Akash Nagaraj

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Education

PES University (PES Institute of Technology) *Bangalore, India*

BACHELOR OF TECHNOLOGY | MAJOR: COMPUTER SCIENCE | MINOR: DATA SCIENCE *2015 - 2019*

- Overall GPA: 9.02/10 | Minor GPA: 10/10 | **Major GPA: 9.51/10**
- **Dean's list** for 6/7 semesters (Merit scholarship for being in the top 20 students of the batch)
- **Best undergraduate thesis** in the Computer Science department

RELEVANT COURSES

- **AI/ML:** Computational Methods for Mind, Brain and Behavior*, Deep Learning*, Advanced Machine Learning
- **Computer Science:** Data Structures, Design & Analysis of Algorithms, Cloud Computing, Big Data, Operating Systems
- **Mathematics:** Computational Probability & Statistics*, Information Theory*, Statistical Inference*, Discrete Mathematics and Logic, Linear Algebra & Applications.

= Audited as a Research Scholar at Brown University

Research Experience

Serre Lab, Carney Institute for Brain Science, Brown University *Providence, RI, USA*

RESEARCH SCHOLAR, *Advisor: Thomas Serre* *October 2021 - Present*

- **Learning Representations:** Developed novel, scalable data diets using NeRF trajectories for causal 3D visual representation learning. Trained large-scale vision models on TPUs to make biologically aligned models *(NeurIPS 2023 UniReps, Google DeepMind Grant)*.
- **Human-aligned Intelligence:** Investigated 1,320 one-shot generative algorithms (VAEs, GANs, and diffusion models). Introduced the *originality* metric to compare AI-generated drawings to human drawings collected using a novel web app–QuickDraw-ClickMe *(Oral Presentation, ICML - Top 2.3% of papers)*. Also designed a web app (clickme.clps.brown.edu) to collect identifying visual features humans rely on for object recognition.
- **Clinical Scar Characterization:** Developed an NIH-funded system to analyze medical images to detect and categorize self-harm scars to assign a suicide risk score for each individual, aiding in mental health assessments. Used a custom Transformer architecture with SSL for better tissue damage detection (mAP=0.81) compared to trained human annotators (mAP=0.64) *(Collaboration with MGH)*.
- **Deep Behavioural Phenotyping:** Built a self-supervised computer vision system to detect fine-grained behaviors for external cues and robust pain models; reducing experimenter bias while facilitating replication across experimenters and labs. Used Generative Modelling, Transformers & RNNs achieving 94% accuracy compared to trained human annotators *(SfN'23, Cosyne'24)*.
- **Recurrent Neural Network modeling:** Optimized feedback-based neural circuits with cRBP to align model and human behavior using neural data (fMRI). Authored tutorials on recurrent feedback loops to work with neural, sequential, and visual data.

Centre for Cloud Computing and Big Data, PES University *Bangalore, India*

RESEARCH INTERN, *Advisors: Dinkar Sitaram, K V Subramanium, Sanchika Gupta* *August 2017 - May 2019*

- **Machine Learning-based Analysis of *Filarial lymphoedema*:** Built an EHR system for the Indian Institute of Applied Dermatology and worked on identifying the most effective permutations of treatments for *Filarial lymphoedema* using machine learning.
- **Learning Algorithms in Static Analysis:** Reduced false positives in source code vulnerability detection using static fuzzing and machine learning from 73% to 6.5% (sponsored by HCL Technologies).
- **Teaching Assistantship:** Mentored and evaluated students building a microservice platform with container orchestration.

Crucible of Research and Innovation, PES University *Bangalore, India*

SUMMER INTERN: EMBEDDED SYSTEMS, *Advisor: Vinod K Agrawal* *April 2016 - July 2016*

- Built a cost-effective blood pump for dialysis in rural settings and worked on modules currently onboard the nanosatellite–PiSat.

Research Publications and Presentations

Ecological data & objectives align DNN representations with humans *2023*

PRESENTATION AND PUBLISHED AT UNIREPS WORKSHOP NEURIPS 2023 | ARXIV

Akash Nagaraj, *Alekh Karkada Ashok, Drew Linsley, Francis E Lewis, Peisen Zhou, Thomas Serre*

Diffusion Models as Artists: Are we Closing the Gap between Humans & Machines? *2023*

ORAL PRESENTATION AND PUBLISHED AT ICML 2023 (TOP 2.3% OF PAPERS) | ARXIV

Victor Boutin, Thomas Fel, Lakshya Singhal, Rithik Mukherjee, **Akash Nagaraj**, *Julien Colin, Thomas Serre*

Closed-Loop Optogenetic System for Deep Behavioral Phenotyping *2023*

PRESENTATION AT SOCIETY FOR NEUROSCIENCE 2023, IN REVIEW AT COSYNE 2024, MANUSCRIPT IN-PREPARATION

Remy Meir, **Akash Nagaraj**, *Samir Samadov, Obinna Okasi, Thomas Serre, David Sheinberg, Jason Ritt, Diane Lipscombe*

Real-time Automated Answer Scoring *2018*
Presentation and Published at ICALT 2018 (**Best Student Paper**) | arXiv | Video
Akash Nagaraj, Mukund Sood, Gowri Srinivasa

Cross-domain Variational Capsules for Information Extraction *2020*
Oral Presentation and Published at ICSE 2020 | arXiv
Akash Nagaraj, Akhil K, Akshay Venkatesh, Srikanth H R

Machine Learning-based Analysis of *Filarial lymphoedema* *2018*
Oral Presentation at National Colloquium on Evidence-Based Integrative Medicine | arXiv
Akash Nagaraj, Mukund Sood, Bishesh Sinha, Ashok Raman, Dinkar Sitaram

Research Preprints and Working Papers

Leveraging Computer Vision to Augment Suicide Risk Prediction *2023*
Manuscript In Preparation
Akash Nagaraj, Taylor Burke, Thomas Serre

Real-time Action Recognition for Fine-Grained Actions & The Hand Wash Dataset *2020*
Preprint | Patent-pending | arXiv | Code | Dataset | Undergraduate Thesis
Akash Nagaraj, Mukund Sood, Chetna Sureka, Gowri Srinivasa

A Concise Introduction to Reinforcement Learning in Robotics *2020*
Preprint | arXiv
Akash Nagaraj, Mukund Sood, Bhagya M Patil

Learning Algorithms in Static Analysis of Web Applications *2018*
Preprint | arXiv
Akash Nagaraj, Mukund Sood, Vivek Kapoor, Yash Mathur, Bishesh Sinha, Sanchika Gupta, Dinkar Sitaram

Digital Image Forensics using Deep Learning *2019*
Preprint | Published in eForensics Magazine-May 2020 Edition | arXiv
Akash Nagaraj, Bishesh Sinha, Mukund Sood, Vivek Kapoor, Yash Mathur

Industry Experience

Goldman Sachs *Bangalore, India*
Senior Analyst (Promoted in December 2020) *January 2020 - September 2021*
- **Derivative Trading Flows:** Worked on algorithmic trading, high-touch and low-touch flows for derived equity instruments (bonds, ETF, stocks) for the Global Equities Trading Desk in New York.
- **Trade Enrichment Module:** Solely responsible for the development and implementation of the Trade Enrichment Module.
- **Securities Trading Platform:** Developed a high-capacity (5x previous) trading platform, enhancing throughput to manage 100k+ orders while achieving ultra-low latency (<1ms) to handle daily cash flows of $5 billion efficiently.
- **Design and Scaling:** Architected and engineered system design plans to improve and scale trading workflows.

Cisco Systems *Bangalore, India*
Software Development Engineer (offered a full-time position from Internship) *January 2019 - January 2020*
- **Failure Analysis Senti-meter:** Streamlined pipeline for sentiment analysis and prediction of corrective action of Cisco product failures globally from over 24 hours to 2 minutes using Feature Engineering, Machine Learning, and Natural Language Processing.
- **Gnosis Signature Effectiveness:** Reduction of vulnerabilities using a signature-based approach to identify and rectify bugs.
- **LIFR:** Invented an AI-based solution to improve inventory Line-In Fill Rate, placed first in the Cisco Intern Global Case Competition.

Services and Outreach

Teaching

2023	**Course Design and TA**, *CLPS-1291* Computational Methods for Mind, Brain and Behavior	*Brown University*
2022	**Course Design and TA**, *CLPS-1291* Computational Methods for Mind, Brain and Behavior	*Brown University*
2019	**Project Mentor and TA**, *CS-341* Cloud Computing *(Mentored and TAed a cohort of 44 students)*	*PES University*
2018	**Project Mentor and TA**, *CS-314* Big Data *(Mentored and TAed a cohort of 60 students)*	*PES University*

Advising

2023	**Research Mentor**, Mentored Obinna Okasi (Cornell University) and Samir Somadov (Brooklyn College) participating in NSF Funded Summer Research Program. Project: Closed-Loop Deep Behavioral Phenotyping *(Presented at SfN 2023, Manuscript in Preparation)*	*June 2023 - Present*

Academic/Professional

2023	**Academic Reviewer**, ICML 2023, NeurIPS 2023 UniReps	*2023 - Present*
2021	**Open-source Contributor**, SymPy, MetaBrainz, OpenMM	*2018 - Present*

Outreach

2020	**Education Mentor & Tech Writer**, GirlScript Foundation (India's Largest Tech Education NGO)	*Mar 2020 - Nov 2020*
2020	**Data Structures and Algorithms Mentor**, CodeChef	*Apr 2020 - July 2020*
2018	**Education Support Fellow**, Make A Difference (India) - Grade 10 (400+ hours)	*Jun 2017 - Mar 2018*
2017	**Core-organizer**, The Amateur Scientist, National Science Fest	*6000+ attendees*
2017	**Volunteer Teacher**, Workshop Innovation Science Experiments (WISE) - Grades 4 and 5	*Apr 2017 - Jul 2017*

Awards

2023	**Grant**, Google DeepMind Travel Grant for NeurIPS 2023	*NeurIPS*
2022	**Fourth Place**, NeurIPS Workshop: Sensorium 2022 - Mouse Visual Cortex Modelling	*40+ teams overall*
2020	**First Place**, Cisco Global Intern Case Competition	*100+ teams overall*
2020	**Finalist (top 5)**, Microsoft code.fun.do++ (Final round)	*6000+ teams overall*
2020	**First Place**, Microsoft code.fun.do++ (Regional Round)	*300+ teams overall*
2016-2019	**Scholarship**, Prof. CNR Rao Scholarship	*Top 20/430 students*
2019	**First Place**, IEEE Cisco Internet of Things Hackathon - 2019	*200 teams overall*
2018	**First Place**, Cisco Data Analytics Hackathon - 2018	*50+ teams overall*
2018	**Ninth Place**, IEEE Signal Processing Society - Camera Model Identification (Student Category)	*581 teams overall*

Selected Projects

Sensorium: Visual Cortex Modeling *2022*

- Accurate predictive models of 28,000 neurons from primary visual cortex responses (captured using calcium imaging) to thousands of natural stimuli. Achieved single-trial correlation of 0.41 using an optimized HMAX model with neural circuits & recurrent connections.

Real-time Action Recognition in Videos | Preprint: 📄 | Code: ⭘ | Dataset: 🗄 *2020*

- Action Recognition System for automated real-time hand sanitization auditing, using real-world data from PES Institute of Medical Science and Research. Aimed at reducing bedside infections in hospitals, using a new approach to Action Recognition in videos.

CDAE4InformationExtraction *2019*

- A system for the extraction of hierarchical information across multiple, unrelated domains that uses Capsule Networks, statistical-distribution-based systems, and Variational Autoencoders to extract 'characteristics' of an image.

Rahat: Disaster Management Platform | Code: ⭘ | Video: 📺 *2019*

- Multilingual, end-to-end, AI-based disaster management platform using a custom protocol over GSM (no internet required).
- Entry to Microsoft code.fun.do++, and ranked 4th amongst 6000+ entries.

Unvoiced: Sign Language to Speech | Code: ⭘ | Dataset: 🗄 *2019*

- A real-time system for converting sign language from video streams into speech, utilizing deep learning and image processing.
- Created and published the **ASL Alphabet Dataset**, which has 300+ citations and over 50,000 downloads.

Skills

Programming	Python, Java, C++, C, JavaScript, Go, Rust, R, Lua, PHP, HTML, MySQL
Skills	GPU and TPU training, UNIX System Programming, Web development, Electron
Frameworks	PyTorch, PyTorchXLA, Tensorflow, CUDA, MuJoCo, SpringBoot, Flask, Django, ReactJS, Docker
Technologies	DeepLabCut, Git, AWS, Azure, GoogleCloud, Jenkins CI/CD