# Yatharth Goswami

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## ACADEMIC DETAILS

| Examination | Department / Board | Institute | Year | CPI/% |
|---|---|---|---|---|
| Exchange Semester | Computer Science and Engineering | EPFL | 2022 - 23 | Ongoing |
| Graduation | Computer Science and Engineering | IIT Kanpur | 2023 | 9.82/10.0 |
| Intermediate/+2 | Maharashtra Board (HSC) | Alpha Junior College of Science | 2019 | 90.31 |
| Metriculation | Board of Sec. Education, Rajasthan | SMJT Senior Sec. School, Bikaner | 2017 | 93.67 |

## SCHOLASTIC ACHIEVEMENTS

- Institute Rank **1** among **1000+** students in the **2019-20** undergraduate batch at **IIT Kanpur** *(2022)*
- Secured **All India Rank 110** in **JEE Advanced 2019** among 2.3 Lakh eligible aspirants *(2019)*
- Secured **All India Rank 448** in **JEE Mains 2019** among 11,57,125 candidates *(2019)*
- **Academic Excellence Award** for exceptional performance in Academics at IIT Kanpur *(2019-21)*
- Recipient of prestigious **Director's Scholarship**, awarded to 6 students at IIT Kanpur *(2020)*
- Secured perfect **10.0/10.0** grade points in **1st, 4th, 5th** and **6th** semester at IIT Kanpur *(2022)*
- Awarded **A\*** grade in **PG Level** course of **Modern Cryptology** under **Prof. Manindra Agarwal** *(2021)*
- Awarded **A\*** grade in **PG Level** course of **Intro to Machine Learning** Awarded to only **1** student in a class of **204** students which included UGs, Masters and PhD students from IITK *(2021)*
- Amongst the **3** students from IIT Kanpur to get selected for **Exchange Semester** for **EPFL** *(2021)*

## OLYMPIADS AND OTHER ACHIEVEMENTS

- **Gold Medalist** in the Saptang Lab Security Hackathon in **9th Inter IIT Tech Meet** *(2021)*
- Recipient of prestigious **KVPY fellowship** by Dept. of Science and Technology, Govt. of India *(2018,2019)*
- Received **Gold Medal** and **Certificate of Merit** for being in the national top 42 candidates at INChO *(2019)*
- Attended the **OCSC** Camp for **International Chemistry Olympiad** *(2019)*
- India rank **151** out of **9004** global participants in **Google HashCode 2021** *(2021)*
- Participated and completed the **Google FooBar** challenge *(2021)*

## INTERNSHIPS AND RESEARCH PROJECTS

### Concurrency Verification                                          *[Oct2022-Dec2022]*
*Research Assistant | Prof. Sanidhya Kashyap*                          *RS3 Lab, EPFL*

- Worked on studying the problem of verifying concurrent programs
- Studied state-of-the-art works on formally verifying large concurrent systems like **Dafny**, **CSL** and **Armada**
- Learned about **linear type systems** and their use in **verification**
- Particularly studied a very recent work **Seagull** involving technique of state machine sharding and **linear dafny**
- Explored **Seagull's** very large codebase written in **linear dafny** to clearly articulate its working in a final **report**

### Quantitative Strategist Intern                                    *[May2022-July2022]*
*Summer Internship | Gurgaon, India*                                  *QaudEye Securities*

- Designed a **statistical arbitrage-based** pairs trading strategy on extensively **cleaned market data**
- Designed variations of multiple **indicators** to filter out **false trading signals**
- Developed and backtested **advanced mathematical models** for proprietary **alpha research**
- Combined **technical indicators** from diverse time-frames to capture **market trends**

### Privacy Preserving Heavy Hitters                                  *[May2021-July2021]*
*Research Intern | Summer@EPFL'21 | Prof. Jean Pierre Hubaux*         *LDS Lab, EPFL*

- Worked on **Securely** tackling **Heavy hitter problem** for Origin-Destination flows
- Learned and worked on modern Crypto Primitives like **Fully Homomorphic Encryption**
- Studied **SOTA** comparison and sorting algorithms for **BFV/BGV** and **CKKS** schemes
- Learned data-structures for compactly representing **large datasets** like **Count-min sketches / Bloom Filters**
- Used python libraries like **Bokeh** for visualisation and **Dask** for performing large **Distributed Operations**
- Designed an initial prototype of the solution using the **BFV** scheme in **GoLang**

### Malware Needs "Attention" too! ↗                                 *[Jan2021-Apr2021]*
*Research Project | Prof. Sandeep Shukla*                             *C3i Centre, IIT Kanpur*

- Used **API fragments** and **NLP models** for **classifying malicious** and **benign** files
- Used the analogy of **language vocabularies** to generate **API call embeddings** using **Word2Vec**
- Combined normal **LSTMs with attention** layers to get the **global correlations**

- Built technique stable to measures like **obfuscation** and **outperforms** other works using similar approach

### Decentralised Mechanism Design using Blockchains ⏻ *Code Here* [Oct2020-Nov2020]
*Course Project CS711 | Guide: Prof Swaprava Nath*                                        IIT Kanpur
- Implemented various **Sealed-Bid Auction Mechanisms** using Blockchains
- Learned about various problems in Blockchains related to **privacy** and tackling them using **Secure MPC**
- Modelled **privacy problem in Blockchain** as **Normal Form Game** and inferred various **equilibriums**
- Proposed an **alternative better approach** for a particular step of **Enigma** protocol by using **VCG Mechanisms**

### Memory Overhead Analysis of container based android devices [Jan2022-Apr2022]
*Undergraduate Researcher | Guide: Prof Debadatta Mishra*                                  IIT Kanpur
- Ported a recent android sandboxing solution **VPBox** for Android phones to **emulator** systems. **Presentation**
- Manually adapted the vanilla **aosp** and **goldfish kernel** for emulators to include changes in **VPBox** paper
- Implemented a BFS inside kernel to walk over **VM** areas of all the processes in the subtree of the given process
- Used the **pseudo sysfs filesystem** in linux kernel to get the memory usage of the **host** and **virtual phones**
- Reported potential **ineffectiveness** in sharing of some **physical pages** using memory data captured

## ▬▬▬ OTHER KEY PROJECTS

### Formal Verification of Closest Pair of Points Algorithm ⏻ *Code Here* [Oct2022-Dec2022]
*Course Project CS550 (Formal Verification, EPFL) | Guide: Prof. Viktor Kuncak*
- Implemented and verified a **fully functional** implementation of the famous **divide and conquer** algorithm for finding the closest pair of points in a plane. **Report Presentation**
- Wrote the complete implementation from scratch in **Scala** and verified it using the **Stainless** verifier
- Worked extensively on formulating the **verification properties** in **logic** and verifying them using modern verifiers
- **report** and **presentation**

### GIPSC: Golang to MIPS Compiler ⏻ *Code Here* [Jan2022-Apr2022]
*Course Project CS335 (Compiler Design) | Guide: Prof. Amey Karkare, Prof. Subhajit Roy*
- Implemented a **compiler** for a fully functional subset of the **Go** language, using **Python** to **MIPS** ISA.
- Designed a **lexer**, **parser** and **semantic analyzer** that supports Go features including **Short Variable Declaration, Multilevel Pointers, Struct, Array, Floats** and **Labelled Statements**.
- Supported **advanced** features like **Constant folding, Syscall wrappers, Custom File Importing, Multiple Returns** and **Multiple Assignments**.

### Parallel Programming ⏻ *Code Here* [Jan2022-Apr2022]
*Course Project CS433 (Parallel Programming) | Guide: Prof. Mainak Choudhary*
- Implemented and compared various software locks like **Lamport's Bakery, Spin-lock, Test-and-test-and-set, Ticket** and **Array Lock** with no **false sharing** using instructions like **cmpxchg**
- Implemented and compared various barriers like **Sense-reversing** and **Tree barrier** both using **busy wait** and **POSIX Conditional Variables**
- Optimized algorithms for distributed systems for **travelling salesman problem, matrix inversion, matrix product** and **Gauss-seidel** iterative solver using **OpenMP** and **CUDA**

### Building GemOS [Aug2021-Nov2021]
*Course Project CS330 (Operating Systems) | Guide: Prof. Debadatta Mishra*
- Created **file archiving utility** and enabled **IPC** using C system calls like **pipe(), fork()** and **exec()**
- Implemented **system calls** for **pipe** and **persistent pipe** structures sharing data between multiple processes
- Developed a basic **debugger** using **INT3** for functions featuring **stack backtrace** of function addresses
- Improvised **clone()** system call to develop a library of **threading APIs** with **private memory areas**

### HCL-C3i Hub Cybersecurity Hackathon ⏻ *Code Here* [Jul2020-Aug2020]
*Online Project (Hackathon) | C3i Hub, IITK*
- Ranked **25th** out of around **3400** teams from all around the world and built a **Deep Learning** based solution to distinguish Malicious executables.

## ▬▬▬ KEY COURSES UNDERTAKEN

| Formal Verification*# | Functional Programming* (5.75 / 6.0) | Mathematics of Data*# |
|---|---|---|
| A* Intro to Machine Learning | A* Modern Cryptology | A Compiler Design |
| A Operating Systems | A Statistical Simulation & Data Analysis | A Parallel Programming |
| A Computer Networks | A Theory of Computation | A* Real Analysis |
| A Advanced Algorithms | A Game Theory and Mechanism Design | A Computer Organisation |
| A Software Development and Operations | A Probability in Computer Science | Abstract Algebra* (6.0 / 6.0) |
| A Logic for Computer Science | A Microeconomics | A Linear Algebra |
| A : *Grade* | A* : *Grade for Exceptional Performance* | * : Course taken at EPFL |
| # : Grade yet to come | | |