# Kushal Kumar Gupta

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## Academic Details

| Year | Degree | Institute | CGPA/Percentage |
|---|---|---|---|
| 2020-2024 (Current) | B.Tech in Computer Science and Engineering | Indian Institute of Technology Delhi | 9.452/10 (after 5th semester) |
| 2020 | MSBSHSE HSC (class 12 board exam) | Shubham Raje Junior College, Thane | 96.46% |
| 2018 | CBSE AISSE (class 10 board exam) | DAV, Thane | 98.40% |

## Scholastic Achievements

- **Joint Entrance Exam (JEE) Advanced 2020:** Secured **All India Rank 81** out of 1.5 lakh students
- **Joint Entrance Exam (JEE) Mains 2020:** Secured **All India Rank 737** out of 9 lakh students
- **IITD Semester Merit Award:** Awarded Merit Prize for being in the top 7% of the department in semesters 1, 2, 4 and 5. (2023)
- **Quadeye Excellence Scholarship:** Merit based scholarship provided through the Quadeye Excellence program (2022)
- **Assistance to Meritorious Students scholarship:** Awarded by the Govt. of Maharashtra for being one of the top 5 students out of 15 lakh students in class 12 board exam (2020)
- **TOI Student of the Year award:** Awarded by The Times of India for outstanding academic performance (2019)

## Projects

**IITD freeroam game** *Prof. Rijurekha Sen, March 2022 - April 2022 (Course Project)*

• Created an interactive 2 player game set in the IITD campus using SDL library in C++.
• Implemented sockets for connecting 2 players over a common Wi-Fi. Made the map for the entire campus using Tiled software.

**Designing an ARM processor** *Prof. Anshul Kumar, January 2022 - April 2022 (Course Project)*

• Designed hardware for implementing a processor that can execute ARM instructions. The designs are expressed in VHDL and then simulated and synthesized.
• Designed modules for ALU, Register File, Memory, Program Counter, Multiplier, Shifter and for updating and checking flags.

**Designing the WHILE programming language** *Prof. S. Arun-Kumar, March 2022 - April 2022 (Course Project)*

• Designed a **strongly typed programming language** with static type checking having if-then-else and while statements using **SML, ML-Lex and ML-Yacc**.
• Designed the lexical analyser, parser to generate the AST, and VMC machine to execute the program.

**Modified P2P file sharing network** *Prof. Abhijnan Chakraborty, August 2022 - September 2022 (Course Project)*

• Designed a **network architecture** with server and multi-threaded clients with socket programming on python simulating a modified version of **P2P file sharing architecture**.
• Each peer initially has incomplete chunks of the file sent by the server. Using TCP/UDP for file transfer and UDP/TCP for control messages, the complete file is shared across all peers through the server.

**AI Self-driving car** *Prof. Rohan Paul, August 2022 - September 2022 (Course Project)*

• Simulated a car on a block grid in python having a sensor which gives noisy measurements of the positions of other

cars in vicinity. Used particle filter to estimate and update the belief states of other cars over time.

• Making use of the particle filter, the car tries to reach the checkpoints by deciding the direction to move into and the speed to avoid collisions with walls and with other cars by forecasting their positions.

**Audio processing library in C++** *Prof. Rijurekha Sen, January 2022 - Februrary 2022 (Course Project)*

• Implemented a small audio processing library in C++ using Deep Neural Networks which takes 1 second audio samples and detects the word spoken from a predetermined set of keywords.

• The DNN comprises of 4 fully connected layers. Implemented matrix multiplication using my own multithreading and also MKL and OpenBlas libraries, and made performance comparisons using gnuplot.

**Implementing a cryptocurrency in Java** *Prof. Bagchi and Prof. Koppula, August 2021 - October 2021 (Course Project)*

• Defined roles of moderators, miners, and users, and appropriately developed the program.

• Used Merkle-trees and blockchains for proof-checking of transactions, and defined appropriate rewards and incentives for miners. Developed procedures to limit the threat of malicious miners to a reasonable level.

**Other projects-**

• Designed a **stopwatch** in **VHDL**, and a 2 layer **neural network** that predicts the image category in VHDL. Also synthesised on **Basys-3 hardware**.

• Designed a **game playing AI** with depth-limited minimax search and alpha-beta pruning for playing a modified version of the game **Connect-4** in python.

• Implemented a **Neural Network architecture** with variable number and size of hidden layers in python with **backpropagation** for training on data. Also implemented many other ML algorithms like **regressin with stochastic gradient descent and Newton's method, GDA, Naive-Bayes, and SVM using convex solvers**.

• Designed a program in Java to efficiently support queries asking for number of restaurants within a certain area, used **k-dimensional trees** and achieved a square-root asymptotic time complexity

• Implemented the **AVL Tree** data structure over the set of integers with insert, delete and find functions

• Implemented a secure Academic **Blockchain** for storing grades of students, across several academic years

• Built an **interpreter in SML** for a basic arithmetic machine with loops and if-else statements

• Implemented Merge Sort algorithm in **ARM assembly** language

## Relevant Courses

• **Completed**

| | |
|---|---|
| *Computer Science* | Programming Languages, Computer Architecture, Data Structures and Algorithms, Digital Logic and System Design, Machine Learning, Artificial Intelligence, Analysis and Design of Algorithms, Computer Networks |
| *Mathematics* | Numerical Methods and Computations, Discrete Mathematical Structures, Probability & Stochastic Processes, Linear Algebra & Differential Equations, Calculus |

• **Ongoing**

| | |
|---|---|
| *Computer Science* | Operating Systems, Parallel programming, Natural Language Processing Theory of Computation |
| *Mathematics* | Optimisation Methods |

## Technical Skills

**Languages:** C++, C, Python, Java, SML, HTML, LaTeX

**Tools:** MATLAB, Matplotlib, pandas, NumPy, C++ STL, Vim, VHDL, ML-Lex, ML-Yacc, NS3

## Extracurricular activities

- Completed "Fundamentals of Accelerated Data Science with RAPIDS" workshop organised by NVIDIA *(2022)*
- Won numerous awards in roller skating at District and Zonal levels, participated in State Championship