ETH zürich

Shubh Goel

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MSc. in Computer Science

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Education

Degree/Certificate	Institute/Board	CGPA/Percentage	Year
B.Tech.	Indian Institute of Technology, Delhi	9.154	2020-2024
CBSE/SSCE	Mount Carmel School Dwarka	97.8%	2020
CBSE/AISSE	Mount Carmel School Dwarka	95.4%	2018

Scholastic Achievements

- **IIT Delhi Semester Merit Award:** Made it to the **top 7% (among 1200+ students)** in **6 out of 8** semesters
- **Department Change:** Got selected for department change based on academic excellence in the first year at IIT Delhi
- **Department Rank:** Made it to the **top 3 out of 128** students in the Electrical Engineering undergraduate program at IIT Delhi
- **JEE(Mains and Advanced):** Secured **AIR 2209(GE)** in JEE Mains and **AIR 1323(GE)** in JEE Advanced among 1.1 M candidates
- Awarded **CBSE Merit Certificate** in grade X for standing in the **top 0.1%** students nationally in Science
- Awarded **CBSE Merit Certificate** in grade XII for standing in the **top 0.1%** students nationally in Math, Physics, and CS
- **National Science Olympiad 2018:** Won the **silver medal** for securing a **Zonal Rank 2** and an **International Rank 27**

Internships

- **JP Morgan Chase and Co., Mumbai/QR-Counterparty Credit Risk** *May, 2023 - Jun, 2023*
  IMM Back-testing Failure Analysis and Remediation
  – Improved **equity market factor back-testing failures by 40%** by proposing a new outlier removal algorithm for historical vol calibration
  – Worked on the analysis of **MtM** diferences between **Commodity Swap/Index Swap** pricing models and FO models
  – **Automated** the process of Onboarding and Ofboarding of counterparties to/from **exposure back-testing** portfolio

- **Implementation of Contour Tracing Algorithms on an FPGA board | Prof. Subrat Kar** *Jun 2022-Nov 2023*
  Global Internship Program in Engineering Design and Innovation, IIT Delhi
  – Implemented Adapted and Segmented(AnS) **Pixel-Following, Vertex-Following and Run-Data-Base-Following algorithms** in Verilog
  – Implemented a novel hardware accelerator for contour tracing in image analysis and CV using the AnS algorithms on **Xilinx-7 FPGA platform**
  – Achieved a **speedup of 55x** compared to existing methods, making it ideal for parallel processing arrays and mesh-connected networks

Publications

- **A Hardware Accelerator for Contour Tracing in Real-Time Imaging [DOI]** *Nov 2023*
  Sonal Gupta, Shubh Goel, Ayush Kumar, and Subrat Kar, Senior Member, IEEE IEEE Sensors journal

Projects

- **Multi-Modal Sensor Fusion Model for Autonomous Driving(Bachelor's Thesis)** *Aug 2023 - May 2024*
  Prof. Seshan Srirangarajan IIT Delhi
  – Designed an **attention-based cross-modal feature learning** model having robustness to sensor failure, to fuse multi-modal sensor data
  – Utilized **CARLA**, an open-source simulator tailored for autonomous driving research, to create realistic urban environments
  – Tested the fusion model on object detection task, achieving a high Mean Average Precision of **80.09%** on the generated data

- **Table Cell Classification for Question Answering** *Mar 2024*
  Prof. Mausam IIT Delhi
  – Built a **Bi-LSTM** based model for predicting correct column and row for the given the question and the corresponding table
  – Utilized **nltk** library for tokenization and initialized the token embeddings with pre-trained **Fasttext embeddings**
  – Achieved a high column accuracy of **89 %**, indicating the efectiveness of the developed model in correct column prediction

- **Lay Summarization of Biomedical Research Articles using PEFT** *Apr 2024*
  Prof. Mausam IIT Delhi
  – Used a **pre-trained Flan-T5 model** and trained a system that produces a layman's summary given a research publication
  – Utilized **Low-Rank Adaptation (LoRA)** parameter efficient fine-tuning method with a rank of 32 to enhance model performance

- **State Estimation using Kalman Filter** *Feb 2024*
  Prof. Rohan Paul IIT Delhi
  – Developed a state estimation model using Kalman Filter to track the position and velocity of a plane, incorporating noisy measurements
  – Applied the Extended Kalman Filter (EKF) algorithm to handle nonlinearities in the system, improving the accuracy in complex scenarios

- **Planning in Markov Decision Process and Deep Q-Learning** *Mar 2024*
  Prof. Rohan Paul IIT Delhi
  – Implemented **value iteration**, **policy iteration**, and their respective variants to find an optimal policy for a given MDP
  – Implemented Q-learning using **OpenAI Gym** and **PyTorch** to learn a state-action value function for a **model-free** setting

- **Imitation Learning and Policy Gradients** *Apr 2024*
  Prof. Rohan Paul IIT Delhi
  – Implemented **DAGGER** and **Reinforce** to learn an optimal policy in **Hopper-v4** and **Ant-v4** environments from OpenAI Gym
  – Utilized **SAC algorithm** with **Hindsight Experience Replay** to train a goal-conditioned policy for the **PandaPush-v3** environment

- **Denoising EEG Signals Using Deep Learning** *Jun 2022 - Dec 2022*
  Prof. Lalan Kumar IIT Delhi
  – Built **MLP**, **CNN-LSTM**, **LSTM-Resnet** based Deep Learning models to remove various **artifacts** from a raw EEG signal
  – Prepared the dataset for training by performing **Independent Component Analysis(ICA)** on the raw EEG Signals
  – Achieved a high PCC of **0.933**, indicating the efectiveness of the developed models in artifact removal and signal enhancement

- **Rollerball: A Chess variant** *Nov 2023*
  Prof. Mausam IIT Delhi
  – Engineered a Rollerball playing AI agent using **minimax** algorithm with **alpha-beta** pruning and early cut-off
  – Improved the agent's performance using **quiescence search, heatmaps, transposition tables and opening book**

- **Graph Neural Networks** *Nov 2023*
  Prof. Sayan Ranu IIT Delhi
  – Designed a **GIN** based architecture using **Pytorch Geometric** to predict whether a molecule inhibits HIV virus replication or not
  – Achieved a high ROC-AUC of **0.76** on the test data by introducing skip connections, dropout layers and weight decay

- **Medical Diagnosis** *Oct 2023*
  Prof. Mausam IIT Delhi
  – Implemented **Expectation Maximization** to learn a Bayesian network modelling inter-relationships between diseases and symptoms

- **Transactional Data Compression** *Aug 2023*
  Prof. Sayan Ranu IIT Delhi
  – Implemented the **FP-growth** algorithm efficiently to mine frequent item sets in the provided dataset, achieving a compression ratio of **11.862%**
  – Used heuristics such as performing the mining process several times with decreasing support values to improve the compression ratio

- **Creating a New Cryptocurrency** *Sep 2021 - Nov 2021*
  Prof. Venkata Koppula IIT Delhi
  – Built a nearly complete, **counterfeit-resistant**, **buyer-seller-miner** based cryptocurrency **DSCoin** using **blockchains**
  – Used **CRF(sha-256)** for encryption; data structures like **Merkle Trees, Linked Lists, Queues** for implementing **transaction blocks**
  – Handled **malicious miners** using incentive engineering; modified the blockchain structure from a Linked list to a tree-like structure

Technical Skills

Programming Languages(Proficiency Level)	JAVA/C/C++/Python(Advanced), MATLAB(Basic)
Software/Libraries/Frameworks	Pandas, Numpy, Scikit-Learn, TensorFlow, PyTorch, Gensim, NLTK, HuggingFace, OpenAI Gym, Vivado, LaTeX
Hardware Description Language	Verilog

Key courses taken

Computer Science	Data Structure & Algorithms, Discrete Math, Analysis & Design of Algorithms, Computer Architecture, Machine Intelligence & Learning, Artificial Intelligence, Data Mining, Principles of Autonomous Systems, NLP
Mathematics and Statistics	Probability & Stochastic Processes, Linear Algebra & Differential Equations, Calculus
Electrical	Signals & Systems, Circuit Theory, Digital Electronics, Embedded Systems, Control Engineering, Communication Engineering

Academic Service

- **Undergraduate Teaching Assistant** *Jan 2024 - May 2024*
  COL100: Introduction to Computer Science
- **Undergraduate Teaching Assistant** *Aug 2023 - Nov 2023*
  ELL101: Introduction to Electrical Engineering

Positions Of Responsibility

- **Core Team Member** *March 2021 - May 2024*
  Algorithms and Coding Club(ANCC) IITD
  – Assisted my team in launching the **Summer of Competitive Programming(SoCP)** program for the frst time in July 2021
  – Led my team to **organize inter-college tournament**, a Competitive Programming knock out tournament **for the frst time** in Tryst'23
  – Worked with my team in planning and organising activities that helped the club to attain official status in 2023