Ankit Kumar

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Achievements & Positions

- **Teaching Assistant** for Database Systems (Jan-May 2020) and Intro to CS (Oct 2020-Jan 2021, Feb-May 2021)
- **Academic Mentor** (July-Nov 2018), mentored 100+ first year students for the Intro to Computer Science
- Developer at the **Game Development Club**, responsible for designing and building multiple games in Unity 3D
- **Technical Coordinator** at Rendezvous 2019, created and managed the main app of the cultural festival
- Secured **All India Rank 11** among the top 35 students selected across India in CBSE Mathematical Olympiad 2015-16
- **International Rank** below **25** thrice in SOF International Mathematics Olympiad conducted in 2014, 2015 and 2016
- Became a National Talent Search Examination (**NTSE**) scholar for being in **top 1000** at National level in 2015
- Selected as **KVPY** Scholar in 'Kishore Vaigyanik Protsahan Yojana' by Indian Institute of Science given to **top 1%**

Publications

- **Identification of Misinformation in COVID-19 Tweets Using BERTweet** @ NLP4IF, 2021
- **Hands-off Model Integration in Spatial Index Structures** @ VLDB, 2020

Professional Experience

Operating System Development — LG Ads / Alphonso
Software Developer [Full Time] — *Feb 2021 - Present*

- Write modern, performant, maintainable code for a diverse array of client and internal projects
- Communicate with multi-disciplinary teams of engineers, designers, and clients on a daily basis
- OS Team: Currently working on Operating System for Automated Content Recognition on TV
- Tech used day to day: C/C++, Java, Swift, JavaScript, MySQL, Kubernetes, AWS, Maven, GNU Make, Android Studio

Software Defect Prediction — University College London
Software Engineering Research [Intern] — *May-July 2020*

- Used Snorkel for combining different code smell detectors like PMD, Infer, Error-Prone into a strong labeller
- Proposed pipeline to **improve the performance of any bug detection tool**, thus identifying more real world bugs
- Proposed a bug detection framework using current state of the art self-attention Transformer

Learned Spatial Indexes — Imperial College London
Database Research [Intern] — *Dec 2019-April 2020*

- Proposed using Interpolation-Friendly R-Tree, KD-Tree, Quad-Tree and Oc-Tree instead of conventional structures
- Reduced query execution time by **60%** while simultaneously shrinking the index's memory footprint by over **90%**

Automated Jupyter Notebook Generation — Elucidata Data Consulting Pvt. Ltd.
Software Developer/Data Analyst [Intern] — *May-July 2019*

- Developed an Abstract Factory Pattern based highly scalable package **reducing data analysis time by 95%**
- Generates Jupyter Notebook from YAML file, allowing user to focus more on interpretation of results instead of code
- Designed to be highly scalable, with seemless integration of new features/algorithms & no version incompatibility issues

Major Projects

Building OS Components, Operating Systems *Feb 2021 - Apr 2021*

- Memory allocator: Implemented `malloc()` and `free()` using a free list and first fit based allocation
- Virtual Memory: Simulated a page table and implemented page replacement strategies like clock, LRU and MLFQ
- Threads: Implemented reader & writer preference rw locks using semaphores for concurrent read and exclusive write

Mini Torrent, Computer Networks *Nov 2020 - Jan 2021*

- Developed a tool to download large files, spreading connection between servers, while being resilient to disconnections
- Whenever TCP connection breaks, thread tries to open a new connection, downloading more chunks on resumption

Implementing Distributed Systems, Distributed Systems *Feb 2021 - May 2021*

- Pastry: Implemented Pastry, supporting addition/deletion of nodes, lookups & addition of KV pairs to the DTH
- GHS: Simulated the GHS algorithm to find MST of a graph, implementing each node/process as a separate thread
- Bitcoin: Implemented a Bitcoin system with multi-transaction support & smart contracts and evaluated its security

MPI and OpenMP, Parallel Programming *Feb 2021 - Apr 2021*

- Matrix Decomposition: Implemented Crout's algorithm using MPI and OpenMP, reducing execution time by 50%
- Sum of an array: Implemented and analysed tree-based and partition-based algorithms for sum using OpenMP

Security, Networks & Systems Security and Artificial Intelligence & Cybersecurity *Feb 2021 - May 2021*

- Cryptography: Implemented (and cracked) the RSA cryptosystem & the Birthday Attack on SHA-3
- Transport Layer Security: Implemented the TLS protocol to securely send a message from the server to the client
- Message Handling System: Performed security analysis of IITD email MHS, comparing protocols employed with Gmail
- IDS: Built ML models (Random Forest, LGBM & CatBoost being best 3) to detect suspicious network activity

Code Generation, Compiler Design *Oct 2020 - Jan 2021*

- Emitted LLVM IR for the C code it is able to parse, running as expected using the LLVM interpreter *lli*
- Implemented local optimizations like local constant-folding, dead-code removal, constant propagation optimization, etc.

Playing with Backend, Database Systems & Information Retrieval *Jan 2019 - May 2019*

- Disk algorithms: Implemented search, insertion & external sorting on top of buffer manager in C++ for very large DBs
- Social Website: Developed client (HTML, CSS, JS) and server side (PHP, PostgreSQL) of a Facebook like website
- Search Engine: Implemented BM25 document retrieval model on a collection of 100K docs, querying in less than 1 sec

Reinforcement Learning, Planning & Estimation for Autonomous Systems *Feb 2021 - May 2021*

- GridWorld: Solved the grid world problem using Markov Decision Process and Q-Learning with greedy exploration
- Atari: Implemented DeepMind's DQN and Linear Q-Net approximation to build an agent for the Atari Pong environment

PacMan, Artificial Intelligence *Sept 2020 - Dec 2020*

- Search: Implemented DFS, BFS, Uniform cost and A* search algorithms
- Multi-Agent: Implemented multiagent minimax & expectimax algorithms with evaluation functions
- Capture the flag: Created strategies in adversarial setting for agents to play a multi-player capture-the-flag Pacman

Prediction Models, Machine Learning and Deep Learning *Feb 2021 - May 2021, Jan 2019 - May 2019*

- Named Entity Recognition: Implemented Bi-LSTM with GloVe and character level word embeddings for NER task
- Normalizations: Implemented Resnet with Batch, Instance, Layer and Group norms for CIFAR, achieving 80% accuracy
- Payment Default: Performed EDA and trained different classifiers to predict whether a customer will default payment

Augmented Reality & Segmentation, Computer Vision & Image Processing *July 2019 - May 2020*

- Marker Based Augmented Reality: Created a 2D AR car motion using AR markers and homography calculation
- Music Player: Developed a hand-gesture recognition based music player to play next song, previous song or stop