Purva Pruthi

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Summary

My research combines causality, compositionality, and modular deep learning to develop efficient, scalable, and robust models for real-world systems. I have extensive experience in applying machine learning techniques to solve complex problems across diverse domains, including finance, agriculture, biology, and material science.

Education

University of Massachusetts Amherst 2018 – 2026 (Expected)
Ph.D. Candidate, Computer Science
Thesis: Compositional models for causal reasoning

University of Massachusetts Amherst 2018 – 2021
M.S. in Computer Science; GPA: (3.95/4.0)

Indian Institute of Technology, Roorkee, India 2011 – 2015
Bachelor of Technology in Computer Science and Engineering; CGPA: (8.5/10.0)

Experience

University of Massachusetts Amherst June 2020 – Present
Graduate Research Assistant

- Doctoral thesis focuses on combining the principles of causality, compositionality, and modular deep learning to develop efficient and scalable models of real-world systems.
- Systematic training and evaluation of the transformer architectures on task-based compositional generalization.
- Developed a novel compositional framework for individual causal effect estimation in hierarchical systems: SQL query execution engine, software programs, and manufacturing assembly lines (CLeaR 2025).
- Improved evaluation methods for observational causal inference using experimental and empirical datasets (ICML 2021).

Toyota Research Institute, Los Altos, USA June 2025 – August 2025
Research Intern – Energy and Materials Division

- Developed an LSTM-based time-series model to predict fuel cell performance on irregularly sampled time-series.
- Implemented causal models using ChiRho to estimate the effects of interventions on fuel cell performance.
- Applied a continuous optimization-based structure learning approach combined with prior knowledge to learn causal structure among material properties.

Google X, Mountain View, USA September 2021 – May 2022
Ph.D. AI Resident

- Developed predictive and causal modeling techniques for time-series forecasting of crop harvests in agriculture.
- Designed gene–gene interaction structure learning model for efficient design and editing of programmable plants for an early-stage biology project, now known as Heritable Agriculture.

Amazon Research Center, Cambridge, UK May 2019 – August 2019
Research Intern – Supply Chain and Optimization

- Designed a causal structure learning–based reinforcement learning approach to enable efficient transfer learning in domains with perceptually changing state features but identical underlying causal dynamics models (ICML Workshop 2020).

Goldman Sachs, Bengaluru, India June 2015 – July 2018
Quantitative Analyst, Operations and Global Investment Research Division

- Designed and built infrastructure in C++ and R to backtest quantitative investment strategies based on company fundamentals and market data.
- Improved team efficiency by 25% by automating the reconciliation of external receipts and internal records using association rule mining.

Projects

Evaluation of compositional generalization in large language models March 2025 – Present

- Fine-tuning of large language models on the systematic train-test splits of code-reasoning tasks.
- Implemented transformer program-based architectures to generate mechanistically interpretable models on compositional reasoning tasks.

Single-cell modeling of breast cancer datasets Feb 2023 – Oct 2023

- Performed a systematic comparison of gene expression between healthy donors and cancer donors across two large-scale single-cell datasets: Human Breast Cell Atlas (117,346 cells) and Breast Cancer Atlas (130,246 cells).
- Performed various analyses – data integration, donor type prediction, DNA copy number variation analysis using a single-cell variational inference-based approach on large-scale and sparse single-cell data sets.

Selected Publications

[1] **Purva Pruthi** and David Jensen. "Compositional Models for Estimating Causal Effects." *Causal Learning and Reasoning.* PMLR, 2025.

[2] Amanda Gentzel, **Purva Pruthi**, and David Jensen. "How and why to use experimental data to evaluate methods for observational causal inference." *International Conference on Machine Learning.* PMLR, 2021.

[3] **Purva Pruthi**, Javier Gonzalez, Xiaoyu Lu, and Madalina Fiterau. "Structure Mapping for Transferability of Causal Models." *Inductive Biases, Invariances, and Generalization in Reinforcement Learning Workshop, ICML 2020.*

Preprints

[4] **Purva Pruthi**, Andrew Yuan, Alexander D'Amour, and David Jensen. "Why Transformers Succeed and Fail at Compositional Generalization: Composition Equivalence and Module Coverage." (2025). (Submitted; under review)

Technical skills

Languages: Python, C/C++, Java, R, SQL
Frameworks/Databases: PyTorch, TensorFlow, PostgreSQL, Git, Docker
Developer Tools: Git, Docker, Visual Studio, PyCharm, Jupyter Notebook, RStudio, Jira
Domains: Causal inference, reinforcement learning, modular deep learning

Honors and Awards

UMass CICS Dissertation Writing Fellowship 2024

Data Science for the Common Good Fellowship May 2023 – August 2023

Service and Outreach

Chan-Zuckerberg Institute Industry Project Ph.D. Mentor 2023

Reviewer/Program Committee: CLeaR'25, AAAI'24, AISTATS'24, AAAI'23, AISTATS'23, AISTATS'22 2022-2024

Data Science Industry Mentor for Chan Zuckerberg Initiative (CZI), Goldman Sachs 2023-2024

Mentor, Ph.D. Applicant Support Program, UMass CICS 2021

Mentor, EMBER Undergraduate Mentorship Program, UMass CICS 2021

Social Chair, UMass Graduate CS Women Group 2019-2020

Relevant Graduate Coursework

Machine Learning, Neural Networks: A Modern Introduction, Reinforcement Learning, Probabilistic Graphical Models, Distributed Operating Systems, Mathematical Statistics, Research Methods for Empirical Computer Science, Advanced Algorithms, Graph Theory