

# Khushang Singla

May 2024

Pursuing **Honors in Computer Science and Engineering** at IIT Bombay

## SCHOLASTIC ACHIEVEMENTS

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- Secured **All India Rank 30** in **Joint Entrance Examination Advanced** amongst the **2,50,000** candidates (2021)
- Achieved **All India Rank 203** in Joint Entrance Examination Main amongst the **1 million** candidates (2021)
- Bagged **All India Rank 72** in the **SX** stream and awarded the prestigious **KVPY Fellowship** by IISc, Bangalore (2020)
- Secured **All India Rank 130** and was awarded the prestigious **KVPY fellowship** in the SA stream (2019)

## OLYMPIADS AND SCHOLARSHIPS

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- Ranked **29** in the Merit list of Online **Mathematics Olympiad Orientation Camp(MOOC)** based on marks of the **Indian National Mathematics Olympiad(INMO)** conducted by HBCSE (2021)
- Amongst the **48** students invited to attend the selection camp of the **International Mathematical Olympiad** (2020)
- Awarded with the National Talent Search Examination **NTSE** Scholarship by NCERT, Government of India (2019)
- Ranked **24** in **Indian Olympiad Qualifier in Chemistry Part-II** conducted by HBCSE, India (2021)
- Amongst the **top 64** students invited for **Chemistry Olympiad Orientation Camp** conducted by HBCSE (2021)
- Achieved **International Rank 1** in the International Mathematics Olympiad (IMO) conducted by SOF (2018-19)

## WORK EXPERIENCE

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### Stock Market Prediction Model

May-June 2023

*MindWealth Inc.*

- Developed a web application utilizing **Dash and Plotly** in Python to generate monthly signals for optimal stock trading
- Acquired in-depth knowledge of **stochastic indicator and divergence**, and used these concepts to derive accurate signals
- Trained a model that **generates signals** based on the stochastic oscillator and its divergence with stock prices

## KEY PROJECTS

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### The Unshared Spectre

October-November 2023

*Guide: Prof. Biswabandan Panda | Course Project: Advanced Computer Architecture*

- Explored various intricacies of **Spectre** and developed a **covert channel** based on **Flush Reload** and Spectre
- Utilized **Prime and Probe** technique to develop a side channel attack out of the **Spectre** attack vulnerability

### Exploring TLB Attacks

January-April 2024

*Guide: Prof. Biswabandan Panda | Research and Development*

- Explored limitations of **amdprefetch** attack on recent processors introduced by linux and TLB structure changes
- Explored TLB reversing technique that desynchronizes TLB from memory and exploits this to get better accuracy in results

### Compiler for SCLP

January - April 2024

*Guide: Prof. Uday Khedker | Course Project: Implementation of Programming Languages*

- Developed a compiler for a Simple C like programming language that supports loops, conditions and functions
- Implemented lexer and parser using Flex and Bison along with building AST, RTL and finally MIPS assembly for the program

### Analysing Cache Hierarchy

March-April 2023

*Guide: Prof. Biswabandan Panda | Course Project: Digital Logic Design and Computer Architecture*

- **Compared various Cache Hierarchies** like inclusive, exclusive, non-inclusive for performance in Graph Workloads
- Implemented various replacement policies in **ChampSim simulator** to analyse memory bottleneck issues in graphs
- Improved IPC values in graph workloads on using a hybrid of **exclusive and non-inclusive** cache hierarchies

### Process Fingerprinting

August-November 2023

*Guide: Prof. Biswabandan Panda | Research and Development*

- Explored the Website Fingerprinting attack that uses interrupt as a side channel to leak information about website accessed
- Utilized the interrupt side channel to leak information about the process being run inside a virtual machine and analysed cause

### Anonymous Communication Tools - Reading

February-April 2023

*Guide: Prof. Manoj Prabhakaran | Course Project: Cryptography and Network Security*

- Investigated the implementation and cryptographic aspects of **onion routing (TOR)** and **garlic routing (I2P)**
- Researched and gained insights into diverse anonymous communication tools, their practical uses and constraints

## OTHER PROJECTS

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### CNN-lytical - Convolutional Neural Networks

May-July 2022

Seasons of Code | Institute Technical Council

- Developed **image prediction** model from **scratch** using NumPy for **MNIST** dataset with accuracy of **95.06 %**
- Implemented classification model for **CIFAR-10** using **convolutional neural network** and got an accuracy of **66.24 %**
- Designed an **image segmentation** model for the **Caravana dataset** using **U-Net** with an accuracy of **89.71 %**

### FastChat

October-November 2022

Guide: Prof. Kavi Arya | Course Project: Software Systems Lab

- **Built an application** for people to interact with each other personally or in groups along with **E2E encrypted** messages
- Implemented **loadbalancers** to obtain **high throughput** with the limited resources dedicated to the servers
- Used the **socket module** in python, **PyNaCl** for encryption, salting for authentication and **SQL server database**

### Rail Planner

August-November 2022

Guide: Prof. Supratik Chakraborty | Course Project: Data Structures and Analysis Lab

- **Implemented** data structures like **dictionary and tries** and used these for auto-completion of station names
- Implemented a **rating and filtering system** for journey reviews creatively using **KMP, heaps, and priority queues**
- Adopting a **modular programming** approach to develop the components individually and compile them together

### File Transfer Protocol

March 2023

Guide: Prof. Bhaskaran Raman | Course Project: Computer Networks

- Implemented file transfer protocol server with support for **multiple clients** as well as client with **get and put support**
- Used **socket constructs** for implementing TCP connection and **selectors** for supporting multiple clients in C++

### Minesweeper Solver

March 2022

Submission for Year of Security Module | CSeC

- Programmed a minesweeper solver in **python** for an **interactive minesweeper game** that can be played on a terminal
- Used process module from **pwntools library** in python for interacting with the process running within python

### Image Generation Using PCA

October 2022

Guide: Prof. Suyash P. Awate | Course Project: Data Analysis and Interpretation

- Performed **dimensionality reduction, hyperplane** fitting on fruit images and MNIST dataset using **PCA** in **R**
- Implemented a **generative model**, hence sampling some unseen data from the above implementation of hyperplane

## TECHNICAL SKILLS

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<b>Programming Languages</b>	<b>Proficient in:</b> C++, Python, Bash, Awk, Sed, Markdown, HTML, CSS, Javascript
<b>Softwares Used</b>	<b>Familiar with:</b> Java, R, x86_64 Assembly, Prolog, FLTK
<b>Computer Vision</b>	LaTeX, Git, Neovim, GDB, Sphinx, Doxygen, Jupyter, Docker, Wireshark
	Numpy, Matplotlib, Pandas, Torch, Torchvision, Sklearn

## POSITION OF RESPONSIBILITY

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Institute Technical Convener | June 2022 - April 2023

Cyber Security Community, IIT Bombay

- Participated in various **Capture The Flag (CTFs)** competitions as a part of the team **IITBreachers**
- **Created challenges** and **hosted the website** for tyroCTF, a CTF for beginners which saw **100+** registrations
- Prepared modules for **Year of Security**, a year-long course on the basics of cybersecurity organized by the community
- Taught various topics in **Reverse Engineering ELF files** for CTM training of following tenure's Core Team Members

## RELEVANT COURSES

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<b>Computer Science</b>	Advanced Computer Architecture, Data Structures and Algorithms, Design and Analysis of Algorithms, Logic for Computer Science, Discrete Structures, Computer Networks, Data Analysis and Interpretation, Digital Logic Design and Computer Architecture, Abstractions and Paradigms for Programming, Cryptography and Network Security, Principles of Data and System Security, Automata Theory, AI & ML, Operating Systems
<b>Mathematics</b>	Calculus, Differential Equations, Linear Algebra

## EXTRACURRICULAR

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- Emerged rank 1 with **full score** in **TrustCTF**, a CTF for all students across the institute, conducted by TrustLab (2023)
- **Mentored** students to make a **Secure and Distributed Cloud Storage System** in Seasons of Code by WnCC (2023)
- Completed Summer of Science in **Stock Market Analysis** conducted by Maths and Physics Club, IITB (2022)
- Made a **Remote Controlled car** with a browser website used on a mobile phone as a remote under **XLR-8** (2022)
- Finished in **top 50** teams across IITB in **Algo trading** organized by Limestone, Tower Research Capital (2023)
- Completed 1-month long Summer Camp in **Hockey** organised by Institute Sports Council, IIT Bombay (2022)