



ELECTRICAL AND COMPUTER ENGINEERING SEMINAR



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Causality: From Learning to Generative Models

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Abstract: Causal inference is fundamental for multiple disciplines ranging from medical research to engineering, statistics and economics. It is also central in machine learning and is now becoming a core component of artificial intelligence research. Although causal inference has been studied for a long time in various fields under different frameworks, today we need tools that can process a large number of variables to handle modern large datasets. The graphical approach to probabilistic causation advocated by Judea Pearl and others provides a way to compactly represent the causal relations using directed acyclic graphs and paves the way for the design of algorithms that can answer causal questions for many variables.

In this talk, I first provide a friendly introduction to causality and explain why causal understanding is important. As my first contribution, I propose a framework called entropic causal inference for inferring the causal direction between two variables from data. I show that entropy can be used to capture the complexity of a causal mechanism. Further, if the true direction has a simple mechanism, we can identify it from data. The entropic causal inference framework leverages tools from information theory for causal inference. As my second contribution, I show how we can apply causality in deep generative models - deep neural networks used for modeling complex data. I demonstrate how to define and train a causal deep generative model, called CausalGAN for generating images with labels. As an extension of generative adversarial networks (GANs), CausalGAN allows sampling not only from the observed data distribution but also from the interventional distributions of images. I conclude with future directions for causal inference and its applications in supervised learning and reinforcement learning.

Bio: I received my B.S. degree in Electrical - Electronics Engineering with a minor degree in Physics from the Middle East Technical University in 2010. I received my M.S. degree from the Koc University, Turkey in 2012 under the supervision of Prof. Ozgur B. Akan, and Ph.D. degree from The University of Texas at Austin in 2018, under the supervision of Prof. Alex Dimakis and Prof. Sriram Vishwanath. I am currently a Research Staff Member in the MIT-IBM Watson AI Lab in IBM Research, Cambridge, Massachusetts. My current research interests include causal inference, generative adversarial networks, and information theory.