

Utilize my experience and expertise for personal and institutional goals and to further improve my knowledge and skills enabling myself to serve the society in a better way.

## EDUCATION

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### Indian Institute of Technology (IIT) Delhi

*PhD in Computer Science and Engineering*

*2018 – Pursuing*

### Birla Institute of Technology and Science (BITS) - Pilani

*M.Tech in Software Systems*

*2016 – 2018*

## THESIS: FRUGAL SENSING AND COMPUTE USING AI/ML FOR SOCIAL GOOD

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### • Chapter 1: Expensive & accurate sensing, with limited sensors, practical computation

Cameras are installed in many traffic intersections even in developing country cities like Delhi, for rule violation detection and fining. This application can tolerate higher latencies, as fines are imposed offline. Thus Neural models for object detection can work at lower FPS, on edge GPUs with slower clocks (to reduce temperature rise) or in the cloud. However, traffic intersection control needs to be real time. Hence, I have developed FrugalLight and EcoLight, that create traffic density summaries from rich camera data, and uses efficient RL models or lookup tables for intersection control.

*Papers: NeurIPS 2020 (A\*) published, ACM-JCSS 2024 (journal) published, Compass 2024*

### • Chapter 2: Scaling sensing with low cost sensors

Like cameras are expensive to set up for traffic monitoring, for PM monitoring the reference grade sensors (CAAQMS) are even more expensive to setup. Each CAAQMS installation costs in millions of rupees and therefore limited sensors are present in Indian cities. To complement the high cost sensors, I build a network of low cost PM sensors in Delhi and Kolkata, that are deployed statically or in public transport like buses. This is the largest dataset for benchmarking ML problems like pollution interpolation and forecasting problems.

*Papers: NeurIPS 2023 (A\*) published for Delhi*

### • Chapter 3: Finding optimal locations for installing high cost sensors using Calibrated low cost sensing mechanisms with ML

I present ML methods for the low cost sensing measurements and calibration. I tackle another problem of finding locations for optimal placement of high cost sensors using the pollution data for two cities of Delhi and Kolkata, across different seasons of summer, post-monsoon and winter.

*Papers: NeurIPS 2024 (A\*) review*

## JOURNAL AND CONFERENCE PUBLICATIONS

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### • EcoLight: Intersection Control in Developing Regions Under Extreme Budget and Network Constraints (NeurIPS 2020)

*Authors: Sachin Chauhan, Kashish Bansal, Rijurekha Sen*

I observed that state-of-the-art methods tend to utilize complex ML models in realtime without concerning the deployment scenarios. Such complex designs would require huge number of sensors, and costly GPUs to be installed at road intersections. With the infeasible scenarios in mind, I started to explore simple and low overhead Machine Learning models which would need minimum sensor input and could be handled easily by low-cost edge devices. This work, utilizing *Reinforcement Learning*, is published at the leading neural network conference **NeurIPS**.

- **FrugalLight: Symmetry-Aware Cyclic Heterogeneous Intersection Control using Deep RL with Model Compression, Distillation & Domain Knowledge (ACM-JCSS 2024)**

*Authors:* Sachin Chauhan, Rijurekha Sen

A significant extension of the EcoLight work has been accepted for publication at the *ACM Journal on Computing and Sustainable Societies (JCSS)* and will also be presented at the COMPASS conference in July. I have generalized the traffic modelling approach to include better domain knowledge, state-of-the-art techniques, and careful improvements to provide an efficient traffic control solution which uses a fragment of computing resources as compared to state-of-the-art solutions while matching/improving the performance metrics.

- **DynCNN: Application Dynamism and Ambient Temperature Aware Neural Network Scheduler in Edge Devices for Traffic Control (COMPASS 2022)**

*Authors:* Omais Shafi, Sachin Chauhan, Gayathri Ananthanarayanan, Rijurekha Sen

I prepared a real traffic data capturing platform using traffic cameras, which would process the camera feeds to generate traffic summary in real-time, which was later used by other machine learning algorithms. The real traffic data generated using this system was used in a joint research work published at a good computation and sustainability conference **COMPASS** in 2022.

- **WebLight: Deep RL based Multi-modal Intersection Control in Developing Countries without Reliable Cameras (COMPASS'24)**

*Authors:* Sachin Chauhan, Rijurekha Sen

A research work to improve traffic control availability in case of camera failures, by maintaining the state of the traffic utilizing Web resources.

- **AirDelhi: Fine-Grained Spatio-Temporal Particulate Matter Dataset From Delhi For ML based Modeling (NeurIPS 2023)**

*Authors:* Sachin Chauhan, Sayan Ranu, Rijurekha Sen, Zeel Patel, Nipun Batra

The pollution sensors installed by the government to measure the pollution levels across the cities costs huge amount of money. So, we opted very low-cost portable pollution sensors to be installed in moving vehicles across the city. Apart from the cost savings, I explored the benefits of using mobile sensors in place of static sensors and explore the utility of the data. This work is published at **NeurIPS** in 2023. The Area Chair recommended our work as *Machine Learning that matters*.

- **Airshot: Effective Pollution Sensor Placement:** I performed data calibrations on the real datasets collected from our low-cost sensor deployments and utilized the calibrated data to recommend best locations for installing new high-cost sensors using *reinforcement learning* and *active learning*. The work is under-review and awaiting acceptance at suitable venue.

## WORKSHOP PUBLICATIONS

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- **RealLight: DRL based Intersection Control in Developing Countries without Traffic Simulators (NeurIPS 2023 workshop)**

*Authors:* Sachin Chauhan, Rijurekha Sen

A work on avoiding traffic simulators and effectively learn ML models utilizing graph based demonstrations using RL is presented at the workshop on Computational Sustainability at **NeurIPS**.

## SERVICE

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- Reviewer: NeurIPS'24 Datasets and Benchmarks Track

## REFERENCES

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