Zachary Espiritu

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Education

Brown University
Sc.M. in Computer Science • GPA: 4.0
Sc.B. in Computer Science • GPA: 4.0
Completing both degrees in Dec 2021.

- *Relevant Coursework:* Algorithms, Binary Exploitation, Cryptography, Distributed Systems, Formal Methods and Provers, Graphics, Human-Computer Interaction, Operations Research, Operating Systems, Probabilistic Methods, Programming Languages, Systems Security, User Experience Design.

Awards *(selected)*

CrowdStrike NextGen Scholarship for Cybersecurity and AI
(6 selected nationwide)

1st Place at Hack@Home Security CTF
(1 out of ~100 participants)

Projects *(selected)*

CS Concentration Validator
Developed Racket microservice using formal provers to synthesize degree completion plans for 300+ CS majors at Brown; currently being integrated into official University advising system.

Dropbox (Secure File Store)
As Head TA, authored new project for security course on using untrusted servers for secure, efficient file storage and sharing. Project scored average student evals of 4.61 / 5.00 in first year.

Vehicle Logistics Solver
Designed top-performing local search solver out of 21 teams for NP-hard vehicle routing problem in graduate-level competition. In Python and Java.

GrblGrader
Created modular feedback distribution system and a custom programming language to simply process of releasing student grades; in JavaScript. Used by 8 CS courses; seen by 1000 students/year.

Weenix
Wrote full operating system kernel in C.

Experience

Encrypted Systems Lab Fall 2020 — Present
Researcher, Applied Cryptographic Systems

- Engineered novel crypto protocol and Java / Node.js system for Massachusetts's *Dept. of Public Health* to securely conduct epidemic research over databases of 22 distributed MA institutions, *eliminating costly, vulnerable manual anonymization* process.

Cryptography, Anonymity, Privacy, Security (CAPS) Group Fall 2020 — Present
Researcher, Encrypted Databases

- Designed 7 novel, O(1)-time, provably secure schemes for computing aggregates over encrypted DBs, *lowering state-of-the-art runtime and storage overhead by up to 83%.*
- Devised novel data structure and mathematical algorithms in Python to *reduce experiment and database setup times by 99%* and include 100x larger benchmarks in final publication.
- Exploited geometric patterns in the index structure of multidimensional encrypted databases to develop 2 novel attacks that *fully reconstruct plaintext* of queried attributes.

Google Summer 2020
Software Engineering Intern, Google Cloud KMS and HSM

- Created open-source OpenSSL engine to enable web servers to use HSM-backed keys for crypto signatures *without any source code changes*. C++ with gRPC and Bazel.
- Devised hierarchical architecture and a system of Bash and Bazel linking scripts to eliminate OpenSSL symbol conflicts with various Google C++ APIs (Abseil, testing, etc.).

Brown PLT (Programming Languages Team) Summer 2018
Research Intern

- Created machine learning package, *used yearly in 90-student introductory CS course*, for Pyret, a functional programming language. Built using TensorFlow.js.

Negotiatus Summer 2016 and Summer 2017
Software Engineering Intern

- Led full-stack product engineering of still-existing, core features, *which converted ~20% of monthly non-recurring revenue into recurring revenue*. Ruby on Rails / JavaScript.
- Optimized internal-facing PostgreSQL queries for *up to 100x faster product searches*.

Teaching Service *(@ Brown Computer Science)*

Head Teaching Assistant (for 6 Computer Science Courses) Fall 2018 — Present

- Hired, trained, and managed 54 TAs for 6 CS courses, including **Computer Systems Security** (2021, 2020, 2019), a course on web application security, cryptography, networks, etc. in Bash, C, Java, JavaScript, Python, PHP, Ruby, SQL, and Go (Golang).
- Automated grading and project setup via shell scripts spawning Linux Docker containers in Google Compute Engine, saving 250 staff hours in total and $4k/year in dept. budget.
- Taught in 2021 as main lecturer for 9 of 22 lectures and designer for 80% of assignments.

Meta Teaching Assistant (TA Program Coordinator) Fall 2019 — Present

- Led hiring / training of 781 TAs over 56 courses by managing 112 HTAs over 14 time zones.

Research Publications

- **Zachary Espiritu**, Evangelia Anna Markatou, Roberto Tamassia. **"Time- and Space-Efficient Aggregate Range Queries on Encrypted Databases"**. 2021. *Under review.*
- Francesca Falzon, Evangelia Anna Markatou, **Zachary Espiritu**, Roberto Tamassia. **"Encrypted Range Search in Multiple Dimensions"**. 2021. *Under review.*