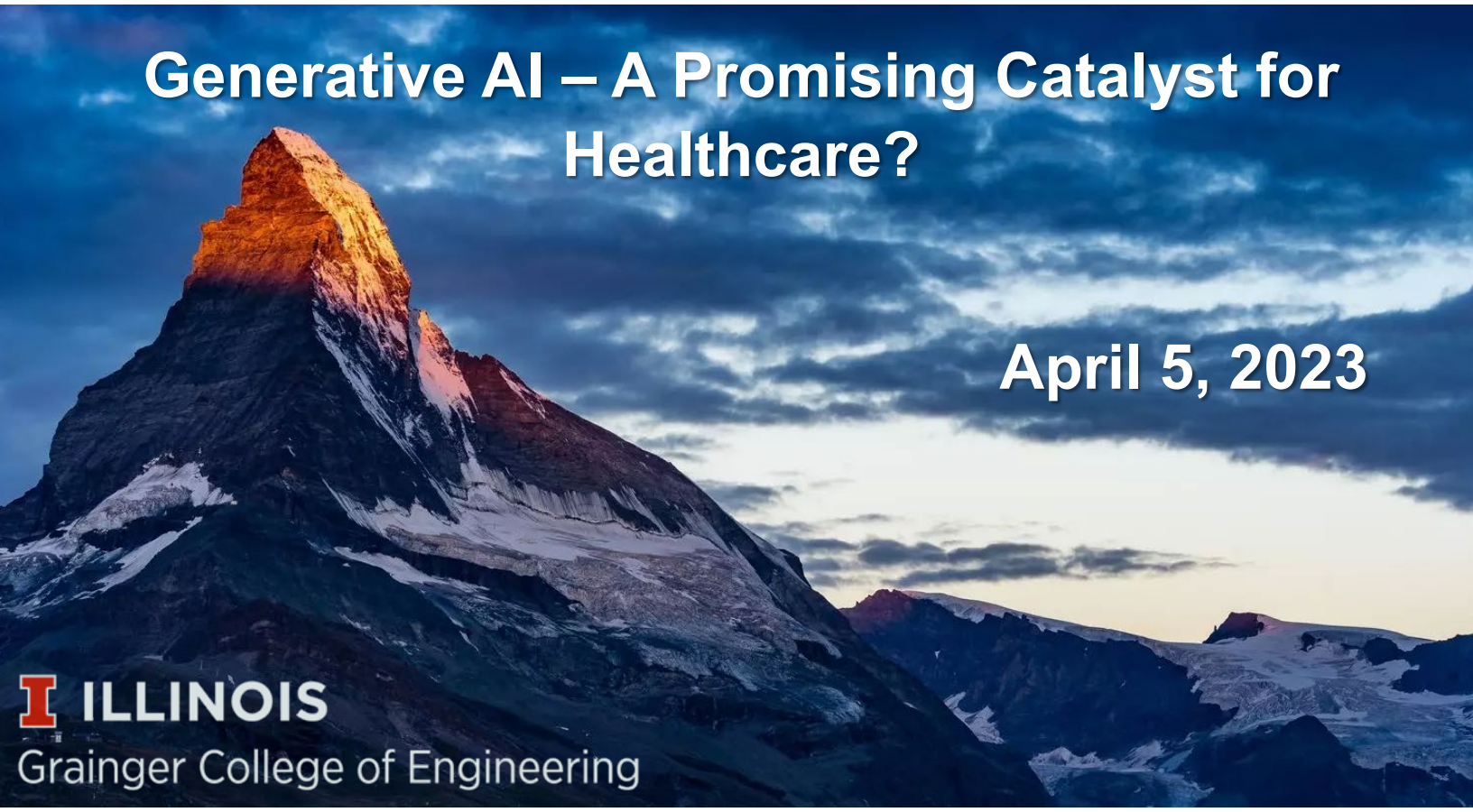
6th Illinois Health Data Analytics Summit



Health Data Analytics Initiative

Health Care Engineering Systems Center

Summit Theme

This year, we focus on applications of rapidly emerging Generative Models and investigate how they can be leveraged to synthesize increasingly realistic and useful electronic health record (EHR) data, including images, sounds, and videos. We discuss various deep generative model frameworks, their applications, and the risk of generative AI and its potential positive economic impact in accelerating healthcare-related predictive model development.

AGENDA

8:45 – 9:00 am **Welcome and Opening Remarks**

Susan Martinis, Ph.D., Vice Chancellor for Research and Innovation
University of Illinois Urbana-Champaign

Rashid Bashir, Ph.D., Dean, Grainger College of Engineering
University of Illinois Urbana-Champaign

James Rehg, Ph.D., Founder Professor, Computer Science, and Industrial and Enterprise Systems Engineering, and Director, Health Care Engineering Systems Center
University of Illinois Urbana-Champaign

Chairs of the 6th Illinois Health Data Analytics Summit-
Ilan Shomorony, Ph.D., Assistant Professor, Computer & Electrical Engineering
Yuxiong Wang, Ph.D., Assistant Professor, Computer Science
University of Illinois Urbana-Champaign

9:00 – 9:45 am **Keynote | Towards Generative Models for Analyzing Computer Tomography Scans**

Alan L. Yuille, Ph.D., Bloomberg Distinguished Professor of Cognitive Science and Computer Science, Johns Hopkins University
Chair: **Yuxiong Wang**

9:45 - 10:30 am **Keynote | Out of Distribution Generalization**

Rajesh Ranganath, Ph.D., Assistant Professor, Computer Science and Data Science
Courant Institute, New York University (NYU)
Chair: **Ilan Shomorony**

10:30 – 10:50 am **Break**

10:50 – 11:50 am **Session I The Different Modalities of Generative AI**
Description: Panel discussions of different modalities of Generative AI sequence, image, text, graphs, algorithms, architectures, and their latest advancements including security and privacy .
Chair: Ilan Shomorony

SDFusion: Multimodal 3D Shape Completion, Reconstruction, and Generation

Alexander Schwing, Ph.D., Associate Professor, Department of Electrical and Computer Engineering University of Illinois Urbana-Champaign

Clinically-Driven Virtual Patient Cohorts Generation: An Application to Aorta

Miguel Lozano, Ph.D., Associate Professor, School of Engineering
University of Valencia, Spain

Large Scale Machine Learning Models in Mobile Health

James Rehg, Ph.D., Founder Professor, Computer Science, and Industrial and Enterprise Systems Engineering, and Director, Health Care Engineering Systems Center
University of Illinois Urbana-Champaign

Generative language models for clinical documentation

Jon Stevens, Ph.D., AI Language Capability Lead, Information Research
AbbVie

Mind's Eye: Mental Hallucination for Open-World Perception

Yuxiong Wang, Ph.D., Assistant Professor, Computer Science
University of Illinois Urbana-Champaign

Large Language Models Encode Clinical Knowledge

Vivek Natarajan, MS, AI Researcher
Google

11:50 am - 12:00 pm **Break**

12:00 – 12:45 pm **Keynote | Generative AI in Healthcare**

Jimeng Sun, Ph.D., Health Innovation Professor, Computer Science, and Carle Illinois College of Medicine, University of Illinois Urbana-Champaign
Chair: **James Rehg**

12:45 - 2:00 pm **Panel | Generative AI in Healthcare**

Moderators:
Kapila Monga, MS., Head of Data Science, Bon Secours Mercy Health
ChengXiang Zhai, Ph.D., Professor, Computer Science, University of Illinois Urbana-Champaign

Description: This panel brings academia and industry together in one forum to discuss and assess the promise of Generative AI for healthcare. The panel will deliberate on early successes, opportunity areas, and clinical workflow integration related aspects of Generative AI. The panel will also discuss the impact of Generative AI on different types of healthcare organizations (big hospitals / small hospitals / research driven organizations / hospitals in rural areas) at the current stage of evolution.

Panelists

- **Jimeng Sun**, Ph.D., Health Innovation Professor, Computer Science, and Carle Illinois College of Medicine, University of Illinois Urbana-Champaign
- **Jon Stevens**, Ph.D., AI Language Capability Lead, Information Research, AbbVie
- **Brandon Nelson**, Ph.D., Fellow, Division of Imaging, Diagnostics, and Software Reliability, U.S. Food & Drug Administration (FDA)
- **Alexandre Carvalho**, M.D., Infectious Disease Fellow, Northwestern Memorial Hospital
- **Vivek Natarajan**, MS, AI Researcher, Google

2:00 – 3:00 pm **Session II | Generative Models applied in Healthcare**
Description: Use cases from different areas of healthcare, application/risks in medical education, issues in ethics, compliance/legal, IP.
Chair: Yuxiong Wang

Assessing the ability of deep generative models to learn canonical medical image statistics

Varun Kelkar, Ph.D. Candidate, Computational Imaging Science Lab, Electrical & Computer Engineering
University of Illinois Urbana-Champaign

Abstract: Developing Generated AI Solutions for Rare Disease Care

May Dongmei Wang, Ph.D., Professor, and The Wallace H. Coulter Distinguished Faculty Fellow and Director of Biomedical Big Data Initiative
Georgia Institute of Technology and Emory University

Synthesizing Medical Data with Privacy Guarantees: Fantasy or Plausibility?
Vincent Bindschaedler, Ph.D., Assistant Professor, Computer & Information Science & Engineering, University of Florida

Generative Modeling for Medical Education and Training
Yogatheesan Varatharajah, Ph.D., Research Assistant Professor, Bioengineering
University of Illinois Urbana-Champaign

I didn't know StyleGAN could do *THAT*

David Forsyth, Ph.D., Fulton Watson Copp Chair, Computer Science
University of Illinois Urbana-Champaign

Accelerating Pediatric Medical Device Innovation with Regulatory Science Tools (RSTs): A Case Study on Pediatric Deep Learning CT Image Reconstruction

Brandon Nelson, Ph.D., Staff Fellow, Division of Imaging, Diagnostics, and Software Reliability
U.S. Food & Drug Administration

3:00 - 3:30 PM **Live Demonstration | Synthetic Data Generation**
Chair: Jimeng Sun

Live demonstration of PyHealth, a powerful library and tool set designed for both machine/deep learning researchers and medical practitioners to train, test and validate algorithms with publicly available data sets. Organized by Sunlab Students.

3:30 PM **Closing Remarks**
Summit Chairs: Yuxiong Wang, Ilan Shomorony

OPENING REMARKS

Susan Martinis
Vice Chancellor for Research and Innovation
University of Illinois Urbana-Champaign

Susan Martinis is Vice Chancellor for Research & Innovation at the University of Illinois Urbana-Champaign, where she provides leadership for the campus-wide interdisciplinary research institutes, promotes new research initiatives, and oversees the administrative and business processes that ensure the safe, ethical, and productive conduct of research at Illinois.

Dr. Martinis, the Stephen G. Sligar Professor of Molecular and Cellular Biology, studies the mechanisms, evolution, and biomedical applications of protein synthesis and RNA-protein interactions. She is a successful researcher, engaged in entrepreneurial and corporate partnerships, a committed educator, and an experienced administrator.

Rashid Bashir
Dean, The Grainger College of Engineering
University of Illinois Urbana-Champaign

Dr. Rashid Bashir is Dean of The Grainger College of Engineering, the Grainger Distinguished Chair in Engineering and Professor of Bioengineering at the University of Illinois at Urbana-Champaign. Previously, he was the Executive Associate Dean at the Carle-Illinois College of Medicine (2017 – present), the Abel Bliss Professor of Engineering, Head of Department of Bioengineering (2013 – 2017), and Director of the Micro and Nanotechnology Laboratory (a campus-wide clean room research facility) (2007 – 2013). Prior to joining UIUC, he was at Purdue University (1998 – 2007) with faculty appointments in Electrical and Computer Engineering, and Bioengineering. From 1992 to 1998 he worked at National Semiconductor Corporation in Santa Clara, CA as Sr. Engineering Manager.

His research integrates biology and medicine with micro and nanotechnology in two broad areas, how micro/nanotechnology can help solve problems in life sciences (diagnostics and therapeutics), and how life science can help solve problems in micro/nanotechnology (bio-inspired self-assembly). His research projects span from solid state nanopores to 3D biofabrication due to his interest in bionanotechnology, biosensors and bioelectronics, and nanotechnology.

James Rehg
Director, Health Care Engineering Systems Center
University of Illinois Urbana-Champaign

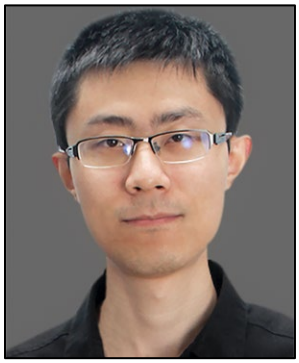
Dr. James Rehg is the new director of the Health Care Engineering Systems Center (HCESC). He is appointed as the Founder Professor with joint faculty appointments in the Departments of Computer Science and Industrial and Enterprise Systems Engineering. Due to a current project with Meta, Dr. Rehg will ramp up his leadership involvement with UIUC by August 2023.

He was previously a professor at Georgia Institute of Technology's School of Interactive Computing. He was also the co-director of the Center for Health Analytics and Informatics. His research interests include computer vision and machine learning, and his research group at Georgia Tech works in several interdisciplinary areas: developmental and social psychology, autism research, mobile health, and robotics.

SUMMIT CHAIRS

Ilan Shomorony
Assistant Professor in Electrical and Computer Engineering
University of Illinois at Urbana-Champaign

Dr. Shomorony is an assistant professor in the department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign. His main research interests are in information theory and its applications, particularly to computational biology.



Yuxiong Wang
Assistant Professor in Computer Science
University of Illinois at Urbana-Champaign

Dr. Yuxiong is an Assistant Professor in the Department of Computer Science at the University of Illinois at Urbana-Champaign. Before joining Illinois CS, he was a postdoctoral fellow in the Robotics Institute at Carnegie Mellon University.

His research lies in computer vision, machine learning, and robotics, with a specific focus on meta-learning, few-shot learning, predictive learning, and streaming perception.

SUMMIT ORGANIZER

George Heintz
Assistant Director for Health Data Analytics
Health Care Engineering Systems Center
University of Illinois Urbana-Champaign

George Heintz focuses on identifying, developing, and delivering data science projects to advance clinical and medical research with our clinical partners. He provides AI, ML, statistical modeling, algorithm design, and software development delivered in an iterative process involving healthcare experts and data science researchers. He has extensive practical experience in designing enterprise and IT architectures and implementing ITIL processes and IT governance models. In his industry career he served as executive manager and management consultant for IBM, Swisscom, and 1&1 Internet AG.

His past clients include Fortune 50 companies providing IT services, healthcare providers, re-insurers, and a world leading automotive manufacturer. George gained his experience in academic environments at the National Center for Supercomputing Applications (NCSA), and at the University of Illinois' NIH BD2K Center for Large Genomic Data, where he served as Associate Director.

KEYNOTE SPEAKERS

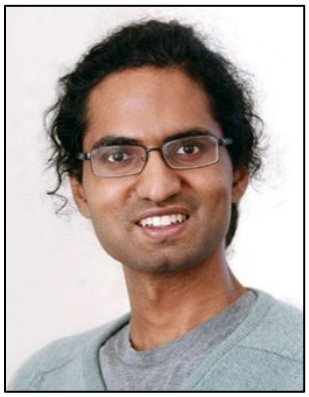
Alan L. Yuille

Bloomberg Distinguished Professor of Computer Science and Cognitive Science
Whiting School of Engineering and the Krieger School of Arts and Sciences
Johns Hopkins University

Title: *Towards Generative Models for Analyzing Computer Tomography Scans.*

Abstract: Artificial Intelligence (AI) algorithms has enormous potential for medical image analysis and diagnosis. This talk concentrates on the early detection and analysis of tumors from CT scans. If annotated data is available then AI shows impressive performance which approaches, and can even surpass, the performance of expert radiologists. But it is challenging to obtain large, annotated datasets for training and evaluating these AI algorithms. This is particularly problematics because it is necessary to ensure that AI will work on data from a variety of different hospitals where annotated data may not be available, which means addressing domain transfer. This talk first reports progress on the FELIX project for detecting pancreatic cancer where large, annotated datasets are available and high performance is obtained. Then we describe how synthetic generative tumors can also enable high performance on detecting and localizing tumors in the liver and the pancreas when little or no annotated tumors are available.

Dr. Alan Yuille received the BA degree in mathematics from the University of Cambridge in 1976. His PhD on theoretical physics, supervised by Prof. S.W. Hawking, was approved in 1981. He was a research scientist in the Artificial Intelligence Laboratory at MIT and the Division of Applied Sciences at Harvard University from 1982 to 1988. He served as an assistant and associate professor at Harvard until 1996. He was a senior research scientist at the Smith-Kettlewell Eye Research Institute from 1996 to 2002. He was a full professor of Statistics at the University of California, Los Angeles, as a full professor with joint appointments in computer science, psychiatry, and psychology. He moved to Johns Hopkins University in January 2016. His research interests include computational models of vision, mathematical models of cognition, medical image analysis, and artificial intelligence and neural networks.

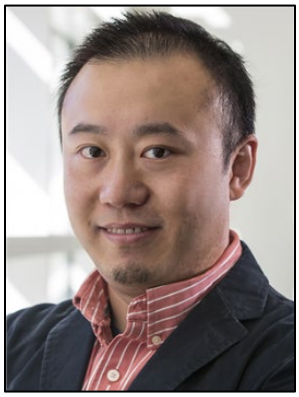


Rajesh Ranganath,
Assistant Professor in Computer Science
Courant Institute of Mathematical Sciences
New York University

Title: *Out of Distribution Generalization*

Abstract: Supervised learning typically requires test data being drawn from the same distribution as the training data. This assumption does not hold in many real-world settings. As an example, setting consider a model trained in one hospital and used in another. In such a setting, the test distribution is related to the training distribution, but they are not the same. In this talk, I will discuss our work on representation learning for out of distribution generalization. I will construct a family of representations that generalize under changing spurious correlations with applications to images and chest X-rays.

Dr. Ranganath is an Assistant Professor at the Courant Institute at NYU in Computer Science and at the Center for Data Science. He is also part of the CILVR group. His research interests include causal, statistical, and probabilistic inference, out-of-distribution detection and generalization, deep generative modeling, interpretability, and machine learning for healthcare. Before joining NYU, he earned degrees in computer science; his PhD was completed at Princeton University working with Dave Blei and his undergraduate was done at Stanford University. He has also spent time as a research affiliate at MIT's Institute for Medical Engineering and Science.



Jimeng Sun

Professor in Computer Science
University of Illinois Urbana Champaign

Title: *Generative AI in Healthcare*

Abstract: Generative AI has been successful in natural language processing and computer vision, and this talk will explore its potential for healthcare. Examples of healthcare applications include optimizing clinical trials and supporting clinical decision-making. However, there are challenges that need to be addressed such as limited data and labels, privacy concerns, domain knowledge integration, data distribution shift, model uncertainty and interpretability. The talk will discuss these challenges and ways to overcome them to fully utilize generative AI in healthcare.

Dr. Sun is a Health Innovation Professor at the Computer Science Department and Carle's Illinois College of Medicine at University of Illinois Urbana Champaign. Previously, he was an associate professor at Georgia Tech's College of Computing and co-directed the Center for Health Analytics and Informatics. Dr. Sun's research focuses on using artificial intelligence (AI) to improve healthcare. This includes deep learning for drug discovery, clinical trial optimization, computational phenotyping, clinical predictive modeling, treatment recommendation, and health monitoring. He has been recognized as one of the Top 100 AI Leaders in Drug Discovery and Advanced Healthcare. Dr. Sun has published over 300 papers with over 25,000 citations, and h-index 81. He collaborates with leading hospitals such as MGH, Beth Israel Deaconess, OSF healthcare, Northwestern, Sutter Health, Vanderbilt, Northwestern, Geisinger, and Emory, as well as the biomedical industry, including IQVIA, Medidata and multiple pharmaceutical companies. https://www.sunlab.org/

Session I: The Different Modalities of Generative AI

Chair: Ilan Shomorony

Alex Schwing

Associate Professor in Electrical and Computer Engineering
University of Illinois Urbana-Champaign

Title: *SDFusion: Multimodal 3D Shape Completion, Reconstruction, and Generation*

Abstact: In this work, we present a novel framework built to simplify 3D asset generation for amateur users. To enable interactive generation, our method supports a variety of input modalities that can be easily provided by a human, including images, text, partially observed shapes and combinations of these, further allowing to adjust the strength of each input. At the core of our approach is an encoder-decoder, compressing 3D shapes into a compact latent representation, upon which a diffusion model is learned. To enable a variety of multi-modal inputs, we employ task-specific encoders with dropout followed by a cross-attention mechanism. Due to its flexibility, our model naturally supports a variety of tasks, outperforming prior works on shape completion, image-based 3D reconstruction, and text-to-3D. Most interestingly, our model can combine all these tasks into one swiss-army-knife tool, enabling the user to perform shape generation using incomplete shapes, images, and textual descriptions at the same time, providing the relative weights for each input and facilitating interactivity. Despite our approach being shape-only, we further show an efficient method to texture the generated shape using large-scale text-to-image models.

Dr. Alex Schwing is an Associate Professor in the Department of Electrical and Computer Engineering at the University of Illinois in Urbana-Champaign and affiliated with the Coordinated Science Laboratory and the Computer Science Department. Prior to that he was a postdoctoral fellow in the Machine Learning Group at the University of Toronto collaborating with Raquel Urtasun, Rich Zemel and Ruslan Salakhutdinov. He completed his PhD in computer science in the Computer Vision and Geometry Group at ETH Zurich working with Marc Pollefeys, Tamir Hazan and Raquel Urtasun, and graduated from Technical University of Munich (TUM) with a diploma in Electrical Engineering and Information Technology.

Miguel Lozano

Associate Professor at the School of Engineering
University of Valencia, Spain

Title: *Clinically-Driven Virtual Patient Cohorts Generation: An Application to Aorta*

Abstract: The combination of machine learning methods together with computational modeling and simulation of the cardiovascular system brings the possibility of obtaining very valuable information about new therapies or clinical devices through *in-silico* experiments. However, the application of machine learning methods demands access to large cohorts of patients. As an alternative to medical data acquisition and processing, which often requires some degree of manual intervention, the generation of virtual cohorts made of synthetic patients can be automated. However, the generation of a synthetic sample can still be computationally demanding to guarantee that it is clinically meaningful and that it reflects enough inter-patient variability. This talk addresses the problem of generating virtual patient cohorts of thoracic aorta geometries that can be used for *in-silico* trials.

Dr. Miguel Lozano is an Associate Professor at the School of Engineering at the University of Valencia, where he specializes in Artificial Intelligence and Computer Simulations. Over the past few decades, he has worked extensively in various domains, including Machine Learning techniques for Multiagent systems, Multiscale simulation computer-architectures, and Coordination Models for Multiagent Systems (JMADEM, MARL-PED). During the last years, he has been driving the CoMMLab research group with Dr. Rafael Sebastian, focused on the combination of Electro-Physiology simulations with Machine Learning models which enable the analysis of different types of cardiology pathologies. Dr. Lozano Ibáñez has also supervised 4 PhD theses and more than 15 MSc theses in these fields. Dr. Lozano has published over 50 scientific publications and is recognized as a reviewer in different simulation journals, including Simulation Modelling Practice and Theory (Elsevier), Frontiers in Physiology or Nature Scientific Data.

James Rehg

Director, Health Care Engineering Systems Center
University of Illinois Urbana-Champaign

Title: *Large Scale Machine Learning Models in Mobile Health*

Abstract: In order to leverage and adapt recent successes in deep learning to the domain of mobile health (mHealth) it is necessary to solve several tasks: 1) Identifying the key properties of mHealth signals that ML models must address, 2) Design effective architectures for analyzing mHealth signals, 3) Identify appropriate large scale datasets for model training. In this talk I will describe a novel dataset and task, PulseImpute, which allows deep models to be used for the purpose of imputing missing data in pulsatile mHealth signal types such as ECG and PPG. I will show that deep feature learning enabled by PulseImpute leads to SOTA imputation performance in comparison to earlier ML and statistical imputation methods. This is joint work with Ph.D. student Maxwell Xu.

Dr. James Rehg is the new director of the Health Care Engineering Systems Center (HCESC). He is appointed as the Founder Professor with joint faculty appointments in the Departments of Computer Science and Industrial and Enterprise Systems Engineering. Due to a current project with Meta, Dr. Rehg will ramp up his leadership involvement with UIUC by August 2023. He was previously a professor at Georgia Institute of Technology's School of Interactive Computing. He was also the co-director of the Center for Health Analytics and Informatics. His research interests include computer vision and machine learning, and his research group at Georgia Tech works in several interdisciplinary areas: developmental and social psychology, autism research, mobile health, and robotics.

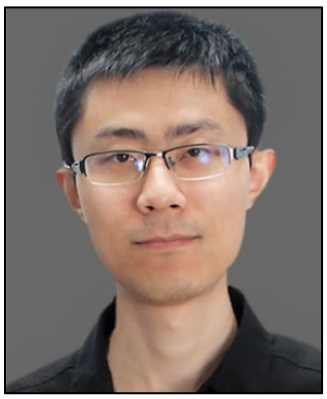
Jon Stevens

AI Language Capability Lead, Information Research, AbbVie

Title: *Generative language models for clinical documentation*

Abstract: Medical writing for clinical trials is a labor-intensive and time-consuming process, and demand for AI assistance is high. We present two applications of large language models (LLMs) for clinical medical writing: (1) auto-complete word processor plugins which are customized to document type and (2) long-form summarization models that can distill 1000+ page clinical study reports into short manuscripts. Both of these applications have functioning prototypes using EleutherAI's GPT-J 6B model, with plans underway to scale up and build out automated fact-checking tools.

Dr. Stevens received his Ph.D. in linguistics from the University of Pennsylvania in 2013, specializing in mathematical models of meaning in context. He was a computational linguistics researcher for five years before moving to the healthcare industry in 2018. In his current role, Jon applies NLP models and techniques to build custom AI applications for AbbVie.



Yuxiong Wang

Assistant Professor in Computer Science
University of Illinois at Urbana-Champaign

Title: *Mind's Eye: Mental Hallucination for Open-World Perception*

Abstract: The visual world which artificial intelligent agents live in and perceive is intrinsically open, streaming, and dynamic. However, despite impressive advances in visual learning and perception, state-of-the-art systems are still narrowly applicable, operating within a closed, static world of fixed datasets. In this talk, I will discuss our efforts towards developing generalizable and adaptive open-world perception and learning systems. Our key insight is to introduce a mental model with hallucination ability – creating internal imaginations of scenes, objects, and their variations and dynamics not actually present to the senses. I will focus on how to integrate such an intrinsic mental model with extrinsic task-oriented models and construct a corresponding closed-loop feedback system. I will demonstrate the potential of this framework for scaling up open-world, in-the-wild perception in application domains such as healthcare.

Dr. Yuxiong Wang is an Assistant Professor in the Department of Computer Science at the University of Illinois Urbana-Champaign. He is also affiliated with the National Center for Supercomputing Applications (NCSA). He received a Ph.D. in robotics from Carnegie Mellon University. His research interests lie in computer vision, machine learning, and robotics, with a particular focus on few-shot learning, meta-learning, open-world learning, and generative modeling. He is a recipient of awards including the Amazon Faculty Research Award, the ECCV Best Paper Honorable Mention Award, and the CVPR Best Paper Award Finalist. For details: https://yxw.cs.illinois.edu/.

Vivek Natarajan

MS, AI Researcher,(MedPALM), Google

Title: *Large Language Models Encode Clinical Knowledge*

Abstract: Large Language Models (LLMs) promise to have a great impact in medicine. However, the quality bar for such applications is high. In my talk, I will sketch out our recent efforts on benchmarking and evaluating LLMs for medical question answering at Google. Using insights derived from them, we developed Med-PaLM and Med-PaLM 2. These models were the first AI systems to obtain passing equivalent and expert equivalent scores on a benchmark of USMLE questions. Further, Med-PaLM also performed encouragingly when compared to physicians on consumer medical questions suggesting their potential real world utility.

Vivek Natarajan is an AI researcher in the Health AI team at Google working to accelerate biomedical AI's translation from code to clinic and scale world-class healthcare to everyone. He is particularly interested in building large foundation models for biomedical applications and lead a Google Brain moonshot. He works on applications ranging from medical imaging to health records modeling and life sciences. His research has been published in well-regarded journals and conferences like Nature Medicine, Nature Biomedical Engineering, JMLR, CVPR, ICCV and NeurIPS. It also forms the basis for several regulated medical device products under clinical trials at Google, including the NHS AI award winning breast cancer detection system Mammo Reader and the skin condition classification system DermAssist.

Panel: Generative AI in Healthcare

Description: This panel brings academia and industry together in one forum to discuss and assess the promise of Generative AI for healthcare. The panel will deliberate on early successes, opportunity areas, and clinical workflow integration related aspects of Generative AI. The panel will also discuss the impact of Generative AI on different types of healthcare organizations (big hospitals / small hospitals / research driven organizations / hospitals in rural area etc.) at the current stage of evolution.

Moderators:

ChengXiang Zhai
Donald Biggar Willett Professor in Engineering
Department of Computer Science
University of Illinois Urbana-Champaign

Dr. Zhai is a Donald Biggar Willett Professor in Engineering of the Department of Computer Science at the University of Illinois at Urbana-Champaign, where he also holds a joint appointment at the Carl R. Woese Institute for Genomic Biology, Department of Statistics, and the School of Information Sciences. He received a Ph.D. in Computer Science from Nanjing University in 1990, and a Ph.D. in Language and Information Technologies from Carnegie Mellon University in 2002.

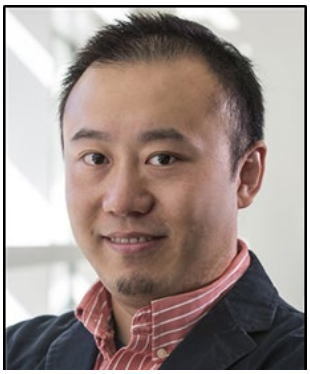
He worked at Clairvoyance Corp. as a Research Scientist and a Senior Research Scientist from 1997 to 2000. His research interests are in the general area of intelligent information systems, including specifically information retrieval, data mining, natural language processing, machine learning, and their applications in domains such as biomedical informatics, and intelligent education systems. He has published over 300 papers in these areas with a Google Scholar h-index of 73 and holds 5 patents. (http://czhai.cs.illinois.edu/)

Kapila Monga
Head of Data Science - Bon Secours Mercy Health

Ms. Monga is the Head of Data Science and Intelligent Process Automation at Bon Secours Mercy Health and has over 15+ years of experience in designing and delivering end to end data science and machine learning solutions. In her role at BSMH she is responsible for ensuring data science value realization in the $ 11 BN pro forma operating revenue / 50 hospital chain health system.

Prior to BSMH, Kapila was leading the Data Science and Machine Learning solutioning for Healthcare across NA for Cognizant Technology Solutions. She has worked with Health insurance companies and provider systems across the US to partner with them on their journey of AI and Data science value realization. Kapila writes for Journal of AHIMA on topics related to Healthcare AI/ML and is passionate about using Digital technologies to Care for Caregivers.

Panelists:



Jimeng Sun
Professor in Computer Science
University of Illinois Urbana Champaign

Dr. Sun is a Health Innovation Professor at the Computer Science Department and Carle's Illinois College of Medicine at University of Illinois Urbana Champaign. Previously, he was an associate professor at Georgia Tech's College of Computing and co-directed the Center for Health Analytics and Informatics. Dr. Sun's research focuses on using artificial intelligence (AI) to improve healthcare. This includes deep learning for drug discovery, clinical trial optimization, computational phenotyping, clinical predictive modeling, treatment recommendation, and health monitoring. He has been recognized as one of the Top 100 AI Leaders in Drug Discovery and Advanced Healthcare. Dr. Sun has published over 300 papers with over 25,000 citations, and h-index 81. He collaborates with leading hospitals such as MGH, Beth Israel Deaconess, OSF healthcare, Northwestern, Sutter Health, Vanderbilt, Northwestern, Geisinger, and Emory, as well as the biomedical industry, including IQVIA, Medidata and multiple pharmaceutical companies. https://www.sunlab.org/

Jon Stevens
AI Language Capability Lead, Information Research, AbbVie

Dr. Jon Stevens obtained his BA/MA in Linguistics from Ohio State University, in 2008 and his PhD in Linguistics from the University of Pennsylvania, 2013 is a computational linguist and cognitive scientist specializing in modeling meaning, particularly meaning in context. His research career is in developing mathematical models of conversational meaning and testing those models on empirical data. He applied this work in the area of natural language generation, aiming to create more human-like dialogue systems. Most recently he has turned his focus to combining linguistic theory and machine learning to improve natural language generation and understanding, and he is currently applying these techniques in the biopharmaceutical domain as an NLP developer at AbbVie. https://www.jonscottstevens.com/about

Brandon Nelson
Research Fellow, Food and Drug Administration (FDA)

Dr. Nelson is an FDA Staff Fellow in Machine Learning for Medical CT Image Reconstruction and Denoising. He obtained his Ph.D. from Mayo Clinic Graduate School of Biomedical Sciences. His research focuses in Biomedical Imaging with thesis studies on preclinical applications of advanced x-ray technologies, grating interferometer x-ray dark-field.

Alexandre M. Carvalho
General Internal Medicine
Northwestern Medicine-Northwestern Memorial Hospital

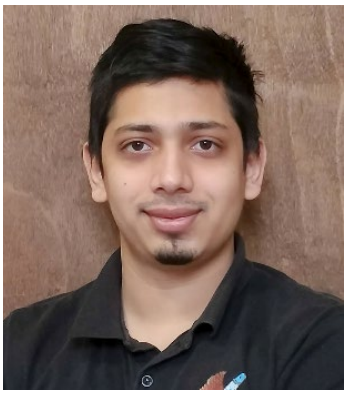
Dr. Alexandre M. Carvalho is an Internist and an Infectious Disease Fellow at Northwestern Memorial Hospital. He received his medical degree (MD) from Faculdade de Medicina da Universidade Federal do Rio de Janeiro. He also holds a Master of Public Health (MPH) from the New York University.

Vivek Natarajan
(MedPALM), Google

Vivek Natarajan is an AI researcher in the Health AI team at Google working to accelerate biomedical AI's translation from code to clinic and scale world-class healthcare to everyone. He is particularly interested in building large foundation models for biomedical applications and lead a Google Brain moonshot. He works on applications ranging from medical imaging to health records modeling and life sciences. His research has been published in well-regarded journals and conferences like Nature Medicine, Nature Biomedical Engineering, JMLR, CVPR, ICCV and NeurIPS. It also forms the basis for several regulated medical device products under clinical trials at Google, including the NHS AI award winning breast cancer detection system Mammo Reader and the skin condition classification system DermAssist.

Session II: Generative Models applied in Healthcare

Chair: Yuxiong Wang



Varun Kelkar

Graduate Student in Bioengineering
University of Illinois Urbana-Champaign

Title: *Assessing the ability of deep generative models to learn canonical medical image statistics*

Abstract: In recent years, deep generative models have gained tremendous popularity for potential applications in medical imaging. Despite the impressive progress in generating perceptually realistic images, it is not clear if modern generative models reliably learn the statistics that are relevant to a downstream medical imaging application. In this talk, I will summarize our efforts in collaboration with researchers from the US Food and Drug Administration towards systematic empirical evaluation and benchmarking of medical image generative models in terms of medically meaningful and pertinent measures of image quality.

Varun Kelkar is a final year PhD candidate in the Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, where he works with Prof. Mark A. Anastasio. His work develops machine learning-based algorithms for inverse problems in medical imaging. He also works on rigorous task-based assessment of ML-based tools for imaging science. His research interests include deep generative models, tomographic imaging, compressed sensing and objective image quality assessment. He was a 2021 Oak-Ridge Institute (ORISE) fellow with the Division of Imaging, US FDA, a mentor for the 2022 Fatima al-Fihri computer science fellowship, and a recipient of the 2019 SPIE education scholarship.

May Dongmei Wang

The Wallace H. Coulter Distinguished Faculty Fellow, Professor of BME, ECE, and CSE, Director of Biomedical Big Data Initiative, Georgia Distinguished Cancer Scholar, Petit Institute Faculty Fellow, Kavli Fellow, AIMBE Fellow, IAMBE Fellow, IEEE Fellow, Board of Directors of American Board of AI in Medicine, Georgia Institute of Technology and Emory University

Title: *Developing Generated AI Solutions for Rare Disease Care*

Abstract: Many rare health conditions have only a small dataset. With small datasets for training in biomedicine and healthcare, one major challenge is how to obtain viable AI models for decision making. Thus, generated AI research such as GAN or diffusion techniques are growing rapidly. In this brief panel talk, I will present a recent work in pediatric heart transplant patient rejection early diagnosis as one example.

Dr. May Dongmei Wang is Wallace H. Coulter Distinguished Faculty Fellow and full professor of Biomedical Engineering, Electrical and Computer Engineering, Computational Science and Engineering at Georgia Institute of Technology (GT) and Emory University (EU). She is Director of Biomedical Big Data Initiative, Georgia Distinguished Cancer Scholar, Petit Institute Faculty Fellow, Kavli Fellow, AIMBE Fellow, IAMBE Fellow, IEEE Fellow, and Board of Directors of American Board of AI in Medicine. Her research is in Biomedical Big Data with AI-Driven Intelligent Reality (IR) for predictive, personalized, and precision health (pHealth). She has 20+ years academic professorship and ~4 years industrial research experience, published 290+ articles in referred journals and conference proceedings with 15,000+ Google Scholar citations, and delivered 280+ invited and keynote lectures. Dr. Wang received BEng from Tsinghua University China, and MS with PhD degrees from GT. She is a recipient of GT Outstanding Faculty Mentor for Undergrad Research Award, and EU MilliPub Award (for a high-impact paper that is cited over 1,000 times). At Georgia Tech, Dr. Wang is in 2022 President Leading Women Program and 2021 Provost Emerging Leaders Program. She was 2018-2021 Carol Ann and David Flanagan Distinguished Faculty Fellow, and 2015-2017 GT Biomedical Informatics Program Co-Director in Atlanta Clinical and Translational Science Institute (ACTSI). Before 2016, Dr. Wang was Director of Bioinformatics and Biocomputing Core in NIH/NCI-sponsored U54 Center for Cancer Nanotechnology Excellence, and Co-Director of GT Center of Bio-Imaging Mass Spectrometry for over 10 years. Dr. Wang is the Senior Editor for IEEE Journal of Biomedical & Health Informatics (J-BHI, Impact Factor 7.02), an Associate Editor for IEEE Transactions for BME and IEEE Reviews for BME, a panelist for NIH CDMA (Clinical Data Management and Analysis) Study Section, NSF Smart and Connect Health, Brain Canada every year. She was 2016 IEEE-EMBS Annual Conference Co-Chair, 2014-2015 IEEE-EMBS Distinguished Lecturer, and an Emerging Area Editor for Proceedings of National Academy of Sciences (PNAS). She organized IEEE-JBHI Special Issue on AI-driven Informatics, Sensing, Imaging and Big Data Analytics for Fighting the COVID-19 Pandemic. Dr. Wang has chaired IEEE Biomedical and Health Informatics (BHI) community and ACM Special Interest Group in Bioinformatics. Currently, Dr. Wang serves in both IEEE Future Directions Committee and International Academy of Medical and Biological Engineering (IAMBE) Executive Committee, and is IEEE-Engineering in Medicine and Biology Society (IEEE-EMBS) Vice President.

Dr. Wang's research has been supported by NIH, NSF, CDC, VA, Georgia Research Alliance, Georgia Cancer Coalition, Shriners' Hospitals for Children, Children's HealthCare of Atlanta, Enduring Heart Foundation, Coulter Foundation, Imlay Foundation, Microsoft Research, HP, UCB, and Amazon.

Vincent Bindschaedler

Assistant Professor in Computer & Information Science & Engineering
University of Florida

Title: *Synthesizing Medical Data with Privacy Guarantees: Fantasy or Plausibility?*

Abstract: Generative AIs are now in the spotlight because of their ability to produce realistic synthetic data, including high-resolution images, short videos, and coherent text. The capabilities of these AIs are based on their underlying generative models, which are trained to estimate the distribution of real-world data using billions of examples. A natural question is whether the same techniques can be harnessed to generate electronic medical records. In this talk, I will discuss the problem of using generative models to synthesize medical records with a particular focus on privacy. I will outline approaches that can yield privacy guarantees. I will also discuss the potential role that transfer learning techniques may play in a solution.

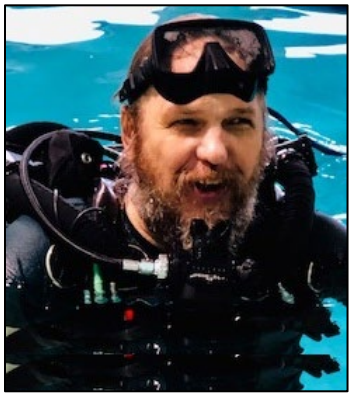
Vincent Bindschaedler is an Assistant Professor in the Department of Computer & Information Science & Engineering at the University of Florida. His research interests include trustworthy machine learning, data privacy, and generative models. His recent work focuses on understanding privacy threats to machine learning and the use of synthetic data to solve privacy and security problems. Prior to joining UF, Dr. Bindschaedler received a Ph.D. in Computer Science from the University of Illinois at Urbana-Champaign (UIUC) in 2018.

Yogatheesan Varatharajah
Research Assistant Professor in Bioengineering
University of Illinois Urbana-Champaign

Title: *Generative Modeling for Medical Education and Training*

Abstract: Patient case studies are an important part of medical education that rely on sharing patient-collected data between hospitals and schools. Although such data is shared with patient consent and proper anonymization of clinical information, some recent studies have shown that data such as head MRI scans and retinal fundus images contain identifiable information that can reveal patient identities. To address this issue, this talk proposes the idea that realistic data synthesized using generative machine learning can be used in medical education while protecting patient identities. Several recent studies have demonstrated this potential where expert clinicians could not differentiate between real and synthesized images. While this is promising, several improvements are needed to make this a reality: a) be able to provide privacy guarantees, b) be able to generate high quality data representing rare diseases, and c) be able to detect and overcome unrealistically synthesized data (i.e., hallucinations).

Dr. Varatharajah is a Research Assistant Professor in the Department of Bioengineering at the University of Illinois at Urbana-Champaign. He obtained his Ph.D. and M.S. degrees from the Department of Electrical and Computer Engineering at the same university under the supervision of Prof. Ravi Iyer. During his graduate program, he was mentored by Dr. Gregory Worrell at the Mayo Clinic through the Mayo-Clinic-Illinois Partnership. Prior to that, he obtained his bachelor's degree in Electronic and Telecommunication Engineering at the University of Moratuwa in Sri Lanka. He has worked at Google and collaborated with Google Accelerated Science and Medical Brain teams.



David Forsyth

Fulton Watson Copp Chair in Computer Science
University of Illinois Urbana-Champaign

Title: *I didn't know StyleGAN could do *THAT**

Abstract: Making something that is really an image involves some knowledge of underlying structures, etc. that go into an image. There is already evidence that some image generation models can be used to edit images (add/remove spectacles, moustaches, etc.). I adduce evidence that these models know about scene lighting and surface normals, too. This suggests that these models could be used to produce a much wider range of medical images than previously suspected.

Dr. Forsyth is currently Fulton-Watson-Copp chair in computer science at U. Illinois at Urbana-Champaign, where he moved from U.C Berkeley, where he was also full professor. He has occupied the Fulton-Watson-Copp chair in Computer Science at the University of Illinois since 2014. He has published over 170 papers on computer vision, computer graphics and machine learning. Dr. Forsyth served as program co-chair for IEEE Computer Vision and Pattern Recognition in 2000, 2011, 2018 and 2021, general co-chair for CVPR 2006 and 2015 and ICCV 2019, program co-chair for the European Conference on Computer Vision 2008, and he is a regular member of the program committee of all major international conferences on computer vision. He has served six years on the SIGGRAPH program committee, and he is a regular reviewer for that conference. He has received best paper awards at the International Conference on Computer Vision and at the European Conference on Computer Vision. He received an IEEE technical achievement award for 2005 for his research. He became an IEEE Fellow in 2009, and an ACM Fellow in 2014. His textbook, "Computer Vision: A Modern Approach" (joint with J. Ponce and published by Prentice Hall) is now widely adopted as a course text (adoptions include MIT, U. Wisconsin-Madison, UIUC, Georgia Tech and U.C. Berkeley). My recent textbook, "Probability and Statistics for Computer Science", is in the top quartile of Springer computer science chapter downloads. A further textbook "Applied Machine Learning" has just appeared in print. He has served two terms as Editor in Chief, IEEE TPAMI. He serves on a number of scientific advisory boards.

Brandon Nelson

Research Fellow, Food and Drug Administration (FDA)

Title: *Accelerating Pediatric Medical Device Innovation with Regulatory Science Tools (RSTs): A Case Study on Pediatric Deep Learning CT Image Reconstruction*

Abstract: As the rate of technological advances moves faster than the science for evaluating the benefits and risks of new products, the FDA's Center for Devices and Radiological Health (CDRH) is helping to ensure that device developers have the right test methods to evaluate new innovations. Regulatory Science Tools (RSTs) expand the scope of innovative science-based approaches to help improve the development and assessment of emerging medical technologies. These tools reduce the need for device developers and innovators to design ad-hoc test methods and allow them to focus their limited resources on how well their new product works, not how well it may be tested.

This case study presents tools and methodologies to enable developers of CT deep learning image reconstruction devices to ensure that pediatric patient populations are appropriately represented in algorithm assessments. These tools include digital pediatric-sized image quality and anthropomorphic phantoms along with other generative techniques aimed to address the lack of pediatric image data for deep learning model assessment.

Dr. Nelson is an FDA Staff Fellow in Machine Learning for Medical CT Image Reconstruction and Denoising. He obtained his Ph.D. from Mayo Clinic Graduate School of Biomedical Sciences. His research focuses on Biomedical Imaging with thesis studies on preclinical applications of advanced x-ray technologies, grating interferometer x-ray dark-field.

ABOUT HCESC

Health Care Engineering Systems Center (HCESC) at the University of Illinois Urbana-Champaign was established in 2014 as a research center housed under the Coordinated Science Laboratory in The Grainger College of Engineering. HCESC provides clinical immersion and fosters collaboration between engineers and physicians with expertise in the broad areas of simulation technologies, smart health systems, health data analytics, and medical robotics. The Health Care Engineering Systems Center has grown throughout the past six years as a place where engineering meets medicine in innovative ways, designing and developing collaborative solutions that improve health care outcomes.

HCESC manages the Jump Applied Research for Community Health through Engineering and Simulation endowment (Jump ARCHES) with Jump Trading Simulation and Education Center in Peoria, Illinois to provide funding for researchers working at the intersection of health care and engineering. They also manage the Jump Simulation Center located on the University of Illinois campus and the Health Data Analytics Initiative.

THE HEALTH DATA ANALYTICS INITIATIVE

The Health Data Analytics Initiative is a central hub connecting clinical investigators with AI and data scientists at Illinois, committed to enabling and driving fundamental medical research and improving health care delivery by designing tailored AI and data retrieval solutions for our partners. The initiative has received grants from C3.ai Digital Transformation Institute, NSF, and Discovery Partners Institute.

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