Prateek Garg

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Academic Qualifications

Year	Degree	Institute
2017 - 2021 (Expected)	B.Tech in Computer Science (Minor in Robotics)	Indian Institute of Technology, Delhi

Work Experience

- **Research Intern at Mila-Quebec AI Institute, Montreal, Quebec, Canada** (*July'20-Present*)
  - Exploring how well a meta-learner trained with a population of *self-play* and *other-play* do in zero-shot coordination settings
  - Implemented *Deep Counterfactual Regret Minimization* & *Simplified Action Decoder* for cooperative two step **Matrix Game**
- **Research Intern at Alberta Machine Intelligence Institute, Edmonton, Canada** (*May'20-July'20*)
  - Conceptualized the effect of *state-similarities* on generalization in Monte-Carlo Tree Search using AlphaZero architecture
  - Built a bot on top of *KataGo*, state-of-the-art Go bot, using **Memory-Augmented MCTS** technique. *Paper in pipeline*
- **Research Intern at RIKEN Center for Advanced Intelligence Project, Tokyo** (*Nov'19-Dec'19*)
  - Built a Reinforcement Learning framework using **Deep Q-Learning** & **MCTS** for robots, integrating with ROS in Python
  - Designed toy problem for Car Racing AI setting using ROS, making the bot navigate its path through the maze optimally
- **Core Team Member at Robomuse 5.0, New Delhi** (*Discovery and Learn 1-2-3-4 Project*) (*Sept'18-Jan'2020*)
  - Deployed **vision algorithms** for obtaining **Stereo-Image** & **extracting depth data** for SLAM purposes in mobile robot
  - Used standard navigation packages in **ROS** to develop complete back end for a fully **Autonomous Navigating Robot**
  - Designed a vision based **Landmark Recognition** technique for estimating global position state of the robot
  - Developed *Human Detection* and *Object Detection* modules in integration with ROS to add human safety features in bot
- **Research Intern at RIKEN Center for Advanced Intelligence Project, Tokyo** (*May'19-July'19*)
  - Performed an experimental study for the **traffic state prediction** during **Hiroshima disaster in June, 2018**
  - Prepared a comparative study between **RNNs** and Conventional Machine Learning Methods ***(SVMs, Random Forest)***
  - Conceptualized and merged the **effects of various features** on **Q-K curve** for critical nodes during the natural disaster
  - Compared the interpretation of spatio-temporal features obtained from Machine Learning models with **traffic flow theory**
- **Project Associate at D-LIVE, Mahindra Autonomous Car Challenge, IIT Delhi** (*Feb'18-Aug'18*)
  - Received **Design Innovation Summer Award (DISA)** and sponsorship by *Institute R&D Dept., IIT Delhi*
  - **Improved odometry by 90%** at *35 kmph* using ZED Camera, GPS, IMU and obtained **correct loop closure results**
  - Worked on improving **ORB_SLAM2** to compute camera trajectory and sparse **3D reconstruction** for **visual odometry**
  - Implemented the **robot_localisation package** for accurate state approximation and integrating data obtained from GPS

  *Received a **Letter of Recommendation** for exemplary results and excellent contribution*

Key Projects

- **Traffic Adaptability (B.Tech Thesis)**, **Prof. Rijurekha Sen**, Department of Computer Science, IIT Delhi (*Sept'20-Present*)
  - Worked towards improving the adaptability of *traffic management models* based on Meta Learning techniques like **MAML**
  - Extending our work to develop a continual learning method to support our traffic model after deployment in online fashion
- **PageRank**, **Prof. Rijurekha Sen**, Department of Computer Science, IIT Delhi. (*April'20-May'20*)
  - Developed an *open-source* implementation of the *Google's official **PageRank** algorithm* for large distributed systems
  - Used **MapReduce** algorithm with **MPI** in C++ for fast processing *large graphs* (of webpages). Tested upto **300,000** edges
- **Spine Classification & Segmentation**, **Prof. Prathosh AP**, Dept. of Electrical Engineering, IIT Delhi. (*April'20-May'20*)
  - Performed experimental study using Deep Learning techniques (**mainly CNNs**) to assess the spine structure from X-Rays
  - Used **U-Net** for segmentation and **Transfer Learning** from pre-trained model for pneumonia prediction for good results
- **AI Bots**, **Prof. Mausam**, Department of Computer Science, IIT Delhi. (*July'19-Sept'19*)
  - Gene String Mapping: Implemented ***Hill Climbing*** and ***Simulated Annealing*** search to find similarity between genes
  - The Game of Cannon: Made AI bot for the game by constructing ***MinMax Tree*** and implementing *Alpha-Beta Pruning*
  - Graph Subset Mapping: Formulated the problem as *constraint satisfaction problem* and further solved it by **SAT Solver**
  - Tic-Tac-Toe: Designed a computer player with various mastery levels using improved **Monte Carlo Tree Search** technique
- **Chat Application**, **Prof. Aaditeshwar Seth**, Department of Computer Science, IIT Delhi. (*Aug'19-Sept'19*)
  - Built a chat application similar to *WhatsApp* that allows user to do **encrypted chat**, which cannot be decrypted at server
  - Simulated on different network configurations by dynamically running for **multiple senders**, receivers on parallel threads
- **Multi-Cycle Processor Design**, **Prof. Anshul Kumar**, Department of Computer Science, IIT Delhi. (*Jan'19-April'19*)
  - Developed a multi-cycle processor for **ARM** language, supporting memory access, arithmetic operations and functions
  - Designed on **VHDL**, using **Xilinx** for simulation and generation of bitstream so it works on the **BASYS 3** board
- **ReMark**, **Prof. Rijurekha Sen**, Department of Computer Science, IIT Delhi. (*April'18-May'18*)
  - Developed a Q/A game for a **social cause** on **android** platform with the aim of moderating extremist views in the society
  - Designed using **Android Studio**, the game uses **Bluetooth** and was reviewed positively for it's amazing **themes** and **UI**

Fun Projects

- **Neural Style Transfer**: Tried generating new artificial artwork using Transfer Learning.
- **Hanabi Bot**: Built a Hanabi bot for exploring Multi Agent RL, achieving a mean score of 23.3
- **RL Ensemble:** Implementing and visualising various RL algorithms on various OpenAI Gym environments
- **GANs**: Implemented and visualised the results of various GANs like DCGAN, Wasserstein GAN and Info-GAN
- **Car Racing AI**: Using RL techniques on TORCS Simulator, trying to build an AI for autonomous movement of car

Scholastic Achievements

- **Reviewed** a paper for the ***Transportation Research Board***
- **All India Rank- 96** in *Joint Entrance Examination (Advanced), 2017* among **1.5 million** students
- **All India Rank- 99** in *Joint Entrance Examination Main (B.Arch), 2017* among **150 thousand** students
- Awarded *Merit Certificate* for being in **top 1%** in **Indian National Physics and Astronomy Olympiads, 2017**
- Awarded with **Kishore Vaigyanik Protsahan Yojana, 2016** Fellowship by **IISc Bangalore** securing **All India Rank 303**
- Completed **Vijyoshi National Science Camp, 2016** organised by **KVPY** with **IISc Bangalore** and ***Government of India***
- Awarded **Scholarship** for qualifying both stages of **National Talent Search Examination, 2015** by ***Government of India***

Technical Skills and Courses Done

- **Skills:** C, C++, Python, Java, OCaml, Bash, Tensorflow, Keras, Pytorch, Sci-kit Learn, VHDL, ROS, OpenCV, OpenGL, MPI
- **Coursework:** Deep Learning, Pattern Recognition, Computer Vision*, Artificial Intelligence, Reinforcement Learning*, Learning for Cognitive Robot Intelligence, Computer Architecture, Computer Networks, Programming Languages, Design and Analysis of Algorithms, Discrete Mathematics, Robotics Technology, Data Structures, Operating Systems, Parallel Programming

Publication

- Short-term traffic prediction under non-recurrent congestion: A machine learning approach for traffic management during disaster
  Makoto Chikaraishi, ***Prateek Garg****, Varun Varghese, Kazuki Yoshizoe, Junji Urata, Yasuhiro Shiomi, Ryuki Watanabe (2019)*

Past Supervisors

- **Prof. Martin Mueller**
  DeepMind Chair in Artificial Intelligence, Department of Computing Science, University of Alberta, Canada
- **Dr. Kazuki Yoshizoe**
  Head, Search and Parallel Computing Unit, RIKEN, Center for Artificial Intelligence Project, Tokyo, Japan
- **Prof. Makoto Chikaraishi**
  Associate Professor, Chikaraishi Lab, Hiroshima University, Japan
- **Prof. Sunil Jha**
  Professor, Indian Institute of Technology, Delhi