Shravan Chaudhari

NYU Courant | Johnson & Johnson | CERN | Google Summer of Code

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EDUCATION

Master of Science, Computer Science, New York University (Courant Institute of Mathematical Sciences) **Sep 2021 — May 2023**
Cumulative CGPA: 3.91/4.0
Relevant Coursework: Foundations of Machine Learning, Computer Vision, GPU Programming, High Performance Computing

Bachelor of Engineering, Electronics & Instrumentation, Birla Institute of Technology & Science Pilani **Aug 2017 — May 2021**
Cumulative GPA: 8.52/10.0
Relevant Coursework: Neural Networks & Fuzzy Logic, Object Oriented Programming, Computer Programming

INDUSTRY EXPERIENCE

Machine Learning & Software Co-Op, Johnson & Johnson MedTech (Algorithms & AI team) **May 2022 — December 2022**
- Developed innovative & efficient data-centric semi-supervised machine learning algorithms for minimally invasive surgical robots to automatically curate only the most useful task-specific video clips from hundreds of 3-4 hours long medical surgery videos.
- Developed smart data selection strategies to detect outliers/anomalies and ambiguous data to tackle computer vision model uncertainties & improve the performance of biomedical tool detection & instance segmentation models used in robots during surgical processes.
- **Key results:** Built and deployed end-to-end active machine learning pipeline (including an interface for annotation) to increase the efficiency resulting in at least 70% reduced annotation costs and efforts.
- **Achievements:** This framework including the key frame extraction will be used on human trial data for the endourology surgical processes which recently received 510(k) clearance from the US FDA.

RESEARCH EXPERIENCE

Research Fellow @ National Science Foundation, Princeton Institute of Computational Science and Engineering   **May 2021 — Oct 2021**
- Developed graph based representations of high energy particle (Taus) to identify particle collision energy signals from 3 different types of background noises.
- Worked with graph neural networks to perform the classification between the signals and background noises using SAGEConv functions on generated graph representations.
- Performed a detailed analysis and comparison of graph neural networks, vision transformers and sparse CNNs.
- **Key accomplishments:** Improved the ROC-AUC score on benchmark dataset from 0.7 to 0.85 using GNNs for Tau particle identification which outperformed vision transformers and state of the art ML algorithms. .

Student Researcher @ CERN, Undergraduate Thesis   **Sep 2020 — May 2021**
- Developed novel deep convolutional neural network (DCNNs) based solutions for classification and reconstruction of high energy particles like electrons, photons, quarks, gluons and top jets.
- Performed detailed study analysing the strengths and weaknesses of ResNet based DCNNs on different type of particle image channels like electromagnetic calorimeter, hadronic calorimeter and characteristics of particles such as location of the energy deposit and transverse momentum recorded by silicon detectors at the Large Hadron Collider.
- **Key accomplishments:** Beat the state-of-the-art performance by achieving at least 95% accuracy for each of the particle categories based on raw deposit images. It lead to couple of publications that made this research a pioneer in establishing the use of using deep learning technique for particle identification and reconstruction during the run of the experiments at CERN.

OPEN SOURCE DEVELOPER EXPERIENCE

Google Summer of Code 2021,   **May 2021 — Aug 2021**
- Designed & implemented graph based modelling strategies to represent and classify low momentum particle images having 13 energy channels recorded by various silicon detectors at the Large Hadron Collider.
- Developed a standard framework to deploy graph neural networks (GNNs) within CERN software pipeline using C++ ONNX API and Torch-Geometric library.
- **Key accomplishments:** Benchmarked the graph neural network performance and its deployment using the newly built framework for classification of electrons, photons, quark, gluons and boosted top jets by achieving ROC AUC score of atleast 0.95 for each category

Google Summer of Code 2020,   **May 2020 — Aug 2020**
- Created a C++ based End-to-End Software (E2E) framework to enable advanced data processing and complex analysis on the CERN database.
- **Key Accomplishments:** Integrated the E2E framework with the CERN inference engine to support deployment of machine learning architectures like GNNs, CNNs, Variational Autoencoders, etc. trained with either of the 4 different frameworks: tensorflow, mxnet, onnx and pytorch.

International Nvidia Hackatons 2020-2021, Nvidia CSCS Hackathon, GPU Helmholtz hackathon
- Optimised and parallelized the training and inference of large scale ResNets and graph neural networks on huge CERN dataset containing 4 million particle images each having 8 channels using computing nodes and V100 GPUs provided by Nvidia as part of their International GPU Hackathons, Bootcamps and other collaborations .
- Used horovod framework for optimising tensorflow based ResNet models and tensorRT SDK for optimising the pytorch model inferences.
- **Key Accomplishments:** Accelerated the ResNet training speed by 93% on optimising for a single V100 GPU and by 97% by distributing the model training across 4 V100 GPUs.

Publications

1. M. Andrews *et al.* Accelerating End to End Deep Learning for Particle Reconstruction using CMS open data. *The European Physical Journal Conferences 251:03057* (2021).
2. M. Andrews *et al.* End-to-End Jet Classification of Boosted Top Quarks with CMS Open Data. *The European Physical Journal Conferences 251:04030* (2021).

Talks

- Talk on Accelerating end-to-end deep learning for high energy particle identification using Graph Neural Networks, National Science Foundation IRIS-HEP Fellowship, 2021 ⤤

Teaching Experience

- **Course Tutor for Graduate Computer Vision course CSCI-GA 2271 by Prof. Rob Fergus at NYU:** Organized materials for weekly sections, held office hours and advised student projects.
- **Course Assistant Artificial Intelligence (CSCI-UA.472) courses at NYU:** Assisted students with their homeworks & graded the programming & theory assignments.
- **Course Grader for Data Management & Analysis (CSCI-UA.479)**

Mentoring and Advising Experience

- **Mentor and Organizer @ Machine Learning for Science organisation:** Mentored 3 students through google summer of code 2022 program on machine learning projects for astrophysics & particle physics ⤤ .
- **Organized and mentored international ML4SCI hackathons** in collaboration with CMU, Brown, University of Alabama & University of Florida ⤤ .

Skills

Languages	Python, C++, C, CUDA, SQL, Latex
Frameworks	Pytorch, Tensorflow/Keras, Horovod, ONNX, TensorRt, MxNet
Development Tools	Git, Docker, Singularity
Libraries	Pandas, Numpy, OpenCV, Matplotlib, SciPy, Seaborn
Domain Experience	Domain Adaptation, Out-of-distribution detection, Representation Learning, Machine Learning, Computer Vision.

Other Highlighted Projects

- **Making Every Model Robust:** ⤤

  - Built robust defense mechanism against white box adversarial attacks using natural supervision and quantization techniques agnostic to the victim ML model.
  - This method weakens the adversarial attacks on images generated by AutoAttack by restoring their natural structure and takes advantage of the quantized training of ML models.
  - The results of this technique beat RobustBench benchmarks and were among the best achieved by everyone who had taken the graduate course foundations of machine learning course.

Awards & Honors

- **Winner** at the national TechExpo Startup Hackathon 2020 organized by IIT Guwahati (Indian Institute of Technology)
- **Runner's up** at the national level Data Science Hackathon 2020 organized by IISc Bangalore (Indian Institute of Science)

Relevant Graduate Coursework

- Computer Vision CSCI-GA 2271 by Prof. Rob Fergus ⤤
- Fundamental Algorithms CSCI-GA 1170 by Prof. Yevgeniy Dodis ⤤
- Foundations of Machine Learning CSCI-GA 2566 by Prof. Mehryar Mohri ⤤
- High Performance Computing CSCI-GA 2945 by Prof. Benjamin Peherstorfer ⤤
- GPUs: Architecture & Programming CSCI-GA 3033 by Prof. Mohamed Zahran ⤤
- Operating Systems CSCI-GA 2250 by Prof. Hubertus Franke ⤤
- Programming Languages CSCI-GA 2110 by Prof. Benjamin Goldberg ⤤