Kushal Kumar Gupta

Computer Science & Engineering
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Examination	University	Institute	Year	CGPA/%
Graduation	IIT Delhi	IIT Delhi	2020 - 2024	9.611
Intermediate/+2	MSBSHSE HSC	Shubham Raje Junior College, Thane	2020	96.46
Matriculation	CBSE	DAV, Thane	2018	98.40

Academic Achievements

- **Semester Merit Awardee** for being **Top 7%** in the CSE department *(Fall '20), (Spring '21), (Spring '22), (Fall '22), (Spring '23), (Fall '23)*
- Included in the **Hall of Fame** for **Linux Kernel Development** in the Operating Systems course *(2023)*
- Awarded **Quadeye Excellence Scholarship** in the **Quadeye Excellence Program** *(2022)*
- Secured **All India Rank 81** in **JEE Advanced 2020**, among **200k+** competitors *(2020)*
- Awarded **Meritorious Students scholarship** given to **Top 5 students** in **Class 12 Board Exam** *(2020)*

Internship Projects

Real-time Streaming ML platform *(December 2023 - April 2024)*
TurboML, Remote

- Worked on various components; backend with **Uvicorn**, frontend with **Streamlit**, python SDK, event streaming and DB with **Kafka**, **StarRocks**, **Postgres**, containerization using **Docker** and deployment in **k8s using minikube**.
- Added a **test framework** for parametrized tests using **pytest** and **papermill**, and added a **k8s job** for running tests.
- Added **namespacing** for models & datasets, **authentication**; **ingress** & **reverse proxy** using **Caddy** and **nginx**.

SplashAttention - Sparse Attention in Transformers *(August 2023 - October 2023)*
Abacus.AI, Remote

- Worked on **PyTorch and CUDA** implementation of **SparseMax**, a sparse alternative of Softmax in transformers.
- Integration with **FlashAttention** for **sparse attention in transformers** with **efficient GPU memory access**.

Unified Feature Flag management framework *(May 2023 - July 2023)*
Rubrik, U.S. ***Received Pre-Placement Offer (declined)***

- Implemented a new **feature flag management** framework with **gRPC** and **REST API** endpoints for flag evaluation on both the **Rubrik Security Cloud (RSC)** in **Golang** and the on-site **data clusters** in **Scala**.
- Replaced previous architectures, enabling **dynamic feature rollout** without code changes on cloud and cluster.
- Provided **UI using LaunchDarkly** to modify flags and introduce **rule-based evaluation** based on customer attributes (e.g.,name, clusterID), and update changes on RSC and data clusters with **proper synchronization**.

Developing Math library in Java *(June, 2022 - August, 2022)*
NM Dev, Singapore

- Worked on the solver for the **Dual SOCP** problem using the **Primal Dual Interior Point algorithm** in Java.
- Implemented **backward** and **forward substitution** to get the searching direction at **predictor** and **corrector step**.
- Used **CHOLMOD** from **SuiteSparse** in C++ using **JNI** for sparse matrices to get **33% improvement** in performance.

Course Projects

Inflight Data Error Handling in ML Workflows *(August 2023 - December 2023)*
Guide: Prof. Abhilash Jindal | B.Tech. Project *IIT Delhi, India*

- Implemented a **distributed data processing framework Popper** which enables ML workflows to **catch errors** and **fix them upstream efficiently** by **backward tracing** using **flow-graph schema** maintained in **Redis**.
- Wrote various ML pipelines such as **object tracking**, **CCTV car surveillance**, **ID card processing** in **Popper, Spark, Flink** to demonstrate on-par performance in **runtime, scalability** and **improved accuracy** in **Popper**.

Distributed Streaming MapReduce with Redis *(August 2023 - October 2023)*
Guide: Prof. Abhilash Jindal | Cloud Computing Course Project *IIT Delhi, India*

- Created a **fault-tolerant MapReduce framework** with **straggler mitigation** on **streaming data** using **Redis**.
- Provided **fault-tolerance for Redis** by creating **strongly-consistent cluster** of Redis servers using **RedisRaft**.
- Provided **fault-tolerance for workers** by **atomic ACKing and updating** on Redis using **Lua scripts**.

Linux Kernel v6.2 projects *(February 2023 - April 2023)*
Guide: Prof. Smruti Sarangi | OS Course Project *IIT Delhi, India*

- Add **system calls** to the kernel and create a **Loadable Kernel Module** to implement a **message passing library** for inter-process communication via kernel. Used **timer handler** and **linked list** from kernel API.
- Created a custom **real-time scheduler** for the **RMA** and **DMA** scheduling policies. Added **Priority Ceiling Protocol** for **deadlock-free access** to resources. Used **kmem_cache** and **RB trees** from kernel API.
- Create a new **character device driver** that implements a **LIFO stack**. Used **wait-queues** for efficient access.

Named Entity Recognition in Medical Literature *(April 2023 - May 2023)*
Guide: Prof. Mausam | NLP Course Project *IIT Delhi, India*

- Used **Bi-LSTM** and **CRF** to build a NER system for **bio-medical text** extracted from scientific docs.
- Trained **FastText**, **Character CNN** and **GloVe** word embeddings. Used **Viterbi algorithm** for CRF inference.

Detecting Influencers in Social Networks *(March 2023)*
Guide: Prof. Subodh Kumar | Parallel and Distributed Prog. Course Project *IIT Delhi, India*

- Computed the **k-truss decomposition** of the social network graph using an **elimination-based algorithm**.
- **Parallelised** the computation using **Message Passing with MPI** and **multithreading with OpenMP**.

Judging a Book by its Cover *(November 2022)*
Guide: Prof. Parag Singla | ML Course Project *IIT Delhi, India*

- Devised a multi-class **multi-modal architecture** to **predict the book genre** given the book cover and title.
- Employed **Curriculum Learning** over **BERT** and **BART** for training the word vectors over book titles.
- Fine-tuned the pre-trained **Vision Transformer(ViT)** and **ResNet-50** model on book covers images.

Peer-Server-Peer Network for File Sharing *(October 2022)*
Guide: Prof. Abhijnan Chakraborty | Networks Course Project *IIT Delhi, India*

- Created a **Peer-Server-Peer** network that has a **single multi-threaded server** and **multiple clients**.
- Client has some **file chunks** and communicates with the server using **TCP** and **UDP** to obtain the missing chunks.

Self Driving Car *(October 2022)*
Guide: Prof. Rohan Paul | AI Course Project *IIT Delhi, India*

- Devised a **traffic positioning and estimation** approach based on Bayesian reasoning via **particle filtering**.
- **Simultaneous Localization and Mapping (SLAM)** combines **noisy sensor data** to determine the **position of other cars** and **control steering** and acceleration to **avoid obstacles** and reach the goal safely.

Designing an ARM processor *(April 2022 - May 2022)*
Guide: Prof. Anshul Kumar | Comp. Architecture Course Project *IIT Delhi, India*

- Designed a **pipelined processor** in VHDL that can execute **ARM instructions**. Synthesised the design on **FPGA**.
- Designed modules for **ALU, Register File, Memory, Program Counter, Multiplier, Shifter** and **control plane**.

IITD freeroam game *(March 2022 - April 2022)*
Guide: Prof. Rijurekha Sen | Design Course Project *IIT Delhi, India*

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

Compiler for the WHILE Programming Language in SML *(April 2022)*
Guide: Prof. S. Arun Kumar | Compiler Course Project *IIT Delhi, India*

- Wrote a compiler in **SML** for a **Turing Complete** toy programming language, WHILE, designed by the guide.
- Wrote the **lexer** using **ML-Lex** and the **parser** using **ML-Yacc** with semantic actions to get the AST.
- Created a **postfix stack machine** to execute the program using its **Abstract Syntax Tree (AST)**.

Technical Skills

- **Programming Languages:** C, C++, python, Scala, Go, Java, Prolog, SML-NJ, MATLAB
- **Frameworks and Tools:** minikube, Kafka, StarRocks, PostgreSQL, Redis, Uvicorn, nginx, Caddy, CUDA, PyTorch, TensorFlow, pandas, Spark, Flink, OpenMP, MPI, Jenkins

Other Achievements

- Attended ***Google Research Week***, a research event in AI/ML *2024*
- Bronze medallist at ***ICPC Amritapuri Regionals***, in which the top 228 teams across the nation participated *2023*
- 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 *2020*