Shantanu Ghosh(he/him)

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Last updated on June 23, 2024

Research Interests

Reasoning in vision language models, Explainable AI (X-AI), Computer Vision, Medical Imaging.

Education

Boston University   **Boston, Massachusetts, USA**
Doctor of Philosophy, Electrical Engineering   *Jan 2023 – Dec 2026 (Expected)*
Advisor(s): **Dr. Kayhan Batmanghelich**

University of Pittsburgh *(Transferred to BU)*   **Pittsburgh, Pennsylvania, USA**
Doctor of Philosophy, Intelligent Systems   *Aug 2021 – Dec 2022*
Advisor(s): **Dr. Kayhan Batmanghelich**

Carnegie Mellon University   **Pittsburgh, Pennsylvania, USA**
PCHE Cross registered student   *Aug 2021 – Dec 2022*
Courses: *Foundations of Causation and Machine Learning (PHI 80625) and Visual Learning and Recognition (RI 16824)*

University of Florida   **Gainesville, Florida, USA**
Master of Science, Computer Science, **3.88/4.00**   *Aug 2019 – May 2021*
Advisor: **Dr. Mattia Prosperi**

Publications

Conference Proceedings

[C6] ***Mammo-CLIP: A Vision Language Foundation Model to Enhance Data Efficiency and Robustness in Mammography***
Shantanu Ghosh, Clare B. Poynton, Shyam Visweswaran, Kayhan Batmanghelich
International Conference on Medical Image Computing and Computer Assisted Intervention (**MICCAI**), 2024.
(**Early accept, top 11%**) **[Paper] [Code]**

[C5] ***Distilling BlackBox to Interpretable models for Efficient Transfer Learning***
Shantanu Ghosh, Ke Yu, Kayhan Batmanghelich
International Conference on Medical Image Computing and Computer Assisted Intervention (**MICCAI**), 2023.
(**Early accept, top 14%**) **[Project] [Paper] [Code]**

[C4] ***Dividing and Conquering a BlackBox to a Mixture of Interpretable Models: Route, Interpret, Repeat***
Shantanu Ghosh, Ke Yu, Forough Arabshahi, Kayhan Batmanghelich
International Conference on Machine Learning (**ICML**), 2023. **[Project] [Paper] [Code]**

[C3] ***DR-VIDAL - Doubly Robust Variational Information-theoretic Deep Adversarial Learning for Counterfactual Prediction and Treatment Effect Estimation***
Shantanu Ghosh, Zheng Feng, Jiang Bian, Kevin Butler, Mattia Prosperi
American Medical Informatics Association (**AMIA**) Symposium, 2022 (**Oral**). **[Paper] [Code]**

[C2] ***Anatomy-Guided Weakly-Supervised Abnormality Localization in Chest X-rays***
Ke Yu, **Shantanu Ghosh**, Zhexiong Liu, Christopher Deible, Kayhan Batmanghelich
International Conference on Medical Image Computing and Computer Assisted Intervention (**MICCAI**), 2022.
[Paper] [Code]

[C1] ***Causal AI with Real World Data: Do Statins Protect From Alzheimer'sDisease Onset?***

Mattia Prosperi, **Shantanu Ghosh**, Zhaoyi Chen, Marco Salemi, Tianchen Lyu, Jiang Bian
International Conference on Medical and Health Informatics (**ICMHI**), 2021. **[Paper]**

Journal Articles

[J3] ***Anatomy-specific Progression Classification in Chest Radiographs via Weakly-Supervised Learning***
Ke Yu, **Shantanu Ghosh**, Zhexiong Liu, Clare Poynton, Christopher Deible, Kayhan Batmanghelich
Radiology Artificial Intelligence (**RAD AI**), 2024 (*In print*).

[J2] ***Propensity Score Synthetic Augmentation Matching using Generative Adversarial Networks (PSSAM-GAN)***
Shantanu Ghosh, Christina Boucher, Jiang Bian, Mattia Prosperi
Journal of Computer Methods and Programs in Bio-medicine Update, 2021. **[Paper] [Code]**

[J1] ***Deep Propensity Network using a Sparse Autoencoder for Estimation of Treatment Effects***
Shantanu Ghosh, Jiang Bian, Yi Guo, Mattia Prosperi
Journal of the American Medical Informatics Association (**JAMIA**), 2021. **[Paper] [Code]**

Peer reviewed workshops

[W2] ***Tackling Shortcut Learning in Deep Neural Networks: An Iterative Approach with Interpretable Models***
Shantanu Ghosh, Ke Yu, Forough Arabshahi, Kayhan Batmanghelich
Workshop on Spurious Correlations, Invariance and Stability (**SCIS**), ICML, 2023. **[Paper] [Poster]**

[W1] ***Bridging the Gap: From Post Hoc Explanations to Inherently Interpretable Models for Medical Imaging***
Shantanu Ghosh, Ke Yu, Forough Arabshahi, Kayhan Batmanghelich
Workshop on Interpretable Machine Learning in Healthcare (**IMLH**), ICML, 2023. **[Paper] [Poster]**

Research Experience

Boston University

Graduate Research Assistant   **Boston, Massachusetts, USA**
Batman Lab   *Jan 2023 – Present*
- **Advisor(s):** Dr. Kayhan Batmanghelich
- **Research Area**: Explainable AI; Computer Vision; Medical Imaging.
- Currently developing a slice discovery algorithm using vision language (VLM) multimodal model (*e.g.,* CLIP) to reason why a classifier makes mistakes while detecting breast cancer using breast mammograms and explain with large language models (LLMs).
- Continuing my research by applying the mixture of interpretable models on a real-world Chest-X-Ray dataset – MIMIC-CXR to (1) eliminate the class imbalance problem; (2) transfer efficiently to an unseen domain with limited training data. **(Early) Accepted at MICCAI, 2023**.

University of Pittsburgh

Graduate Student Researcher   **Pittsburgh, Pennsylvania, USA**
Batman Lab   *Aug 2021 – Dec 2022*
- **Advisor(s):** Dr. Kayhan Batmanghelich, Dr. Forough Arabshahi
- **Research Area**: Explainable AI; Computer Vision; Medical Imaging.
- Introduced an iterative algorithm to carve out a mixture of interpretable models from a Blackbox, each specializing in a different subset of data to provide instance-specific First-order logic-based explanations using human-understandable concepts. Also, our method effectively detected and removed the shortcut (biased) concepts from the Blackbox, making it robust. **Accepted at ICML, 2023**.
- Localized Pneumonia and Pneumothorax from **MIMIC-CXR** dataset by leveraging the anatomical landmarks (weak labels) using the **Stanford RadGraph NLP pipleline**. **Accepted at MICCAI, 2022**.
- Investigated why **lottery ticket hypothesis** works or fails in terms of explainability metrics – **Concept activation vectors (TCAV)** and **Grad-CAM** based saliency maps. **[Code] [Report]**

University of Florida

Graduate Research Assistant   **Gainesville, Florida, USA**
Florida Institute for Cybersecurity (FICS) Research   *Mar 2021 – Jul 2021*

- **Advisor(s):** Dr. Mattia Prosperi, Dr. Kevin Butler
- **Research Area**: Causal Inference, Deep Learning.
- Developed a novel deep learning framework to (1) generate the counterfactual outcomes based on treatment using a Generative Adversarial Network with **information-theoretic** regularization; (2) utilized the counterfactual outcomes to estimate the individual treatment effect (**ITE**) using **doubly robust optimization** for faster convergence. **Accepted at AMIA Symposium (Oral), 2022**.

University of Florida

Research Assistant   **Gainesville, Florida, USA**
Data Intelligence Systems Lab (DISL)   *Jan 2020 – Feb 2021*

- **Advisor(s):** Dr. Mattia Prosperi, Dr. Jian Bian
- **Research Area**: Causal Inference, Deep Learning.
- Designed a novel algorithm using a Generative Adversarial Network to generate synthetic treated samples to remove imbalance within an observational dataset for **Propensity score matching**. **Accepted at Computer Methods and Programs in Bio-medicine Update**.
- Developed a **sparse autoencoder** to reduce the dimensionality of the covariates of the patients to calculate the **Propensity score** in an efficient way to estimate the average treatment effect (**ATE**) of the treatment. **Accepted at JAMIA**.

Industry Experience

Amazon

Applied Scientist Intern   **NYC, New York, USA**
AWS, Security Analytics and AI Research (SAAR)   *Jun 2024 – Sep 2024*

- Discovering systematic errors in self-supervised models for AWS logs.

Lexmark International India Pvt Ltd

Software Engineering Professional II   **Kolkata, India**
     Oct 2016 – Jul 2019

- Developed the ISP component of the product **Publishing Platform for Retail (PPR)**.

Cognizant Technology Solutions India Pvt Ltd

Associate, Projects   **Kolkata, India**
     Mar 2013 – Sep 2016

- Developed **WCF** web services in the Contract First Approach using Service Oriented Architecture.

Skills

- **Languages.** Python, C/C++, Java, C#/.Net, Javascript, HTML/CSS
- **Machine Learning.** TensorFlow, PyTorch, Scikit-learn
- **Web Development.** Angular, Node.js, WCF
- **Database.** MySQL, Oracle 9i/10g, MS SQL Server, DB2

Graduate Courses

- Fundamentals of Machine Learning • Machine Learning • Advanced Machine Learning • Deep Learning for Computer Graphics • Causal Inference and Machine Learning • Visual Learning and Recognition • Mathematics for Intelligent Systems • Fundamentals of Probability • Numerical Optimization • Analysis of Algorithms • Advanced Data Structures

Honors & Awards

o Received the **Achievement Award** of 4500 USD during the admission of graduate studies in the University of Florida in Fall 2019.
o Received the **Star Employee** award in Q4, 2013 and Q4, 2015 in Cognizant Technology Solutions.

Academic Service

Journal Review

o Medical Image Analysis (MedIA)
o Journal of the American Medical Informatics Association (JAMIA)
o Journal of Computer Methods and Programs in Biomedicine (CMPB)
o Biometrical Journal

Conference Review

o Medical Image Computing and Computer Assisted Intervention (MICCAI) 2024
o IEEE / CVF Computer Vision and Pattern Recognition Conference (CVPR) - 2024
o Causal Learning and Reasoning (CLeaR) - 2024
o International Conference on Learning Representations (ICLR) - 2024
o Association for the Advancement of Artificial Intelligence (AAAI) - 2024
o Neural Information Processing Systems (NeurIPS) - 2023, 2024
o ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (BCB) - 2022

Workshop Review

o Workshop on Causal Representation Learning workshop (CRL), NeurIPS 2023
o Workshop on Spurious Correlations, Invariance and Stability (SCIS), ICML - 2023
o Workshop on Interpretable Machine Learning in Healthcare (IMLH), ICML - 2023

Teaching Experience

Introduction to Software Engineering (EC 327) - Fall 2023

Student Mentoring

Rayan Syed - Undergraduate Researcher, Boston University
Project: Detecting bias in deep learning models.
LinkedIn: rayan-syed

Akshant Sharma - Undergraduate Researcher, Boston University
Project: Detecting bias in deep learning models.
LinkedIn: akshant-sharma

Abhishek Varshney - Master's Researcher, Boston University
Project: Developing vision language models for large-scale mammograms.
LinkedIn: abhishek-varshney

Akshat Gurbuxani - Master's Researcher, Boston University
Project: Developing vision language models for large-scale mammograms.
LinkedIn: akshatgurbuxani

Talks

o Oral Talk, AMIA 2022 Annual Symposium, Nov 2022 **[Talk] [Slides]**
o Fall ISP AI Forum, University of Pittsburgh, Nov 2023 **[Talk] [Slides]**