Sandeep Kumar **Routray**

MS in Machine Learning | Carnegie Mellon University

(+91) 8328879871 | sroutra2@andrew.cmu.edu | sroutray.github.io | sroutray | sandeep-routray

Education

Carnegie Mellon University — *Pittsburgh, PA*
Master of Science, Machine Learning — *August 2024 - Present*

Indian Institute of Technology, Kanpur — *Kanpur, India*
Bachelor of Technology, Major in Electrical Engineering with Minor in Machine Learning — *July 2017 - May 2021*

- **GPA: 9.8/10**
- Awarded **Academic Excellence Award 2017-18, 2018-19, 2019-20** Equivalent to Dean's List
- Awarded **Prof. Samares Kar Memorial Gold Medal** for the best undergraduate project in Electrical Engineering

Interests

Areas: Deep Learning, Machine Learning, Computer Vision, Self/Weakly-Supervised Learning, Reinforcement Learning, Robotics

Publications

Conference Proceedings

[1] S. R. Dash*, S. Routray*, P. Varshney* and A. Modi, "CS-NET at SemEval-2020 Task 4: Siamese BERT for ComVE", in *Proceedings of the Fourteenth Workshop on Semantic Evaluation, International Committee for Computational Linguistics (ICCL)*, Dec 2020. [Paper]

[2] N. V. Deshpande*, S. Routray* and A. K. Gupta, "Spectral Efficiency in Poisson Cluster Based HetNets with Users-Basestations Correlation", in *IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)*, Dec 2020. [Paper], [Video]

* *indicates equal contribution*

Work Experience

Machine Learning Engineer [Press] — *Seoul, South Korea*
SmartThings Team, Samsung Electronics — *Sep 2021 - Jun 2024*

- Pioneered development of deep learning and vectorization stages of *Map View* engine to convert home layouts in wild (brochures, LiDAR, CAD, hand-drawn, etc.) to interactive 3D model. The engine was unveiled at CES 2024 and has been deployed across 400,000 homes globally.
- Designed a ConvNeXt based model and trained using focal loss to identify rooms, walls, doors and junctions in layouts. Performed integer quantization and deployed in Android and iOS devices using TF Lite C API achieving 4x reduction in size and 3x increase in inference speed.
- Worked on 3D reconstruction from single image by training a neural radiance field (NeRF) on multi-views generated from a diffusion model.

Research Fellow — *Toronto, Canada*
Prof. Sanja Fidler's Lab, Vector Institute of Artificial Intelligence — *Oct 2020 - July 2022*

- Researched ways to leverage inter-image relationships for object-centric self-supervised learning. Designed an image-context aware score function to mine positives/negatives from a queue of images for contrastive loss. Obtained 1 % mIoU improvements over existing benchmarks.
- Experimented ways to incorporate geometrical cues from 2D-mesh decomposition of image and perform hierarchical grouping to discover object-part relationships in a dense feature self-supervised feature learning framework.

Intern [Report] — *Seoul, South Korea*
6G Research Team, Samsung Research — *May 2020 - Jul 2020*

- Implemented a reinforcement learning based resource scheduler for LTE system using Deep Deterministic Policy Gradient (DDPG) algorithm.
- Devised two reward mechanisms to maximize throughput while maintaining QoS requirements of delay and fair allocation among users.
- Achieved lower delay (upto 80% lower) and better scalability than the prevalent Proportional Fair scheduler without compromising data rates.

Research Experience

Minimax Optimization in Non-Euclidean Space Using Bregman Divergence [Slides] — *IIT Kanpur, India*
Undergraduate Project, **Prof. Ketan Rajawat** — *Aug 2020 - Dec 2020*

- Designed an $\mathcal{O}(1/k^4)$ algorithm for minimizing smooth and strongly convex functions in non-Euclidean norm space using Nesterov's Accelerated Gradient Descent Algorithm (AGD) and a novel restarting strategy.
- Designed an $\mathcal{O}(1/k^2)$ *conceptual* algorithm for smooth minimax optimization in non-Euclidean norm space using the above result.
- Proposed an *inexact* and *implementable* version of the above algorithm; but attempts at a proof of convergence was unsuccessful.

Common Sense Validation And Explanation [Paper] — *IIT Kanpur, India*
Undergraduate Project, **Prof. Ashutosh Modi** — *Jan 2020 - May 2020*

- Designed a Siamese architecture and incorporated various transformer-based text encoders like BERT, RoBERTa, ALBERT.
- Enabled efficient inter-relational information extraction among input sentences and eliminated logical fallacies in output.
- Achieved an accuracy of 94.8% for Validation task and 89% for Explanation task. Results published in SemEval-2020.

Throughput Analysis of HetNets Using Poisson Cluster Process [Slides] [Video] *IIT Kanpur, India*

Undergraduate Project, **Prof. Abhishek Gupta** *Mar 2020 - Dec2020*

- Used Poisson Point Process (PPP) and Poisson Cluster Process (PCP) to model base stations and users correlation in a K-tier HetNet.
- Derived an expression for the Laplace Transform of the interference and used it to calculate the average throughput.
- Verified theoretical predictions using Monte Carlo simulations of throughput for special cases of Thomas and Matern Cluster Process.

Relevant Courses

Machine Learning	Fundamentals of Machine Learning, Probabilistic Machine Learning, Natural Language Processing
Optimization	Convex Optimization, Optimization Algorithms Design & Analysis
EECS Fundamentals	Data Structures & Algorithms, Signals, Systems & Networks, Digital Signal Processing, Control Systems, Microelectronics, Digital Electronics, Analog & Digital Communication Systems, Antenna Theory & Transmission Lines
Mathematics	Probability & Statistics, Partial Differential Equations, Complex Analysis Basics, Linear Algebra, Differential Equations

Skills

Programming Languages	Python, MATLAB, C/C++
Software/Tools	CUDA, PyTorch, Keras, TensorFlow, OpenCV, SQL