Avi Amalanshu

Undergraduate Researcher

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New Delhi, IN · Born 2001, Baltimore, MD, USA · US Citizen

About

I am a dual bachelors+masters student at ECE, IIT Kharagpur, one of the most competitive programs in the world. I want to build AI systems that are *usable and democratic*.

Neurosymbolic AI: Neurosymbolic learning, neural program synthesis.

Distributed Optimization: Fault tolerance, asynchronicity, privacy.

Skills

Programming: C/C++, Python (with PyTorch, including Geometric and Lightning), some Rust and OCaml

Systems: git, Slurm, angr, radare2, pwntools, CUDA, OpenMP

Misc: Technical writing and LaTeX, probability & statistics, linear algebra, academic writing, visual design. Broad research experience and coursework.

Experience

Research Assistant (May-Jul '24)
Carnegie Mellon University
– Funded by Boeing, hosted by AirLab
– Project: Amelia Intent Prediction

Research Fellow (May-Aug '23)
Purdue University
– Funded by the NSF (as a SURF REU), hosted by Prof. David Inouye
– Project: Internet Learning

Education

Bachelor and Master of Technology, **Indian Institute of Technology Kharagpur** (2020-2025)
– B.Tech *Electronics & Electrical Communication Engineering*. Minor in Computer Science
– M.Tech *Vision & Intelligent Systems*. Cumulative GPA (8 semesters): 8.85/10

Publications and Preprints

– **A. Amalanshu** et al "Decoupled Vertical Federated Learning for Practical Training on Vertically Partitioned Data" *Under review, AAAI*. (Slightly older) preprint available at arxiv:2403.03871, **2024**.
– **A. Amalanshu** et al "Entity Augmentation for Efficient Classification of Vertically Partitioned Data" *Workshop on Generalizing from Limited Resources in the Open World* at *IJCAI* **2024**. (Archival. Derivative work under preparation)
– S. Ganguli, **A. Amalanshu** et al "Internet Learning: Preliminary Steps Towards Highly Fault-Tolerant Learning on Device Networks." *Workshop on Localized Learning* at *ICML* **2023**.
– A. Shukla, S. Roy, Y. Chawla, **A. Amalanshu**, et al "(RE) From Goals, Waypoints & Paths To Long Term Human Trajectory Forecasting" *ReScience-C Vol. 8 No. 2*, **2022**. (Invited to NeurIPS Reproducibility Track poster session)

More Activities

Teaching Assistant
– **Fall '24**: TAing Network Theory Lab for first-year undergrads
– **Spring '25**: TBD

Autonomous Ground Vehicle
– Selective undergraduate robotics research group (15 from 500+ applications)
– Lead the software team
– Developed vision software for competition robots
– Conducted some novel research on multi-agent classification and inverse RL.
– Trained juniors, presented at reading groups, etc.

Awards & Honors

Fellowships Awarded the selective Guru Kripa Fellowship by IIT Kharagpur Foundation USA, Summer Undergraduate Research Fellowship (a NSF REU) by

Recent Projects (more at avi-amalanshu.github.io)

Information-Theoretic Bridge between Neural and Symbolic AI (ongoing)
Guide: Prof. Saumik Bhattacharya, Indian Institute of Technology Kharagpur
– Working on a computationally tractable semantic loss function for neurosymbolic learning and a novel neural network-based heuristic for search in program synthesis.

Amelia: Airport Movement Forecasting, Intent Prediction (May-Jul '24)
Guide: Prof. Sebastian Scherer, Carnegie Mellon University
– Part of the larger Amelia project investigating DL-based airport surface operations.
– Developed a LLM heuristic to induce procedural bias in inductive logic programming to translate English rules to first-order logic. Few-shot capabilities on simple problems.
– Developed a fast map-matching algorithm to ground trajectories predicted by a deep model to a semantic graph. Uses discrete time warping, Dijkstra's algorithm, B-splines.

Distributed Inference under Communication Constraints (Mar '24)
Guide: Prof. Jithin R, Indian Institute of Technology Kharagpur
– Conducted a survey of some new information theoretic results for binary detection.
– Used those new results to derive elementary corollaries for GoF in distributed inference.

Entity Augmentation for Vertically Partitioned Datasets (Feb-Apr '24)
as Deep Learning Team Leader, Autonomous Ground Vehicle
– Proposed a new algorithm 1eschewing entity alignment in vertical federated learning.
– Developed experiments showing it performs better than SplitNN on classification.
– Published findings at the archival GLOW workshop at IJCAI '24. Preparing submission with generalized algorithm with more experiments for MLSys or VLDB '25.

Decoupled Vertical Federated Learning (Sep-Nov'23, Feb-Mar '24)
Bachelor Thesis. Guides: Prof. David Inouye, Purdue Univ.; Prof. Jithin R.
– A layer-wise greedy strategy for split-ANN training on vertically partitioned data.
– Immune to inference attacks, graceful performance degradation with crash faults.
– Comparable to SplitNN under perfect conditions. Can leverage asynchronicity and unlabelled and misaligned data.

Purdue University.

Research Programs Selected for the Globalink internship program by MITACS, Canada and the SRIP by IIT Gandhinagar. Nominated for the Robotics Institute Summer Scholarship at CMU (ruled ineligible due to being in my 4th year).

Domain Adaptation in Breast Cancer Detection (Dec '24)

Guide: Prof. Chetan Arora, Indian Institute of Technology Delhi

- Wrote internal scripts and analyzed data to investigate poor domain adaptation performance of MRT (Zhao et al, ICCV '23) on Indian mammograms.
- Devised appropriate masking strategy and helped switch from attention to focal modulation for more robust short-range semantics.

Internet Learning (May-Aug '23)

Guide: Prof. David Inouye, Purdue University

- A greedy strategy for ANN training on vertically partitioned data.
- Immune to inference attacks, graceful performance degradation with crash faults.
- Comparable to SplitNN under perfect conditions. Can leverage weak supervision.

Coursework

Core curriculum available on IIT Kharagpur's website.

Elective Courses Advanced Operating System Design, Algorithms, Algorithms Lab, Communication Networks, Computational Neuroscience, Information and System Security, Introduction to Language and Linguistics, Neuronal Coding of Sensory Information, Systems Biology

Additional and Audited Credits Algorithmic Game Theory, Computational Foundations of Cyber-Physical Systems, Information Retrieval, Machine Learning, Reinforcement Learning, Usable Privacy and Security

Workshops and Online Certifications Deep Learning Specialization (DeepLearning.AI via Coursera), Cloud Computing Specialization (UIUC via Coursera), Programming Languages Part A (University of Washington via Coursera), Winter Workshop in Computer Vision (IEEE IIT Kharagpur Section)

Course Projects Summary

Advanced OS Design: Low-level implementation of some distributed algorithms · **Deep Learning**: An analysis of low-rank adaptation and a proposal for SVD initialization · **Reinforcement Learning**: Comparison of online on-policy learning algorithms for a dynamic gridworld· **Computational Neuroscience**: Neural signal processing in MATLAB · **Machine Learning**: · Rice Variety Classificaiton using Naive Bayes · Heart Disease Detection using SVMs · K-means vs. Single-Linkage top-down agglomerative clustering · **Neuronal Coding of Sensory Information**: Processing cat auditory system signals in MATLAB · **Embedded Systems Lab**: Temperature-based fan controller on an 8051 · **Computational Foundations of Cyber-Physical Systems**: Simulating a smart grid with differential privacy · **DIY Project:** Hand-gesture controlled medical robot over WiFi

Extracurricular Stuff

- Participated in the Inter-IIT Cultural Meet twice. Contributed to both gold-winning contingents as a part of the Scrabble, Cryptic Crossword and Word Games teams.
- Helped found WordWeave, the official word games society at IIT Kharagpur.
- Volunteered for the National Social Service for two years.
- Volunteered at an underfunded public school in rural India.
- Volunteered for the Rohini Ghadiok foundation, teaching at-risk and vulnerable students after school hours.
- Competitive programmer and CTF enthusiast.