

RESEARCH INTERESTS

TrustworthyML for Foundation Models. While there has been remarkable progress in developing large-scale complex neural network models in recent years, our understanding of how, what, and why they learn what they learn remains shallow. I study these questions using the lens of interpretability, explainability, robustness, and fairness and believe that examining these trustworthy properties will advance our understanding of neural networks.

Data Protection. Sharing personal information online poses privacy risks and raises concerns about its unauthorized use for commercial machine learning models. This line of research focuses on protecting data from unauthorized usage by making them unlearnable, ensuring that a trained model will fail to learn the real semantics and recognize the user's information in the data during inference, *i.e.*, the user's data gets protected.

Transferability and Distillation. Transfer learning and knowledge distillation (KD) methods have long been used to train smaller models by transferring knowledge from larger models. However, a glaring gap exists in our understanding of these frameworks, like the transferability of a given task or what knowledge gets distilled in KD. I leverage theoretical and empirical analysis to develop new strategies for transferability metrics and KD frameworks in ways that improve efficiency without affecting their trustworthiness.

ACADEMIC & PROFESSIONAL EXPERIENCE

Harvard University

Postdoctoral Research Fellow

2020 – Present

Adobe

Research Scientist

2022 – 2023

Auburn University

Research Assistant

Summer 2019

Robert Bosch LLC

Computer Vision/Augmented Reality Intern

Summer 2018

Tempus labs Inc.

Imaging Science Intern

Spring 2018

Kitware Inc.

Research and Development Intern

Summer 2017

Geisinger Health Systems

Research Intern

Summer 2016

EDUCATION

University of Illinois at Chicago

Ph.D. in Electrical and Computer Engineering

2020

- Thesis: *Robustness and Explainability of Deep Neural Networks*
- Committee: [Dr. Dan Schonfeld](#), [Dr. Bharati Prasad](#), [Dr. Mojtaba Soltanalian](#),
[Dr. Piotr Gmytrasiewicz](#), [Dr. Anh Nguyen](#)

SELECTED HONORS & ACHIEVEMENTS

Spotlight paper, ICML	2021
AINet Fellow by DAAD	2021
AI for Social Good Google Workshop with Dr. Marinka Zitnik and Dr. Hima Lakkaraju (US \$10,000)	2021
Spotlight presentation, ICML workshop on Human Interpretability in Machine Learning	2020
2 × Research Proposal accepted by Google Cloud Platform (US \$1,000)	2020
Spotlight paper, IEEE Conference on Image Processing (ICIP)	2019
Finalist for the Deans Scholarship Award at UIC	2019

RESEARCH ARTICLES

Articles in Peer-Reviewed Journals

51. **C. Agarwal**, O. Queen, H. Lakkaraju, M. Zitnik: Evaluating Explainability for Graph Neural Networks, *Nature Scientific Data*, 2023.
100+ GitHub stars
50. H. Honarvar, **C. Agarwal**, S. Somani, A. Vaid, J. Lampert, T. Wanyan, V. Y. Reddy, G. N. Nadkarni, R. Miotto1, M. Zitnik, F. Wang, B. S. Glicksberg: Enhancing convolutional neural network predictions of electrocardiograms with left ventricular dysfunction using a novel sub-waveform representation, *Cardiovascular Digital Health Journal*, 2022.
49. **C. Agarwal**, S. Gupta, M. Y. Najjar, T. E. Weaver, X. J. Zhou, D. Schonfeld, B. Prasad: Deep Learning Analyses of Brain MRI to Identify Sleepiness in Treated Obstructive Sleep Apnea: A Pilot Study, *Journal of Sleep and Vigilance (JSV)*, 2022.
48. B. Prasad*, **C. Agarwal***, E. Schonfeld, D. Schonfeld, B. Mokhlesi: Deep learning applied to polysomnography to predict blood pressure in obstructive sleep apnea and obesity hypoventilation: A proof-of-concept study, *Journal of Clinical Sleep Medicine (JCSM)*, 2020.
47. **C. Agarwal**, J. Klobusicky, D. Schonfeld: Convergence of backpropagation with momentum for network architectures with skip connections, *Journal of Computational Mathematics (JCM)*, 2019.
46. E. Cha, Y. Veturi, **C. Agarwal**, M. Arbabshirani, S. Pendergrass: Using Adipose Measures from Electronic Health Record Imaging Based Data for Discovery, *Journal of Obesity*, 2018.

Articles in Peer-Reviewed Conference Proceedings

45. M. Llodes, D. Ganguly, S. Bhatia, **C. Agarwal**: Explain like I am BM25: Interpreting a Dense Model's Ranked-List with a Sparse Approximation, *ACM SIGIR Conference on Research and Development in Information Retrieval (SIGIR)*, 2023.
44. A. Seth, M. Hemani, **C. Agarwal**: DeAR: Debiasing Vision-Language Models with Additive Residuals, *Conference on Computer Vision and Pattern Recognition (CVPR)*, 2023.
43. S. Deshmukh, A. Dasgupta, B. Krishnamurthy, N. Jiang, **C. Agarwal**, J. Subramanian, G. Theodorou: Trajectory-based Explainability Framework for Offline RL, *International Conference on Learning Representations (ICLR)*, 2023.
42. J. Cheng, G. Dasoulas, H. He, **C. Agarwal**, M. Zitnik: GNNDelete: A General Unlearning Strategy for Graph Neural Networks, *International Conference on Learning Representations (ICLR)*, 2023.

41. V. Giunchiglia, C. V. Shukla, G. Gonzalez, **C. Agarwal**: Towards Training GNNs using Explanation Directed Message Passing, *Proceedings of the First Learning on Graphs Conference (LoG)*, 2022.
40. **C. Agarwal**, E. Saxena, S. Krishna, M. Pawelczyk, N. Johnson, I. Puri, M. Zitnik, H. Lakkaraju : OpenXAI: Towards a Transparent Evaluation of Model Explanations, *Conference on Neural Information Processing Systems (NeurIPS)*, 2022.
160+ GitHub stars
39. **C. Agarwal**, D. D'Souza, S. Hooker: Estimating Example Difficulty using Variance of Gradients, *Conference on Computer Vision and Pattern Recognition (CVPR)*, 2022.
50+ GitHub stars
38. **C. Agarwal**, M. Zitnik, H. Lakkaraju: Probing GNN Explainers: A Rigorous Theoretical and Empirical Analysis of GNN Explanation Methods, *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2022.
37. M. Pawelczyk, **C. Agarwal**, S. Joshi, S. Upadhyay, H. Lakkaraju: Exploring Counterfactual Explanations Through the Lens of Adversarial Examples: A Theoretical and Empirical Analysis, *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2022.
36. **C. Agarwal**, H. Lakkaraju, M. Zitnik: Towards a Unified Framework for Fair and Stable Graph Representation Learning, *Conference on Uncertainty in Artificial Intelligence (UAI)*, 2021.
35. S. Agarwal, S. Jabbari, **C. Agarwal**, S. Upadhyay, Z. S. Wu, H. Lakkaraju: Towards the Unification and Robustness of Perturbation and Gradient Based Explanations, *International Conference on Machine Learning (ICML)*, 2021.
Spotlight Presentation
34. **C. Agarwal***, S. Khobahi*, D. Schonfeld, M. Soltanian: CoroNet: A Deep Network Architecture for Semi-Supervised Task-Based Identification of COVID-19 from Chest X-ray Images, *SPIE Medical Imaging*, 2021.
33. **C. Agarwal**, A. Nguyen: Explaining image classifiers by removing input features using generative models, *Asian Conference on Computer Vision (ACCV)*, 2020.
32. N. Bansal*, **C. Agarwal***, A. Nguyen*: SAM: The Sensitivity of Interpretability Methods to Hyperparameters, *Conference on Computer Vision and Pattern Recognition (CVPR)*, 2020.
Oral presentation (Top 5%).
31. **C. Agarwal**, S. Khobahi, A. Bose, M. Soltanian, D. Schonfeld: Deep-URL: A Model-Aware Approach To Blind Deconvolution Based On Deep Unfolded Richardson-Lucy Network, *IEEE Conference on Image Processing (ICIP)*, 2020.
30. **C. Agarwal**, A. Nguyen, D. Schonfeld: Improving Robustness to Adversarial Examples by Encouraging Discriminative Features, *IEEE Conference on Image Processing (ICIP)*, 2019.
Spotlight presentation (Top 10%).
29. M. Aloraini, M. Sharifzadeh, **C. Agarwal**, D. Schonfeld: Statistical Sequential Analysis for Object-based Video Forgery Detection, *Electronic Imaging*, 2019.
28. N. Khobragade*, **C. Agarwal***: Multi-class segmentation of neuronal electron microscopy images using deep learning, *SPIE Medical Imaging*, 2018.
27. **C. Agarwal**, M. Sharifzadeh, D. Schonfeld: CrossEncoders: A complex neural network compression framework, *IS&T International Symposium on Electronic Imaging*, 2018.
26. M. Sharifzadeh, **C. Agarwal**, M. Aloraini, D. Schonfeld: Convolutional neural network steganalysis's application to steganography, *IEEE Visual Communications and Image Processing (VCIP)*, 2017.
25. **C. Agarwal**, A.H. Dallal, M.R. Arbabshirani, A. Patel, G. Moore: Unsupervised quantification of abdominal fat from CT images using Greedy Snakes, *SPIE Medical Imaging*, 2017.

24. A.H. Dallal, **C. Agarwal**, M.R. Arbabshirani, A. Patel, G. Moore: Automatic estimation of heart boundaries and cardiothoracic ratio from chest X-ray images, *SPIE Medical Imaging*, 2017.
23. M.R. Arbabshirani, A.H. Dallal, **C. Agarwal**, A. Patel, G. Moore: Accurate segmentation of lung fields on chest radiographs using deep convolutional networks, *SPIE Medical Imaging*, 2017.
22. **C. Agarwal**, A. Bose, S. Maiti, N. Islam, S.K. Sarkar: Enhanced data hiding method using DWT based on Saliency model, *IEEE International Conference on Signal Processing, Computing and Control (ISPCC)*, 2013.
21. S. Maiti, **C. Agarwal**, A. Bose, S.K. Sarkar: Robust data hiding technique in wavelet domain using saliency map, *International Journal of Advances in Engineering and Technology*, 2013.
20. N. Islam S. Maiti, A. Bose, **C. Agarwal**, S. K. Sarkar: An Improved Method of Pre-Filter Based Image Watermarking in DWT Domain, *International Journal of Computer Science and Technology*, 2013.

Preprints and Workshop Articles

19. A. Java, S. Jandial, **C. Agarwal**: Towards Fair Knowledge Distillation using Student Feedback, *Preliminary version presented at the Efficient Systems for Foundation Models, ICML 2023*.
18. S.V. Deshmukh, Srivatsan R, S. Vijay, J. Subramanian, **C. Agarwal**: Counterfactual Explanation Policies in RL, *Preliminary version presented at "Could it have been different?" Counterfactuals in Minds and Machines Workshop, ICML 2023*.
17. **C. Agarwal**: Intriguing Properties of Visual-Language Model Explanations, *Preliminary version presented at RTML Workshop, ICLR 2023*.
16. S. Krishna, **C. Agarwal**, H. Lakkaraju: On the Impact of Adversarially Robust Models on Algorithmic Recourse, *Preliminary version presented at Trustworthy and Socially Responsible Machine Learning Workshop, NeurIPS 2022*.
15. S. Deshmukh, A. Dasgupta, B. Krishnamurthy, N. Jiang, **C. Agarwal**, G. Theocharous, J. Subramanian: Trajectory-based Explainability Framework for Offline RL, *Preliminary version presented at Offline RL Workshop, NeurIPS 2022*.
14. **C. Agarwal**, O. Queen, M. Zitnik: An Explainable AI Library for Benchmarking Graph Explainers, *Preliminary version presented at Graph Learning Benchmarks Workshop, WWW, 2022*.
13. **C. Agarwal**, N. Johnson, M. Pawelczyk, S. Krishna, E. Saxena, M. Zitnik, H. Lakkaraju: Rethinking Stability for Attribution-based Explanations, *Preliminary version presented at PAIR² Struct Workshop, ICLR, 2022*.
Oral Presentation.
12. **C. Agarwal**, M. Zitink, H. Lakkaraju: Towards a Unified Framework for Fair and Stable Graph Representation Learning, *Preliminary version presented at Socially Responsible Machine Learning Workshop, ICML, 2021*.
11. **C. Agarwal**, H. Lakkaraju, M. Zitink: Towards a Rigorous Theoretical Analysis and Evaluation of GNN Explanations, *Preliminary version presented at Theoretic Foundation, Criticism, and Application Trend of Explainable AI Workshop, ICML, 2021*.
10. M. Pawelczyk, S. Joshi, **C. Agarwal**, S. Upadhyay, H. Lakkaraju: On the Connections between Counterfactual Explanations and Adversarial Examples, *Preliminary version presented at Theoretic Foundation, Criticism, and Application Trend of Explainable AI Workshop, ICML, 2021*.
9. D. D'Souza, Z. Nussbaum, **C. Agarwal**, S. Hooker: A Tale Of Two Long Tails, *Preliminary version presented at Uncertainty & Robustness in Deep Learning Workshop, ICML, 2021*.
8. H. Honarvar, **C. Agarwal**, S. Somani, A. Vaid, J. Lampert, T. Wanyan, V. Y. Reddy, G. N. Nadkarni, R. Miotto1, M. Zitnik, F. Wang, B. S. Glicksberg: A novel representation of electrocardiogram waveforms for enhancing deep learning predictions, *Preliminary version presented at Interpretable Machine Learning in Healthcare Workshop, ICML, 2021*.

7. **C. Agarwal***, S. Hooker*: Estimating Example Difficulty using Variance of Gradients, *Preliminary version presented at Human Interpretability in Machine Learning Workshop, ICML, 2020.*
6. **C. Agarwal***, P. Chen*, A. Nguyen: Intriguing generalization and simplicity of adversarially trained neural networks, *Preliminary version presented at Human Interpretability in Machine Learning Workshop, ICML, 2020.* **Spotlight Presentation.**
5. **C. Agarwal**, B. Dong, D. Schonfeld, A. Hoogs: An explainable adversarial robustness metric for deep learning neural networks, 2018.
4. M. Sharifzadeh, **C. Agarwal**, M. Salarian, D. Schonfeld: A new parallel message-distribution technique for cost-based steganography, 2017.

Patents

3. S. Deshmukh, A. Dasgupta, **C. Agarwal**, B. Krishnamurthy, G. Theodorou, J. Subramanian.: Novel Trajectory-based Explainability Framework for RL-based Decision Making. Internal Reference: P11853-US.
2. M. Hemani, A. Seth, **C. Agarwal**: Debiasing vision-language models with additive residual learning. Internal Reference: P11919-US.
1. T. Menta, A. Patil, S. Jandial, Balaji K, **C. Agarwal**, M. Sarkar: HASTE: A Novel Method and Apparatus to Estimate Transferability using Hard Subsets. Internal Reference: P11683-US.

TEACHING EXPERIENCE

Guest Lecture at Harvard University <i>Course on Interpretability and Explainability in Machine Learning</i>	Spring 2021, 2023
Teaching Assistant University of Illinois at Chicago <i>Pattern Recognition, Image Analysis & Computer Vision, Digital Signal Processing, Neural Networks.</i>	Spring, Fall 2014 - 2020

TUTORIALS

Training the Next-Generation of AI Students	CMRISE School 2023
Explainable ML in the Wild : When Not to Trust Your Explanations	FACCT 2021

INVITED TALKS

Computer Vision Talks	2023
TrustML Young Scientists Seminars at RIKEN-AIP, Japan	2022
Adobe Research: XAI: Challenges and Solutions	2022
CAI Summer School at IIIT-Delhi	2022
LOGML Summer School	2022
2d3d.ai	2021
W&B - Weights & Biases Salon	2020

MENTORSHIP

PhD Student: Valentina Giunchiglia <i>Imperial College London</i>	2022-2023
PhD Student: Chirag Varun Shukla <i>LMU Munich</i>	2022-2023
M.Tech Student: Ashish Seth <i>IIT Madras</i>	2022-2023
LOGML Summer School	2022

COMMUNITY SERVICE

External Ph.D. Examiner: Jessica Rumbelow - University of St. Andrews	2023
Open Collaboration Initiatives: TrustworthyML Initiative and MLCollective	2021-2023
Program Committee for Workshops:	
XAI4CV - Explainable AI for Computer Vision (XAI4CV) Workshop	CVPR, 2023
SRML - Workshop on Socially Responsible Machine Learning	ICLR, 2022
AdvML - New Frontiers in Adversarial Machine Learning	ICML, 2022
SRML - Workshop on Socially Responsible Machine Learning	ICML, 2021
SeSML - Workshop on Security and Safety in Machine Learning Systems	ICLR, 2021
AROW - Workshop on Adversarial Robustness in the Real World	ECCV, 2020-2021
WHI - Workshop on Human Interpretability in Machine Learning	ICML, 2020
Program Committee for Conferences:	
NeurIPS - Advances in Neural Information Processing Systems	2021-2023
NeurIPS - Datasets and Benchmark Track	2022-2023
KDD - ACM SIGKDD Conference on Knowledge Discovery and Data Mining	2021-2023
ICML - International Conference on Machine Learning	2021-2023
FAccT - ACM Conference on Fairness, Accountability, and Transparency	2022-2023
ICLR - International Conference on Learning Representations	2022-2023
AAAI - AAAI International Conference on Artificial Intelligence	2023-2024
AISTATS - International Conference on Artificial Intelligence and Statistics	2023
WACV - IEEE/CVF Winter Conference on Applications of Computer Vision	2023
CVPR - IEEE/CVF Conference on Computer Vision and Pattern Recognition	2023
ICCV - IEEE/CVF International Conference on Computer Vision	2023
ACL - ACL Rolling Review	2023
LOG - Learning on Graphs Conference	2022
Journal Reviewing:	
TMLR - The Transactions on Machine Learning Research	2022-2023
TMI - IEEE Transactions on Medical Imaging	2022