Pranav Nyati

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Education

Indian Institute of Technology, Kharagpur **Dec 2020 - May 2025**
Integrated Bachelor and Master of Technology, Computer Science and Engineering ***CGPA - 9.40/10.00***

Scholastic Achievements

- Secured **All India Rank 462** in **JEE Advanced 2020** (among 150K candidates) and **707** in **JEE Mains 2020** (among 1M candidates)
- Awarded the **National Talent Search Examination Scholarship** in 2018 by G.O.I., given to only **2000** students across India each year
- Recipient of the esteemed **DAAD-WISE 2024** Research Scholarship to pursue a research project on **Graph ML** in **Germany**
- Awarded the **MITACS Globalink 2024** Research Scholarship to pursue a research project in **Reinforcement Learning** in **Canada**

Research Experience

Master's Thesis Project | Prof. Sudeshna Kolay (IIT Kharagpur, India) **Aug 2024 - Present**
Topic: Multi-agent Coordinated Motion Planning on Graphs

- Studied existing results on the parameterized complexity of **multi-agent motion planning** problem, which involves finding **optimal routes** (wrt **makespan** or **total distance**) for a set of agents on a graph from their respective source to destination without collisions
- Working on **feasibility** of coordinated motion planning, characterizing graphs that are solvable for **all source-destination** configurations
- Formulated a **deterministic poly-time algorithm** and a **randomized linear-time algorithm** to check if a given graph is solvable for all source-destination configurations, using **group-theoretic** constructs.

DAAD-WISE Research Intern | Prof. Isabel Valera (Saarland University and MPI-SwS, Germany) **May 2024 - Jul 2024**
Topic: Metaheuristic methods for graph counterfactual explanations

- Formulated the problem of finding **counterfactual explanations** for graph classification tasks as a **subset selection problem**
- Implemented the **Ant Colony Optimization** algorithm in **Python** to find explanations for graphs using only **model prediction** access
- Experimented with three different ACO variants, finding counterfactuals with **83–90 % validity** and **average proximity** of **0.72-0.91** across several datasets, optimizing runtime by $\sim$ **10x** using **multiprocessing** for parallelizing the search by the agents

Bachelor's Thesis Project | Prof. Sourav Medya (University of Illinois, Chicago, USA) **May 2023 - Mar 2024**
Topic: Model-Level Explainability of Graph Neural Networks

- Implemented a **K-means clustering**-based pipeline to generate **model-level** explanation graphs from **GNN embeddings** of instance-specific explanations for graph classification tasks using any existing instance-level explanation method such as PGExplainer
- Proposed and implemented a generative approach based on the **Gumbel-Softmax sampling** to generate model-level explanation graphs
- The generated explanations achieved **85–98 %** accuracy across different graph datasets and GNN architectures like **GCN** and **GAT**

Projects

Image Reconstruction Kaggle Challenge | Deep Learning Course | **Apr 2023**

- Implemented a **Pix-2-Pix conditional GAN** model with a U-net-based **generator** and a convolutional PatchGAN **discriminator** using **TensorFlow** for **Image Inpainting** of a dataset of animal images, and also evaluated a pre-trained **Stable Diffusion** model for the task
- Applied **image augmentation** and random noise addition to images to boost the model accuracy, achieving an **RMSE** of **0.167** and mean inference time of **0.31 sec**, securing **4th** position among 37 teams in a Kaggle challenge hosted as part of the Deep Learning course

Intent and Entity Recognition in Healthcare Platform Data | Deep Learning Project | **July 2024**

- Developed an NLP pipeline for **intent** and **entity recognition** in multilingual medical queries in online medical forums for efficient search
- Benchmarked the performance of **Bi-LSTM** and **BioClinicalBERT** models on English queries and of **XLM-RoBERTa** on Indic queries
- Investigated the performance of BioClinicalBERT on English-translated Indic queries using direct and two-step bridge translation

Autonomous Car Navigation in an Obstacle Course | Reinforcement Learning Project | **Sept 2023 - Nov 2023**

- Modelled a simulated **autonomous car** that can learn to navigate through an obstacle course based on **real-time radar** input using **RL**
- Formulated an **MDP** and a custom **reward setup** to make the agent learn an optimal path to finish a lap in less time, avoiding obstacles
- Implemented the **SARSA** and **Q-Learning** algorithms to learn the optimal policy considering unknown MDP dynamics for discrete space, Deep-RL approaches like **DDQN** and Policy Gradient methods like **REINFORCE** for continuous space using **Pytorch**

Distributed Database with Load-Balancing | Distributed Systems Course Project | **Feb 2024 - Mar 2024**

- Engineered a scalable **distributed database** in **Python** consisting of multiple **SQL servers** and a **load balancer** in a **Docker** network
- Implemented **consistent hashing** to distribute asynchronous client requests uniformly and **heartbeat threads** for crash-fault tolerance
- Designed efficient data structures for fast data retrieval and incorporated **Sharding** with **Write-Ahead Logs** for replica consistency

Relevant Coursework

- **AI/ML**: Machine Learning, Deep Learning, Reinforcement Learning, Social Computing, Advanced Machine Learning, AI for Economics
- **Theoretical CS & Math**: Algorithms I & II, Probability & Statistics, Randomized Algorithms, Approximation Algorithms, Parameterized Algorithms, Statistical Learning Theory, Advanced Calculus, Stochastic Processes, Linear Algebra, Convex Optimization, Discrete Math
- **Other CS courses**: Computer Architecture, OS, Computer Networks, Database Systems, Systems Programming, Distributed Systems

Technical Skills

- **Programming Languages**: **Proficient**: Python, C, C++ | **Familiar**: Bash, Java, SQL, LaTeX, Verilog, MATLAB
- **Libraries/Frameworks**: Git, Docker, Jupyter, PyTorch, PyG, TensorFlow, NumPy, Pandas, Matplotlib, HuggingFace, OpenCV

Extra-Curricular Activities

- Attended the **Winter School** on **Theoretical Computer Science** organized by the **CS Dept, IIT Delhi**, in December 2023
- **Team Member, Recreational Math Club, IIT Kharagpur**: Delivered a talk on **Nash Equilibrium** as part of a talk series on Game Theory and helped organize the regular reading sessions of the club
- **Mentor, SWG IIT Kharagpur**: Mentored a cohort of first-year students (2022 batch) regarding academics and extra-curricular pursuit