# Yatharth Goswami

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## Academic Details

| Examination | University | Institute | Year | CPI/% |
|---|---|---|---|---|
| Graduation | IIT Kanpur | IIT Kanpur | 2023 | 9.8/10.0 |
| 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

- 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)*
- 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 and 5th semester at IIT Kanpur. *(2019,2021)*
- 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)*

## 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)*
- Amongst the top students across the nation in **NSEA** selected to appear for **INAO**. *(2019)*
- Awarded the certificate of merit for being in the national top 1% in **NSEJS** (Junior Science Olympiad). *(2017)*
- Global rank **1001** out of **9004** global participants in Google HashCode 2021. *2021*

## Internships and Research Projects

### 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 using modern Crypto Primitives like **Fully Homomorphic Encryption**.
- Studied **SOTA** comparison and sorting algorithms for **BFV/BGV** and **CKKS** schemes.
- Benchmarked the SOTA implementations for performing comparison operations using **Fully Homomorphic Enryption** and **MPC** schemes.
- Learned about data-structures for compactly representing **large datasets** like **Count-min sketches** and **Bloom Filters**.
- Used Geospatial libraries like GeoPandas and Uber's h3 to build a pipeline for converting any custom **shape file** to **Origin-Destination matrix.**
- Used libraries like **Bokeh** for visualisation and **Dask** for performing distributed Operations.
- Implemented an initial prototype of the solution using **BFV** scheme in **Go**.

### Malware Needs "Attention" too!

*[Jan2021-Apr2021]*

*Research Project | Submitted in AISec'21* — *C3i Centre, IIT Kanpur*

- Used **API fragments** and **NLP models** for **classifying malicious** and **benign** files.
- Use the analogy of **language vocabularies** to generate API call embeddings using Word2Vec model which made sense sematically.
- Combining 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 modern Cryptographic Primitives like **Secure MPC**.
- Modelled a game theoretic version of privacy problem in Blockchain as **Normal Form Game** and inferred various **equilibriums** that may be present according to different applications.
- Presented an analysis of how effective the current Enigma Protocol is, and proposed an **alternative better approach** for a particular step by using **VCG Mechanisms.**

## Key Projects

**Building GemOS** *[Aug2021-Nov2021]*
*Course Project CS330 | 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

**Attacking Cryptosystems** ***Code Here*** *[Fall 2021]*
*Course Project CS641 | Guide: Prof. Manindra Agarwal* *IIT Kanpur*

- Broke various cryptosystems like **DES**, **AES** and **RSA** as part of a game during the course.

**Clustering multidimensional data** ***Code Here*** *[Aug2021 - Nov2021]*
*Course Project MTH511 | Guide: Prof. Dootika Vats* *IIT Kanpur*

- Implemented the EM-algorithm **Guasssian mixture model** for **multidimensional data** using R language.
- Cross Validated the result using **BIC criteria** and tuned the hyperparameters accordingly.

**IITK Bucks** ***Code Here*** *[Summer 2020]*
*Programming Club, IITK* *IIT Kanpur*

- Implemented a **Fully Functional** Node of blockchain using NodeJS.
- Learned about the basics of the functioning of **Blockchains**, **Crypto-Currencies** and **Private-Key Cryptography**.
- Learned about Programming Concepts specific to **JavaScript** like **Async Functions** and **Event Loops**.
- Learned about **Tunneling Softwares** like **ngrok** and used them to test the nodes.
- Implemented the **Miner** using the concepts of **Multithreading** in NodeJS.

**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.

**Quantum Computing with Qiskit** ***Code Here*** *[Summer 2020]*
*Online Project (Workshop)*

- Learned the basics of **Quantum Computation** and **Quantum Physics**.
- Implemented various algorithms such as **Teleportation, Deutsch Josza Algorithm, Grover's Algorithm, IBM's BB84 Protocol** and **Quantum Fourier Transform** with IBM's **Qiskit**.

**Private Computation Using Cryptographic Primitives** ***Code Here*** *[Summer 2020]*
*Programming Club, IITK* *IIT Kanpur*

- Implemented **Distributed Point Function (DPF) library** using the principles of **Function Secret Sharing (FSS)** in Rust.
- Learned about various Cryptographic Primitives used for **Private Computation** like **Function Secret Sharing**, **Fully Homomorphic Encryption**, **Yao's Garbled Circuits** and **Shamir's Secret Sharing**.
- Used various libraries like **gtest, grpc, google/benchmark** for making tests and benchmarking final code.

## Technical Skills

- **Programming & Scripting Languages:** C++, C, Python, R, JavaScript, Rust(Familiar), Bash, GoLang(Familiar)
- **Libraries/Technologies:** Pandas, NumPy, matplotlib, GeoPandas, Shapely(Familiar), Dask(Familiar), Bokeh, h3(Familiar), LaTeX , Cutter, IDA, Git, LibreCAD, Tensorflow, Gambit, gcov, gtest, Markdown
- **Development:** HTML, CSS, Bootstrap, JavaScript, NodeJS(Proficient), Django(Familiar), MongoDB(Familiar)

## Key Courses Undertaken

- **Computer Science:** Fundamentals of Programming+Lab, Data Structures and Algorithms, Discrete Mathematics and Abstract Algebra, Game Theory and Mechanism Design, Logic for CS, Probability Theory, Computer Organisation, Software Development, Modern Cryptology(A*), Operating Systems, Theory of Computation, Advanced Algorithms, Intro to Machine Learning (A*)
- **Mathematics and others:** Statistical Simulation and Data Analysis, Real Analysis(A*), Linear Algebra, Introduction to Electronics

## Positions

**Secretary, Programming Club** *[May2020-Apr2021]*
*Programming Club, IITK* *IIT Kanpur*

- Wrote a blog on Reverse Engineering for making campus aware of techniques prevalent in the CTFs
- Helped in conduction of **Deep Learning Hackathons** on various domains and helping students by providing related materials.
- Responsible for managing Competitive Programming Competition for students of the institute for a month.
- Responsible for managing Competitive Programming Competitions and writitng blogs.

**Mentor - Numbers Made Dumber** *[Apr2021-June2021]*
*Stamatics, IITK* *IIT Kanpur*

- Mentored 33 freshman students, covered Number theoretic theorems and basics of cryptography.

**Mentor - Blocks and Chains** *[Apr2021-Ongoing]*
*Association for Computing Activities, IITK* *IIT Kanpur*

- Mentoring 19 freshman and sophomore students, covered basics of how blockchains work through blogs and assignments.