

Akash Trehan

Github: <https://github.com/CodeMaxx>

Internships and RnD Projects

- **Framework for Enforcing Security Policies in API based Web Apps** (May '18 – July '18)
Guide: Prof. Jean Yang Carnegie Mellon University (CMU)
 - Developed a language-agnostic approach to specify and enforce access policies on REST APIs for database-backed apps
 - Implemented approach on top of **Python Django REST framework** with expressive cell-level, query-sensitive permissions
 - Developed case studies and automated testing to demonstrate reasonable performance overheads
- **Improving Fuzzing of Javascript Engines** (May '17 – July '17)
Guide: Prof. Giovanni Vigna and Prof. Christopher Kruegel University of California, Santa Barbara
 - Used instrumentation-guided genetic algorithms in fuzzers to trigger unexpected behaviour in JS Engines
 - Made modifications to American Fuzzy Lop in **C language** which resulted in faster block coverage
 - **Found a bug in Apple Safari's javascript interpreter** - JavaScriptCore
 - Generated environments for automated running of experiments using **kubernetes** and **docker**
- **Programming network switches with P4 and framework for P4 primitives** (Jan '18 – Aug '18')
Guide: Prof. Mythili Vutukuru IIT Bombay
 - Implement a distributed Stateful Load Balancer in P4 using proactive and reactive communication
 - Used **python** Scapy to generate network traffic and extract useful statistics out of PCAP files
 - Implemented a framework that provides primitives to simplify the development of P4-based applications
 - **Published this work in P4EU Workshop at IEEE ICNP 2018**
- **Bachelor Thesis: Blocktree - Solving Blockchain Scalability Problems** (July '18 – Present)
Guide: Prof. Manoj M. Prabhakaran IIT Bombay
 - Designing and analysing a new permissioned and general-purpose **distributed** data structure with flexible policies, to address scalability issues in **Blockchain** in terms of both storage and computation power
 - Developing a proof of concept **python** implementation of the algorithms and network protocols for it
 - Theoretically proving **security** and robustness of the construction in various adversarial environments
- **Isolated Network Infrastructure for Security Experiments** (Dec '16 – May '17)
Guide: Prof. R.K. Shyamasundar IIT Bombay
 - Set up a network of VMs mimicking an infrastructure with a DNS, Mail, Proxy, Web and Time server
 - Used **vagrant combined with VirtualBox** to ease the process automatic generation of VMs
 - Demonstrated **dictionary attacks, stack smashing and Man-in-the-Middle attacks** using the infrastructure

Open Source Contributions

- **OWASP ZeroDay Cyber Research Shellcoder** | Open Web Application Security Project
 - Implemented a new OSX x86 shellcode module using **assembly programming** for penetration testing
 - Successfully demoed at **DEFCON Labs 2016** and **BlackHat EU**
- **SymEngine** | Fastest symbolic manipulation library written in C++
 - Implemented a new Infinity class in **C++** to handle calculations which could lead to infinitely large values
 - Added new functions for manipulations of symbolic polynomials and trigonometric functions

Key Development Projects

- **Indexing Schemes for Data Recording Systems** | (Aug '17 – Nov'17)
 - Hacked **postgres** internals for implementing a new index to support large continuous stream of incoming data and store it in a manner suitable for future access
 - Implemented strategies for incremental organization of B+ trees in memory and on disk to support both insertion and queries with reasonable efficiency, and without the delays of periodic batch processing
 - **Implemented the stepped-merge algorithm paper in C language** for merging B+ trees on disk for faster queries

- **SpamSlam - Spam prevention using Blockchain** | *Hack InOut 4.0 Winner* (Oct '17 – Oct '17)
 - Used Gnosis' **Ethereum** based **javascript** APIs to create mini prediction markets for emails, using a **Django** backend
 - Used **Machine Learning** techniques to create an approximate oracle for the prediction market
- **Real-time Chat Application** (Apr '17 – May '17)
 - Built a multithreaded chat server using Linux socket programming in **C and C++**, with LDAP login support
 - Implemented secure salted password hashing with Argon2i algorithm for storing passwords in database
 - Built an **Android** and command-line client application with features like group chat, friend requests and last seen
- **Malware Classifier** (Apr '17 – May '17)
 - Trained **machine learning** models in **python** with **400 GB data from Microsoft** to classify malware samples
 - Extracted n-gram frequency, segment size, pixel intensity as features from malware binary and assembly
 - Used gradient boosting and filtering based on random forest feature importance score for better results
- **3D Graphical Modelling and Animation** (Jul '17 – Nov '17)
 - Implemented hierarchical models of 3D toys using **C++ OpenGL** and texture mapped for surface detail
 - Simulated a spotlight and general direction lights and used shading algorithms for lighting and shadows
 - Generated an animation video by recording keyframes and interpolating them
- **Compiler for a C-like language** (Jan '18 – May '18)
 - Developed a compiler for a C-like language in **python**, for MIPS instruction set architecture
 - Supported major functionalities like function calls, if-else statements, loops and arithmetic expressions
- **Smashing the Stack** (Apr '17 – May '17)
 - Demonstrated techniques like **ret2libc attack** and **NOP spray** for exploiting buffer overflows, bypassing Data Execution Prevention (DEP) and Address Space Layout Randomization (ASLR) mitigations
 - Demonstrated **format string exploits** to get arbitrary memory reads and writes
- **LendIt - Book lending website** | *Hack InOut 3.0 Finalist - NIT Surat* (Aug '16 – Aug '16)
 - Implemented a backend using **python Django** for the Lendit website, which allows user interaction, sending notifications, searching and lending books, maintaining a user profile among other features
 - Got selected among the **top 7** (out of 50) development projects and went through to the final round

Public Speaking and Blogging

- Gave **talks** on Introduction to cybersecurity, Social Engineering and Introduction to CTFs at IIT Bombay
- Took **sessions** on Sandbox breakout and Format-string attacks at UC Santa Barbara
- Write **blog posts** about computer security, programming and write-ups for CTF challenges
- Make **youtube videos** explaining and demoing various binary exploitation techniques

Academic and Technical Achievements

- Presently **Department Rank 2** in the Computer Science batch of 121 students
- Secured **All India Rank 24** in **JEE Advanced 2015** out of 150,000 students
- Received IIT Bombay's **Institute Academic Prize twice**, for 2015-16 and 2017-18
- Awarded the Kishore Vaigyanik Protsahan Yojana (**KVPY**) Fellowship by Govt. of India
- **1st** position in **InOut Hackathon Blockchain Track 2017**, Bangalore and **Ubisoft GameJam 2017**, Pune
- **Runner Up** in **Yahoo! Japan HackU 2017**
- **2nd Runner Up** in **Microsoft code.fun.do Hackathon 2016** and **Kandy Sugar Hackathon 2016**
- **6th** position among 1028 teams worldwide in **Seccon CTF 2017**
- Audited and **found vulnerabilities** in IIT Bombay TA portal and WnCC internship portal

Programming Skills

C/C++, Python, Bash, x86 assembly, MIPS assembly, SQL, Java, Javascript, Django, jQuery, Docker, kubernetes, Vagrant, OpenGL, L^AT_EX, Arduino, MATLAB, Git

Positions of Responsibility

- **Founder & Manager** | *CSE Cybersecurity Club - IIT Bombay* (Nov '16 – Present)
- **Teaching Assistant** | *Data Structures and Algorithms - IIT Bombay* (Jul '18 – Present)
- **Web Convener** | *Student Technical Activities Body - IIT Bombay* (May '16 – May '17)
- **Volunteer** | *Web and Coding Club - IIT Bombay* (May '16 – May '17)