Manav Singhal

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Education

- **National Institute of Technology Karnataka** — Surathkal, India
  Bachelor of Technology in Electrical and Electronics (Minor in Computer Science). — *July 2018 – May 2022*
  - Cumulative GPA: **9.03/10.00**

Research Experience

- **Microsoft Research** — Bangalore, India
  Research Fellow. *Mentors: Dr. Nishanth Chandran and Dr. Dimitrios Dimitriadis* — *July 2022 - Present*
  - Working on problems related to privacy-preserving machine learning.
- **Carnegie Mellon University** — Pittsburgh, USA
  Robotic Institute Summer Scholar. *Mentors: Prof. Katia Sycara and Dr. Dana Hughes* — *June 2021 - Dec 2021*
  - Worked on providing explanations for a multi-agent **search and rescue task** with the Advanced Agent – Robotics Technology Lab by modeling the beliefs possessed by the agents.
  - Modeled the beliefs using a **Multiple-Observer** model, thus interpreting their decisions via queries in a multi-agent team setting in the simulated search and rescue task in the Minecraft environment.
- **Microsoft Research** — New York City, USA
  Independent Research Developer. *Mentors: Pavithra Srinath and Olga Vrousgou* — *May 2021 - September 2021*
  - Analyzed the effect of **Aggregated Learning** (i.e., saving only those features after training that have crossed a certain threshold of users) on the model learning capabilities of the Open Source library Vowpal Wabbit with the Real World Reinforcement Learning Team.
  - Achieved competitive performance between the public model (does not have access to the user feature mapping) and private model (has access to the user feature mapping) in our empirical analysis of the **privacy-preserving** feature on the OpenML Click Prediction Dataset. [Slides]
  - Implemented two different approaches for the feature and compared the existing benchmarks performances of each, along with developing new **unit tests and benchmarks** for it. [Patch link], [Wiki]
- **Indian Institute of Technology Madras** — Chennai, India
  Research Intern. *Mentor: Prof. Chandrashekar Lakshminarayanan* — *December 2020 - December 2021*
  - Formulated a multiple teacher-student framework, that captures prior approaches for single-agent **Safe Reinforcement Learning** (RL), which can enable designing newer approaches.
  - Experimenting with ideas from operations research in the context of RL, to incorporate the notion of timetables in the problem of efficient real-world **train scheduling** in the Flatland environment.
- **Indian Institute of Science** — Bangalore, India
  IAS Summer Research Fellow. *Mentor: Prof. Shalabh Bhatnagar* — *May 2020 - July 2020*
  - Worked on evaluating widely used single-agent approaches, such as **Dueling Deep Q Networks (DDQN)** and **Proximal Policy Optimization (PPO)**, using distributed scalable implementations from RLlib, to identify their shortcomings on the multi-agent **Flatland** Environment for efficient train scheduling. [Report]
  - Reviewed the existing literature on Markov Decision Process (MDP) for **Vehicle Rescheduling Problem** and the algorithms developed to solve the problem specifically catering to the scheduling of trains. [Report]
- **Indian Institute of Technology Kharagpur** — Kharagpur, India
  Research Intern. *Mentor: Prof. Niloy Ganguly* — *May 2019 - June 2019*
  - Part of the Complex Networks Research Group(CNeRG), experimenting with **Class Activation Maps** in NLP to understand the words affecting the **textual entailment** prediction being made by the CNN model on the SNLI dataset consisting of 570k sentence pairs. Achieved a **60%** test accuracy. [Code], [Report]
  - Built a preprocessing pipeline for **tweets on ebola** for **classification** of their GloVe embeddings with Bidirectional LSTMs. [Code]

Publications

- **Explanations in Multi-Agent Search and Rescue Task** [Poster], [Video]
  ***Manav Singhal**, Vidhi Jain, Dr. Dana Hughes, and Dr. Katia Sycara*
  RISS Working Papers Journal 2021.

Awards and Honors

- Selected to attend the Research Week with Google 2022 organized by **Google Research India**.
- Selected for the Robotics Institute Summer Scholar (RISS) Program 2021 to pursue a summer research internship at the **Robotics Institute, Carnegie Mellon University**. Among 58 selected globally out of 700+ applicants.
- Selected for the Reinforcement Learning Open Source Fest (RLOSF) 2021 to pursue a summer research project with **Microsoft Research, New York City**. Among 10 selected globally out of 200+ applicants.
- Awarded the Summer Research Fellowship (SRFP) 2020 conducted by the **Indian Academy of Sciences** to pursue a summer research internship at **IISc Bangalore**. Among top 5% selected out of 25,000+ applicants.
- Recipient of the OP Jindal Engineering Scholarship (OPJEMS) 2019. Among 80 selected out of 1100+ applicants.
- Ranked **3rd** amongst 75+ participants in Dishathon, a hackathon organized by **DishTV**.

Selected Projects

- **Interactive Multi-Agent Reinforcement Learning**: *Project with IEEE NITK Student Branch.* Worked to develop and improve algorithms that learn to play mixed cooperative-competitive many-player games collaboratively.
- **Predicting Generalization in Deep Learning** (PGDL): Analyzed the Cognitive Neural Activation (CNA) metric as an appropriate complexity measure to predict generalization hence understand the reasoning of the generalization capability of Neural Networks for the NeurIPS 2020 PGDL Competition.
- **Adversarial Attacks on Reinforcement Learning Algorithms**: *Project with IEEE NITK Student Branch.* Implemented Deep Q Networks and Policy Gradient to analyze the effects of trained adversarial attacks on agents in zero-sum robotic environments in a multi-agent domain.
- **Object Tracking using Kalman Filters**: *Project with Prof. Krishnan CMC.* Tracking the movements of four players in a tennis doubles match using using Kalman Filters with a modification to the Hungarian algorithm.
- **Indoor Positioning**: Implemented an approach to determine the precise location of an object within a room using trilateration on the distances of the object obtained from three fixed points determined using time delays between radio and sound waves.
- **Linking E-commerce to OTT media content**: Worked on an application for product recommendations in multimedia. Implemented a pipeline for displaying relevant objects from e-commerce websites for each frame within a video to enable a seamless online shopping experience.

Technical Skills

- **Programming Languages**: **Adept**: Python, C++ **Familiar**: C, Java
- **Relevant Tools/Frameworks**: Keras, Tensorflow, Pytorch, Numpy, Git, Matlab, Pandas, Jupyter, OpenAI Gym

Relevant Coursework

Probability and Statistics, Optimization Techniques, Linear Algebra, Advanced Calculus, Digital Signal Processing, Signal and Systems, Data Structures and Algorithms, Stanford's CS229: Machine Learning*, Deep Learning Specialization* (deeplearning.ai), Reinforcement Learning* (IIT Madras) (* = Online)

Mentorship and Leadership

- Part of the **RISS 2021 Working Papers Journal** team.
- **Secretary** of Web Club NITK: Coordinated 20+ computer science events organized for a group of 70+ students.
- **Executive Member** of IEEE NITK:
  - Gave a TechnoVoice talk guiding junior undergraduate students with my research journey. Link to Podcast.
  - Mentored 15+ students in a Computer Science Summer Program.

Extra Curricular Activities

- Personal Blog: Creating content for blogging my views on thought-provoking issues.
- An avid debater:
  - **Finalist** at the Speak For India 2019 edition.
  - **Finalist** at the Team India selections for World School Debating Championship 2017.