Sankaran Vaidyanathan

✉ sankaranv@cs.umass.edu
sankaranv.github.io
linkedin.com/in/sankaranv8/

Education

Sep '21–May '26 **Ph.D., Computer Science**, University of Massachusetts Amherst

Sep '19–May '24 **M.S., Computer Science**, University of Massachusetts Amherst *GPA: 3.97/4.0*

Aug '13–May '17 **B.E., Electrical and Electronics Engineering**, Anna University *GPA: 8.45/10*

Research Experience

Jan '20–present **Research Assistant**, Knowledge Discovery Lab, University of Massachusetts Amherst
Advisor: David Jensen

Jul '17–Jun '19 **Project Associate**, RISE-IIL Lab, Indian Institute of Technology Madras
Advisor: Balaraman Ravindran

Publications

Applied Network Science '20 **Hypergraph Clustering by Iteratively Reweighted Modularity Maximization**
Tarun Kumar, **Sankaran Vaidyanathan**, Harini Ananthapadmanabhan, Srinivasan Parthasarathy, Balaraman Ravindran

Complex Networks '19 **A New Measure of Modularity in Hypergraphs: Theoretical Insights and Implications for Effective Clustering**
Tarun Kumar*, **Sankaran Vaidyanathan***, Harini Ananthapadmanabhan, Srinivasan Parthasarathy, Balaraman Ravindran *(* denotes equal contribution)*

Projects

Jan '23 – present **Automated Discovery of Actual Causes in Complex Environments**
Joint work with Caleb Chuck, Stephen Giguere, Amy Zhang, and Scott Niekum (UT Austin)

- Extended the theory of actual causality, a framework for defining causal explanations, blame and responsibility, to continuous-valued and complex domains.
- Designed a tractable inference algorithm for identifying actual causes, which are events that actually occurred and were responsible for what happened to the agent during its trajectory.
- Developed a causal discovery algorithm that learns to identify context-specific independencies, which indicate if events that occurred during the trajectory did not affect the agent and can be ignored.
- Detected and explained interactions between the agent and objects in a set of physical reasoning and reinforcement learning domains, by using our approach to learn to identify actual causes.

May '23 – present **Analysis and Prediction of Cognitive Load Among Teams During Cardiac Surgery**
In collaboration with the National Institute of Health and Harvard Medical School

- Predicting cognitive load and stress among members of a surgical team while performing cardiac surgery, by modeling various measures of their heart rate variability over the course of the surgery.
- Implemented MCMC-based imputation for filling in gaps and missing trajectories in heart rate data that resulted from failing heart rate monitors during data collection, and developed transformer-based neural network architectures for predicting heart-rate variability.
- Analyzed and visualized heart rate data for correlations between team members during different phases of the surgery, as well as variations in behavior between different surgeons and nurses.

May '20–Aug '22 **Competence-Aware Machine Learning**
Joint work with David Jensen (UMass Amherst), Joydeep Biswas (UT Austin) and Charles River Analytics

- Determined the causes of failure for a pre-trained reinforcement learning agent navigating in the AirSim driving environment, by estimating causal effects of various environmental conditions on mission failure.
- Learned causal models that estimated the agent's competence (probability of mission success) for a route with pre-specified environmental conditions.
- Developed a system that allowed a human operator to specify environmental conditions for a new episode prior to deployment, and returned an upper and lower bound on the agent's estimated competence.

Jul '17–Jun '19 **Hypergraph Clustering by Iteratively Reweighted Modularity Maximization**
Supervised by Balaraman Ravindran (IIT Madras) and Srinivasan Parthasarathy (Ohio State)

- Discovered clusters in bibliographic and social networks modeled as hypergraphs.
- Extended the modularity maximization framework for graph clustering to the hypergraph clustering task.
- Developed a method for eliminating redundant cluster assignments by reweighting hyperedges that cut across clusters.

Jan-May '17 **Control of Autonomous Quadrotor for Real-Time Object Tracking**

- Built a quadcopter with an Arduino-based flight controller that tracked and followed selected objects in its field of view.
- Implemented video stabilization on the camera feed using Kalman filtering, and Lucas-Kanade optical flow for object tracking.

Teaching Experience

Feb-May '23 **COMPSCI 688: Probabilistic Graphical Models**, University of Massachusetts Amherst

- Developed homework assignments, answered questions on Piazza, and conducted office hours.

Sep-Dec '22 **COMPSCI 383: Artificial Intelligence**, University of Massachusetts Amherst

- Developed a system for outreach and one-on-one check-ins with students who were falling behind, designed programming assignments, and conducted office hours.

Dec '21 **MATH 605: Probability Theory**, University of Massachusetts Amherst

- Gave a guest lecture on sampling methods, Markov Chain Monte Carlo, and Hamiltonian Monte Carlo.

Jan–May '19 **Introduction to Machine Learning**, Indian Institute of Technology Madras

- Developed iPython-based interactive demos and gave supplementary video lectures, designed exams and programming assignments, and led in-person discussion sessions.

Technical Skills

- **Programming Languages**: Python, R, C++
- **Frameworks**: PyTorch, Pyro, NumPy, sklearn, OpenCV
- **Tools and Platforms**: Figma, Git, Kubernetes, Arduino, Linux

Coursework

Bayesian Statistics, Machine Learning, Intro to Causal Inference, Research Methods in Empirical CS, Probabilistic Graphical Models, Artificial Intelligence, Reinforcement Learning, Probability Theory, Distributed and Operating Systems, Quantum Information Systems, Fixing Social Media, Neural Networks: A Modern Introduction