Akash Trehan

Computer Science MS

Graduation Date: August 2019
✉ *akash.trehan123@gmail.com*
(+91) 8879126404
https://www.akashtrehan.com/
Github: https://github.com/CodeMaxx

Education

Indian Institute of Technology Bombay *(July '15 – Present)*
B.Tech. (Hons) in Computer Science & Engineering
GPA: **9.73/10** (**2nd** *among 121 students*)

Publications

- R. Shah*, A. Shirke*, **A. Trehan***, M. Vutukuru & P. Kulkarni
  pcube: Primitives for network data plane programming
  IEEE ICNP 2018 (*Presented at the P4 European Workshop, colocated with ICNP*)
  `DOI: 10.1109/ICNP.2018.00060` [Link]
  * *Co-first authors (ordered by last name)*
- A. Bichhawat, **A. Trehan**, J. Yang, & M. Fredrikson
  Estrela: Automated Policy Enforcement Across Remote APIs (*preprint*)
  `arXiv:1811.08234 [cs.CR] [Link]`

Internships and RnD Projects

• Framework for Enforcing Security Policies in API based Web Apps *(May '18 – Sept '18)*
Guide: Prof. Jean Yang *Carnegie Mellon University (CMU)*
- Developed a **language-agnostic approach** to specify and enforce privacy 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**

• pcube: Primitives for network data plane programming *(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

• Bachelor Thesis: Blocktree - Solving Blockchain Scalability Problems *(July '18 – Present)*
Guide: Prof. Manoj M. Prabhakaran *IIT Bombay*
- Designed and analysed 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 proved 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

Awards and Academic Achievements

- 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 **Student Travel Grant by IEEE** to attend IEEE Security & Privacy Symposium 2017
- Awarded **Student Travel Grant by ACM** to attend PLMW and PLDI 2018
- Awarded **ICNP Student Travel Grant** to present at P4 European Workshop, colocated with IEEE ICNP 2018
- Awarded the Kishore Vaigyanik Protsahan Yojana (**KVPY**) Fellowship by Govt. of India
- Awarded the **National Talent Search Scholarship** by NCERT

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 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 stratergies 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

- **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

- **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

- **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

- **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

- **Safe Reinforcement Learning in Pacman** *(Sep '18 – Nov '18)*
  - Learnt about safe RL using shields built by combining safety specifications written in Linear Temporal Logic and the environment represented as a Markov Decision Process
  - Implemented a simpler shield for pacman environment, evaluated it on six different metrics and made inferences about the usefulness and performance overheads of using the shield

- **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

- **Understanding internals of the InterPlanetary File System** *(Oct '18 – Nov '18)*
  - Studied about the working of distributed hash tables (S/Kademlia, Coral), git internals, self-certified file systems (SFS), P2P protocols, merkle DAGs and how IPFS builds upon those ideas to create a P2P distributed file system
  - Gave a presentation explaining IPFS components and demoed the core features [Link]

- **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

- **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

Technical Achievements

- **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
- **1st** position in XLR8 2015 for making a remote controlled obstacle crossing robot
- **6th** position among 1028 teams worldwide in **Seccon CTF** 2017
- **Semifinalist of business track** in **Eureka!** 2017, Asia's largest Business Model Competition
- Received Hostel **Technical Color Award** 2017-18
- **Conducted a 4-hour hands-on workshop** in freshman year on **Arduino programming** for **50+** students
- Audited and **found vulnerabilities** in IIT Bombay TA portal and WnCC internship portal

Public Speaking and Blogging

- Gave **talks** on Introduction to Cybersecurity, Social Engineering and CTFs at IIT Bombay [Speakerdeck]
- 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

Programming Skills

C/C++, Python, Bash, x86 assembly, MIPS assembly, SQL, Java, Javascript, Django, jQuery, Docker, kubernetes, Vagrant, OpenGL, LaTeX, 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)*