Shantanu Ghosh

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Shantanu Ghosh • Last updated on February 7, 2023

Research Interests

Explainable AI; Computer Vision; Medical Imaging; Deep Learning; Causal Inference

Education

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

University of Pittsburgh — **Pittsburgh, Pennsylvania, USA**
Doctor of Philosophy, Intelligent Systems — *August 2021 – Present*
Advisor(s): Dr. Kayhan Batmanghelich

Carnegie Mellon University — **Pittsburgh, Pennsylvania, USA**
PCHE Cross registered student — *August 2021 – Jan 2023*
***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*** — *August 2019 – May 2021*
Advisor: Dr. Mattia Prosperi

Research Experience

Batman Lab

Graduate Student Researcher — **Pittsburgh, Pennsylvania**
University of Pittsburgh — *August 2021 – Present*

- **Advisor(s):** Dr. Kayhan Batmanghelich
- **Research Area**: Explainable AI; Causal Inference; Computer Vision; Medical Imaging.
- Currently developing a novel algorithm to explain the prediction of a black box classifier with the help of network pruning using **lottery ticket hypothesis**. In this project, we aim to iteratively extract the explainable concepts from a black-box model using a neuro-symbolic explainable model. Also, we aim to detect the shortcut (biased) concepts from the black box and iteratively remove them from the features of the black box to make it robust.
- Analyzed why pruning strategies using **lottery ticket hypothesis** works or fails in terms of explainability metrics – **Concept activation vectors (TCAV)** for global concepts and saliency maps like **Grad-CAM**, **Integrated-Gradient** for pixel attributions.
- Developed an attention model to leverage the anatomical landmarks (weak labels) from **Stanford RadGraph NLP pipleline** to detect Pneumonia and Pneumothorax from **MIMIC-CXR** dataset. Also, designed the baseline using **RetinaNet**. *Paper accepted at MICCAI, 2022.*

Florida Institute for Cybersecurity Research (FICS)

Graduate Research Assistant — **Gainesville, Florida**
University of Florida — *March 2021 – May 2021*

- **Advisor(s):** Dr. Kevin Butler
- **Research Area**: Causal Inference, Adversarial Machine Learning.
- Designed a robust deep learning model amalgamating the theories of **Causal Graphs** and **Deep Variational Information Bottleneck**. Studied the failure modes of the causal model by performing adversarial attacks.
- Developed the baseline using the experiments in the papers **"Deep Variational Information Bottleneck"** (Alemi et al.) and **"A Causal View on Robustness of Neural Networks"** (Zhang et al.) in **Pytorch**.

Data Intelligence Systems Lab (DISL)

Research Assistant — **Gainesville, Florida**
University of Florida — *Feb 2020 – Feb 2021*

- **Advisor(s):** Dr. Mattia Prosperi, Dr. Jian Bian
- **Research Area**: Causal Inference, Deep Learning.
- Developed a novel deep learning framework to generate the counterfactual outcomes based on a treatment using a Generative Adversarial Network and **information-theoretic** regularization. Next, we utilized the counterfactual outcomes to estimate the individual treatment effect (**ITE**) using a novel deep learning network with **doubly robust optimization** for faster convergence. *Paper accepted at AMIA Symposium (**Oral**), 2022.*
- 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**. *Paper accepted at Computer Methods and Programs in Bio-medicine Update.*
- Developed a **sparse autoencoder** to reduce the dimensionality of the feature vectors of the patients to calculate the **Propensity score** in an efficient way to estimate the average treatment effect (**ATE**) of the treatment. *Paper accepted at JAMIA.*

Multimedia Communications and Networking Laboratory (MCN)

Independent Researcher — **Gainesville, Florida**
University of Florida — *Feb 2020 – May 2020*

- **Advisor(s):** Dr. Dapeng (Oliver) Wu
- **Research Area**: Computer Vision.
- Developed a Deep Convolutional Multitask Neural Network(**MTL-TCNN**) to classify textures. We used an auxiliary head to detect normal images other than textures to regularize the main texture detector head of the network. **[Report] [Code]**

Publications

Conference Proceedings

1. ***DR-VIDAL - Doubly Robust Variational Information-theoretic Deep Adversarial Learning for Counterfactual Prediction and Treatment Effect Estimation***
   Shantanu Ghosh, Zheng Feng, Marco Salemi, Tianchen Lyu, Jiang Bian, Kevin Butler, Mattia Prosperi
   American Medical Informatics Association (AMIA) Symposium, 2022 (**oral, *to appear***).
2. ***Anatomy-Guided Weakly-Supervised Abnormality Localization in Chest X-rays***
   Ke Yu, **Shantanu Ghosh**, Zhexiong Liu, Kayhan Batmanghelich
   International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), 2022.
3. ***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.

Journal Articles

1. ***Propensity Score Synthetic Augmentation Matching using Generative Adversarial Networks (PSSAM-GAN)*** **[Code]**
   Shantanu Ghosh, Christina Boucher, Jiang Bian, Mattia Prosperi
   Journal of Computer Methods and Programs in Bio-medicine Update, 2021
2. ***Deep Propensity Network using a Sparse Autoencoder for Estimation of Treatment Effects*** **[Code]**
   Shantanu Ghosh, Jiang Bian, Yi Guo, Mattia Prosperi
   Journal of the American Medical Informatics Association, 2021

Industry Experience

Lexmark International India Pvt Ltd

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

- Worked as a full stack developer to develop the ISP component of the product Publishing Platform for Retail(PPR) using **C# .Net 4.5**, **Angular**, **HTML5** and **SQL Server** with active participation in 2 major releases. Performed unit testing using **Jasmine/Karma Framework**.
- Worked on the Lexmark Digital Media Platform, a multi-tenant enterprise video content management platform hosted in Amazon Web Services.

Cognizant Technology Solutions India Pvt Ltd

Associate, Projects **Kolkata, India**
March 2013 – September 2016

- Worked as a senior developer to develop WCF web services in the Contract First Approach to provide a secure communication channel between the different In-house applications using Service Oriented Architecture (SOA), C# .Net 4.5, Oracle Client 11g.

Skills

- **Languages.** Python, C/C++, Java, C#/.Net, Javascript/Typescript, 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 ▪ Mathematics for Intelligent Systems ▪ Machine Learning ▪ Deep Learning Computer Graphics ▪ Fundamentals of Probability ▪ Advanced Machine Learning ▪ Analysis of Algorithms ▪ Numerical Optimization ▪ Causal Inference and Machine Learning ▪ Visual Learning and Recognition ▪ Advanced Data Structures

Honors & Awards

- Received the **Achievement Award** of 4500 USD during the admission of graduate studies in the

University of Florida in Fall 2019.

- Received the **Star Employee** award in Q4, 2013 and Q4, 2015 in Cognizant Technology Solutions.