentional or accidental) in camera field of view requires adjustment of ROI masks. Here, we introduce and present "xROI" as an interactive web-based application for imagery from PhenoCam. xROI can also be used offline, as a fully independent toolkit that significantly facilitates extraction of phenological data from any stack of digital repeat photography images. xROI provides a responsive environment for phenological scientists to interactively a) delineate ROIs, b) handle field of view (FOV) shifts, and c) extract and export time series data characterizing image color (i.e. red, green and blue channel digital numbers for the defined ROI). The application utilizes artificial intelligence and advanced machine learning techniques and gives user the opportunity to redraw new ROIs every time an FOV shift occurs. xROI also offers a quality control flag to indicate noisy data and images with low quality due to presence of foggy weather or snow conditions. The web-based application significantly accelerates the process of creating new ROIs and modifying pre-existing ROI in the PhenoCam database. The offline toolkit is presented as an open source R-package that can be used with similar datasets with time-lapse photography to obtain more data for studying phenology for a large community of ecologists.

**WEI (WILBUR) SHI** • Princeton University  
**Decentralized Optimization over Networks with Geometric Convergence**

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In this poster, we discuss solving decentralized convex optimization problems in a network, where each node has its own convex cost function and the goal is to minimize the sum of the nodes' cost functions while obeying the network connectivity structure. We present a push-protocol based method for which we can prove its geometric convergence over time-varying networks with simplex communication links. We then present a push-pull-protocol based method and show that the new method converges at a geometric rate over time-invariant networks but illustrates a superior performance over time-varying networks in our numerical experiments. The push-pull based method also unifies algorithms with different types of distributed architecture, including decentralized (peer-to-peer), centralized (master-slave), and semi-centralized (leader-follower) architecture.

**IGOR STEINMACHER** • Northern Arizona University  
**Supporting the Next Generation of Software Engineers**

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Contemporary software development has transitioned from a solo and mainly technical activity to a highly social and collaborative endeavor. The rise and growth of Global Software Engineering and Open Source Software (OSS) development stimulated this increased collaboration. Many developers now contribute to multiple projects, desiring to engage with, learn from, and co-create with other developers, and thereby forming communities of practice. The next generation of software developers needs experience in real-life collaborative software development settings, which will prepare them with more than technical skills. Leveraging the rich variety of OSS projects, new developers can face and eventually overcome barriers to joining these collaborative projects. Additionally, the OSS repositories provide rich information that can be mined and analyzed by techniques such as machine learning and natural language processing. In this seminar, I will focus on my research on understanding the onboarding behavior of newcomer developers and how it laid the foundation to provide support for them. I will introduce the quantitative and qualitative methodological approaches I apply, and then explain in depth how I modeled the barriers and proposed a portal to support newcomers' onboarding. I then show how this study inspired other research lines and future opportunities to support social developers in this new landscape.

**CHENHAO TAN** • University of Colorado Boulder  
**Friendships, Rivalries, and Trysts: Characterizing Relations between Ideas in Texts**

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Understanding how ideas relate to each other is a fundamental question in many domains, ranging from intellectual history to public communication. Because ideas are naturally embedded in texts, we propose the first framework to systematically characterize the relations between ideas based on their occurrence in a corpus of documents, independent of how these ideas are represented. Combining two statistics --- cooccurrence within documents and prevalence correlation over time --- our approach reveals a number of different ways in which ideas can cooperate and compete. For instance, two ideas can closely track each other's prevalence over time, and yet rarely cooccur, almost like a "cold war" scenario. We observe that pairwise cooccurrence and prevalence correlation exhibit different distributions. We further demonstrate that our approach is able to uncover intriguing relations between ideas through in-depth case studies on news articles and research papers.

**WESLEY TANSEY** • Columbia University  
**Interpreting deep neural networks with false discovery rate control**

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Black box models, such as deep neural networks, have shown amazing predictive performance in recent years. However, these methods make a trade off: high predictive power comes at the cost of human interpretability. We present the Heldout Data Randomization (HDR) test for variable selection in black box models that yields a valid p-value for each feature in the model. The HDR test is validated against simulated and real data, demonstrating its usefulness in black box interpretation tasks.

**CUI TAO** • University of Texas Health Science Center at Houston  
**Biomedical Data &Knowledge Management**

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The explosively growing big biomedical data provides enormous opportunities to revolutionize the current clinical practices as well as the biomedical research if the accompanied challenges of heterogeneity in knowledge discovery on biomedical big data can be addressed with novel informatics technologies. Our team has been working on developing semantic technologies to normalize, integrate, query, and analyze the massive volumes of biomedical data as well as to infer new knowledge based on what is known. The core technologies we are developing are based on ontologies and the Semantic Web. Here we share our vision on applying semantic web techniques to clinical knowledge and data representation, as well as to retrieve useful information and knowledge from EHR or online resources

**MOHIT TIWARI** • University of Texas at Austin  
**Abstractions for a Security-plane for Computer Systems**

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My research aims to build a "security-plane" for large-scale computer systems, so that security properties can be imposed orthogonally to applications and operating system services that comprise the computation- and control-planes. A security-

plane is crucial to resolving the dichotomy between building security in from the start and being able to adapt to new threat models, security properties, and vulnerabilities as they emerge in deployed systems. Essentially, systems are built from the ground up to support fundamental security primitives (like enclaves that confine untrusted code on untrusted infrastructure) and to support programmable introspection (to detect anomalous behaviors that indicate attacks).

## **HANGHANG TONG** • Arizona State University

### **Network Science of Teams: Characterization, Prediction, and Optimization**

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Teams are increasingly indispensable to achievements in any organization. Despite the organizations' substantial dependency on teams, fundamental knowledge about the conduct of team-enabled operations is lacking, especially at the social, cognitive and information level in relation to team performance and network dynamics. Generally speaking, the team performance can be viewed as the composite of its users, the tasks that the team performs and the networks that the team is embedded in or operates on. The goal of this poster is to (1) provide a comprehensive review of the recent advances in optimizing teams' performance in the context of networks; and (2) identify the open challenges and future trends. We believe this is an emerging and high-impact topic in computer science as well as social science.

## **TAMMY TOSCOS** • Parkview Health

### **"Give Me More Consumer Health Technology": A Multi-Platform Intervention to Support Medication Adherence**

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This presentation will showcase a novel, multi-platform intervention that was designed using a patient centered approach and deployed in a controlled 6-month trial aimed at improving adherence to oral anti-coagulant therapy in patients living with atrial fibrillation. Participants will learn how various consumer health technologies were integrated into the intervention that uses a novel algorithm for delivering tailored messaging via Epic's patient portal, MyChart. Prevention of thromboembolism (stroke) is key in individuals with non-valvular atrial fibrillation (AF) and nonadherence to oral anticoagulant (OAC) therapy is a frequent causative factor of stroke. There are many factors that contribute to the complexity of medication non-adherence among the AF patient population, including patient knowledge about AF and related therapies, the patient's health beliefs and concerns, patient-provider communication, particular reminder systems and habits that patients develop to help them consistently and correctly take medication. Thus, interventions aimed at changing this behavior must be tailored to address the unique internal motivations and information needs of those confronted with the daily choice to take a medication to prevent stroke. Delivery of tailored health education and medication reminders may be an effective way to empower individuals with NVAF and in consequence, improve OAC adherence. In this talk we will share the technical development of an intervention which is now being tested with 160 patients in a 6-month randomized controlled trial. We will present the design work and preliminary findings from this research study that uses MyChart, custom media-rich content, validated educational content, smart pill bottles, and e-prescribing software to provide a tailored mHealth intervention aimed at improving medication adherence. The intervention leverages a novel algorithm that was developed from 2 years of design with patients living with AF who are taking OAC medications. The audience will learn how these technologies (data from the Surescripts e-prescribing software (medication refill data); the AdhereTech smart pill bottle; validated cardiac educational content from the American College of Cardiology; and custom interactive media-rich educational content; MyChart) were combined to support the algorithm that delivered tailored health messages to study participants the technology trial.

## **DAVID VAN HORN** • University of Maryland

**LEI WANG • Union College**

**Improves localization accuracy and robustness: ARPAP and UMTS**

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Position information has increasingly become important for a variety of location-based applications. In the upcoming 5G standard, the positioning ability has been considered as an integral part of the system. However, it is still a challenging task to provide position information with sufficient accuracy and high reliability. In this poster, I will introduce ARPAP, an antenna radiation pattern awarded power-based positioning method. It improves the positioning accuracy and reliability by estimating the LoS component in the received signal and calculating the contour based on RF signal power distribution model. Also, I will introduce our sensor fusion algorithm, UMTS (ubiquitous mobile unit tracking system), which realizes the ubiquitous localization and tracking in the indoor and outdoor mixed environment.

**TIM WENINGER • University of Notre Dame**

**A Formal Language Theory for Graphs**

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We present a newfound relationship between graph theory and formal language theory. This relationship between graph theory and formal language theory allows for a Hyperedge Replacement Grammar (HRG) to be extracted from any graph without loss of information. Like a context free grammar, but for graphs, the extracted HRG contains the precise building blocks of the network as well as the instructions by which these building blocks ought to be pieced together. By marrying the fields of graph theory and formal language theory, lessons from the previous 50 years of study in formal language theory, grammars, and much of theoretical computer science can now be applied to graph mining and network science. This poster shows some of the first steps we have taken towards reconciling these disparate fields in a mathematically elegant and principled way.

**LAUREN WILCOX • Georgia Institute of Technology**

**Promoting Engagement with Personal Health through Interactive Technology**

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The Health Experience and Applications (Hx) Lab is a research group focused on how technology can enable people to participate in their own healthcare, and how we can design new technologies for health-promoting experiences. This poster describes our research on how to facilitate health-related information awareness and understanding through effective design, prototyping and use of computing technology. I will highlight studies focused on designing technology for a critical yet under-supported group: teens with chronic conditions. Finally, the poster touches on research in the emerging area of consumer health informatics, showcasing how transformative interventions can better support communication of multi-faceted health-related information to a variety of end users.

**PAMELA WISNIEWSKI • University of Central Florida**

**Safety by Design: Sociotechnical Interventions for Adolescent Online Safety**

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The internet is a double-edged sword; it facilitates new opportunities for teens but also amplifies risks. The technologies designed to connect our youth to new experiences and people have outpaced the technologies designed to keep teens safe while doing so. Therefore, this NSF CAREER proposal aims to close the gap between online opportunities versus risks by creating sociotechnical solutions that directly promote the online safety of adolescents (ages 13-17) through developmentally appropriate interventions designed for, by, and with teens.

**LIRONG XIA • RPI**

**Improving Group Decision-Making by Artificial Intelligence**

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We summarize some of our recent work on using AI to improve group decision-making by taking a unified approach from statistics, economics, and computation. We then discuss a few ongoing and future directions.

**DA YAN** • The University of Alabama at Birmingham

**T-thinker: A Task-Centric Framework to Revolutionize Big Data Systems Research**

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Existing Big Data systems are designed for data-intensive problems where data movement is the bottleneck and CPUs are underutilized. However, many real-life problems have a high computational complexity, such as community detection and training random forest. This poster introduces a new task-centric framework, T-thinker, for truly scalable distributed compute-intensive Big Data processing. As a preliminary work, T-thinker has been applied to graph mining: <https://info.cs.uab.edu/yanda/gthinker/>

**YEZHOU YANG** • Active Perception Group, Arizona State University

**Visual Recognition with Knowledge: From an Active Agent's Perspective**

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The goal of Computer Vision, as coined by Marr, is to develop algorithms to answer What are Where at When from visual appearance. The speaker, among others, recognizes the importance of studying underlying entities and relations beyond visual appearance, following an Active Perception paradigm. The poster will present the ASU active perception group (APG)'s recent efforts ranging from 1) a Deep Image Understanding framework (DeepIU) with knowledge, through 2) reasoning beyond visual appearance for solving image riddles and answering visual questions with explanations, till 3) their applications in a Robotic visual learning framework as well as for Human-Robot symbiosis. The poster will also feature several ongoing projects and future directions of ASU APG.

**LANA YAROSH** • University of Minnesota

**Technology for Empowering Social Connections in Critical Contexts**

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Social isolation is a critical challenge for mental health and wellbeing. People are self-identifying as "lonely" at higher rates than ever and many are experiencing effects of social isolation, including depression, and substance use disorders. My work takes on the task of designing technologies to increase connectedness. I work closely with people in specific critical social contexts to design and evaluate the effects of new technologies on social connectedness. The poster elaborates on my work in two critical contexts: parenting & intergenerational mentorship and peer support in health.

**FATEME YOUSEF** • Arizona State University

**Spatiotemporal multidimensional modeling of land and ocean interactions at large scales**

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The evolution of tidal platforms has been extensively studied through observations and models, however, existing work mainly focuses on individual marsh platforms describing local interactions among hydrodynamics, vegetation, and sediment transport. Here, we develop a process-based model to evaluate the relative role of large-scale watershed, estuarine, and ocean controls on salt marsh dynamics and define how these factors interact to determine salt marsh resilience to environmental change at the whole-estuary scale.

**YUNPENG ZHANG** • University of Houston

**Interactive Based Access Control Framework for Connected Vehicle Communication**

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Threats of attack on Vehicle Communications pose the risk of serious and unexpected consequences. We propose a novel Software Defined Networking based Global Access Control (SGAC) to accommodate Vehicle communication systems. SGAC enforces strict rules and dynamic changes based on network activities to yield better consistency and provide information at different levels of abstractions to enable the smooth flow of traffic. The simulation results showed that the SGAC could effectively control the mean speed throughout the entire work zone area.

# NOTES



## NOTES



# CCC

Computing Community Consortium  
**Catalyst**

The mission of Computing Research Association's Computing Community Consortium (CCC) is to catalyze the computing research community and enable the pursuit of innovative, high-impact research. CCC conducts activities that strengthen the research community, articulate compelling research visions, and align those visions with pressing national and global challenges. CCC communicates the importance of those visions to policymakers, government and industry stakeholders, the public, and the research community itself.

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