Greg Cusack

Ph.D. Candidate and Graduate Research Assistant

Building software systems that make large-scale, networked applications and the underlying infrastructure efficient and simple to deploy, manage, monitor, and secure in multi-tenant environments

C, C++, Python, Golang, SQL
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Education

University of Colorado, Boulder CO **Aug. 2017 - Present**
- Ph.D. Candidate in Computer Engineering: Networking and Distributed Systems (GPA: 3.87)
- Graduate Research Assistant in the Network Systems Research Lab (M.S. Received: 2020)

University of California, Los Angeles CA **Sept. 2016 - June 2017**
- M.S. in Electrical Engineering, Embedded Systems (Not completed – GPA: 3.91)

Santa Clara University, Santa Clara CA **Sept. 2012 - June 2016**
- B.S. in Computer Science and Engineering & B.S. in Electrical Engineering
- ***magna cum laude*** (GPA 3.76), Tau Beta Pi, Upsilon Pi Epsilon, Alpha Sigma Nu, Dean's List
- Research with Dr. Krishnan designing a low-cost, mobile device to detect arsenic in water (**C**)

Research

Securing BGP with Smart Contracts | *Project Co-lead* **Oct. 2021 - Present**
- BGP relies on distributed, untrusted, autonomous organizations to agree and trust each other on the state of the underlying peering and routing network. BGP relies on trust without security.
- We're eliminating trust between ASes and increasing BGP security by implementing BGP router configuration validation and route and origin validation with smart contracts

Sub-second Container Resource Allocation | *Project Lead* **April 2019 - Present**
- Leading a five person team (4 Ph.D. students and 1 Masters student) in designing and building a distributed system manager for large scale cloud applications. We dynamically allocate compute resources based on real-time demands, improving hardware utilization and application throughput
- Tools: **C, C++, Golang, Linux Kernel's CFS, Kubernetes, Ansible, Docker, Python**
- Result: Full paper to appear in **IEEE ICDCS 2022**; poster published at **ACM CoNEXT 2019 Posters**

Cloud-Scale Packet-Level Network Analytics in Software **Sept. 2017 – May 2021**
- Designing a general packet-level, network analytics system that processes up to 254 million packets per second (Mpps) per 16-core commodity server entirely in software by leveraging P4 switches and domain-specific optimizations
- Built high performance (>10Mpps per two-core analytic pipeline) network analytic applications
- Designed and built the back-end of the analytics platform for highly scalable packet-level data aggregation and visualization by moving data aggregation out of the processing pipeline
- Tools**: C++, P4, Python, Prometheus, gRPC**
- Results: papers published at **IEEE TNSM 2020**, **SDN/NFV** Sec'18, and poster published at **NDSS 2018** (won best technical poster)

Adversarial Examples for Network Security **July 2018 - Sept. 2019**
- Analyzed how state-of-the-art **neural network**-based network intrusion detection systems (NIDSs) are vulnerable to adversarial examples (attacks) in order to improve security systems
- Built an automation tool (**Python**) to manipulate packets to match target adversarial example network shape, which reduced neural network-based NIDS performance by up to 62%.
- Result: papers published at **AISec'18** and **ACM CoNEXT Workshop - Big-DAMA 2019**

Reconfigurable Secure Hardware **Sept. 2017 - Dec. 2018**

• On team that designed flexible, reconfigurable secure hardware that allows users to control secure hardware features and updates, while also allowing them to choose their root-of-trust.
• Built password managers on SGX and our FPGA-based secure hardware for comparison
• Tools: **C, C++, SGX**
• Result: paper published at **FPGA 2019**

Experience
(Industry)

Netflix | *Compute Platform Engineering Intern* **May 2020 - Aug. 2020**
Los Gatos, CA

• Wrote systems to extract fine-grained, per-container network metrics from Netflix's Titus Hosts
• Improved Titus' developers and users' insight into host and container network usage by 60x.
• Analyzed network data using **Presto**, Spark**-SQL**, and **Scala** to identify containers experiencing possible noisy neighbor issues, allowing OS developers to improve container scheduling decisions

TransMarket Group | *Software Engineer Intern* **June 2017 - Aug. 2017**
Chicago, IL

• Designed an automated testing framework in **Python**, **C++**, **Robot Framework** for exchanges around the world to manage catastrophic risk
• Dramatically improved developers ability to identify bugs quickly and effectively in a million-plus LOC trading platform

Texas Instruments | *Applications Engineering Intern* **June 2015 - Sept. 2015**
Santa Clara, CA

• Developed software to streamline automation for new silicon validation and benchmarking

Honors

Computer Engineering Outstanding Senior Award | *SCU* **June 2016**

• "Presented to a senior by the faculty of the Computer Engineering Department based on academic standing, esprit de corps, and contribution to the department, school, and community."

Alpha Sigma Nu | *Jesuit Honor Society* **May 2015**

• Accepts ~25 students in the top 15% of their class who distinguish themselves in scholarship and service to others. Among the highest honors bestowed at a Jesuit Institution

Side Projects

Recruiting Startup **July 2019 – Aug. 2020**

• Employee #5 and the second engineer brought on board
• Although under NDA, I design and implement proprietary algorithms that the company's product and success depend on (**Python, REST, PostgreSQL**)
• I set company goals, timelines, and requirements for each product release stage

Skills & Knowledge

Kubernetes | Docker | Ansible | Distributed Systems | Networked Systems | ML/Neural Networks | Linux CFS Scheduler | Leadership| Problem Solving | Time Management | Explaining complex concepts to both engineers and non-engineers

Interests

Venture Capital | Road/Mtn. Biking | Trail Running | Skiing | Swimming | Rugby | Improv

Classes

CU
DevOps in the Cloud
Adv. Computer/Network Systems Security
Censorship Circumvention
Security and Ethical Hacking

UCLA
Machine Learning
Adv. Computer Networks
Networked Embedded Systems
Software Engineering

Developing the Industrial IoT
Natural Language Processing
Venture Capital & Private Equity[2]

Entrepreneurship and Venture Initiation[1]

Other

Nerd Night & Science Riot **April 2019 – March 2020**

• I present my research in a casual, standup-like fashion at bars and small venues around Boulder and Denver to help eliminate the notion that computer science is too hard to understand for those not in the field.
• Talk title: "*On My Way to Hack Your Bae: Exploiting Neural Network-based Security Systems*"

Publications

Escra: Event-driven, Sub-second Container Resource Allocation
Greg Cusack, Maziyar Nazari, Sepideh Goodarzy, Erika Hunhoff, Prerit Oberai, Eric Keller, Eric Rozner, Richard Han
To Appear in 42nd IEEE International Conference on Distributed Computing Systems (IEEE ICDCS), July 2022

Software Packet-Level Network Analytics at Cloud Scale
Oliver Michel, John Sonchack, Greg Cusack, Maziyar Nazari, Eric Keller, Jonathan M. Smith
IEEE Transactions on Network and Service Management (IEEE TNSM), 2021

(poster) Efficient Microservices with Elastic Containers
Greg Cusack, Maziyar Nazari, Sepideh Goodarzy, Prerit Oberai, Eric Rozner, Eric Keller, Richard Han
ACM CoNEXT (CoNEXT '19 Posters). December, 2019

Towards the Evaluation of NIDSs in Adversarial Settings
Mohammad J. Hashemi, Greg Cusack, Eric Keller
3rd ACM CoNEXT Workshop on Big DAta, Machine Learning and Artificial Intelligence for Data Communication Networks (Big-DAMA 2019). December, 2019

Breaking the Trust Dependence on Third Party Processes for Reconfigurable Secure Hardware
Michael Coughlin, Greg Cusack, Jack Wampler, Eric Keller, Eric Wustrow
27th ACM/SIGDA International Symposium on Field-Programmable Gate Arrays. February, 2019

Stochastic Substitute Training: A Gray-box Approach to Craft Adversarial Examples Against Gradient Obfuscation Defenses
Mohammad J. Hashemi, Greg Cusack, Eric Keller
ACM Workshop on Artificial Intelligence and Security (AISec) with the 25th ACM Conference on Computer and Communications Security (CCS). October, 2018.

Machine Learning-Based Detection of Ransomware Using SDN
Greg Cusack, Oliver Michel, Eric Keller.
ACM International Workshop on Security in Software Defined Networks & Network Function Virtualization (SDN-NFV Sec). March, 2018

[1] UCLA Anderson School of Management
[2] CU Leeds School of Business/Law School – Only non-business or law student – Result: top 3 of >60 person class

(poster) Machine Learning-Based Fingerprinting of Network Traffic Using Programmable Forwarding Engines
Greg Cusack, Oliver Michel, Eric Keller
Network and Distributed System Security Symposium (NDSS). February, 2018. (won best technical poster)

(poster) Time Analysis of the Feasibility of Vehicular Blockchains
Joshua Joy, Greg Cusack, Mario Gerla
SMARTOBJECTS '17 Proceedings of the 3rd Workshop on Experiences with the Design and Implementation of Smart Objects