Zachary Espiritu

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Education

Sep 2017 – Dec 2021 **Brown University** • **Concurrent Sc.B. and Sc.M. in Computer Science** • GPA: 4.0 / 4.0 (with Honors)

- **Relevant courses:** Algorithms, Cryptography, Distributed Systems, Formal Methods, Human-Computer Interaction, Operations Research, Operating Systems, Probability, Software Security.

Experience

Jan 2021 – Present **Cryptography, Anonymity, Privacy, Security (CAPS) Group** • Researcher

- Designed 7 novel, O(1)-time, provably secure aggregate query schemes for encrypted databases, reducing state-of-the-art runtime and storage overhead by 90% in practice, and preventing all-known attacks.
- Devised novel application of data structures to reduce Python experiment setup times by 99%, allowing larger benchmarks (which would have taken 8.75 years to run) to complete in < 1 hour and appear in final publication.
- Developed novel algorithms to attack and fully reconstruct plaintext of higher-dimensional, encrypted DBs.

Sep 2020 – Present **Encrypted Systems Lab** • Researcher

- Wrote novel crypto protocol and Node.js / AWS distributed system prototype for **MA Dept. of Public Health** to securely conduct epidemic research over DBs of 22 MA institutions and eliminate manual anonymization step.

May 2020 – Aug 2020 **Google** • Software Engineering Intern

- Architected and developed open-source OpenSSL engine allowing web servers to use Google Cloud HSM keys for cryptographic signatures without source code changes. C++ with gRPC and Bazel components.

Jun 2018 – Aug 2018 **Brown PLT (Programming Languages Team)** • Research Programmer

- Built machine learning package, used yearly in 90-student functional programming course, for Pyret language.

Jun 2016 – Aug 2017 **Negotiatus** • **Software Engineering Intern** (Jun 2017 – Aug 2017 and Jun 2016 – Aug 2016)

- Led full-stack development in HTML, JavaScript, and Ruby on Rails of still-existing, core value propositions such as Scheduled Orders, converting ~20% of non-recurring revenue into monthly recurring revenue by 2017.
- Optimized SQL queries via PostgreSQL materialized view caching layer for up to 100x faster product searches.

Research Publications

Under Review **Z. Espiritu**, E. A. Markatou, R. Tamassia. **Time- and Space-Efficient Aggregate Range Queries on Encrypted Databases.**

Under Review F. Falzon, E. A. Markatou, **Z. Espiritu**, R. Tamassia. **Encrypted Range Search in Multiple Dimensions.**

Computer Science Department Teaching Experience

Sep 2018 – Present **Head Teaching Assistant (for 6 Computer Science Courses)**

- Hired, trained, and directly managed 54 TAs as HTA for **Software / Binary Exploitation** (2021), **Computer Systems Security** (2021, 2020, 2019), **Programming Languages** (2020), **Accelerated CS Intro** (2018).
- Designed new Go / Golang cloud security project for 92 students in security course on using untrusted, malicious servers for secure, efficient file storage and sharing. Scored average student evals of 4.61 / 5.00.
- Automated 3 courses' grading and project setup via Bash scripts integrated with Linux VMs and Docker containers in Google Compute API, saving 250 staff hours over 3 courses and $4k/year in dept. budget.

Oct 2019 – Present **Meta Teaching Assistant (TA Program Coordinator)**

- Headed hiring / training of 781 TAs in 56 courses by managing 112 HTAs in 14 time zones as dotted-line reports.
- Created Bash / Python scripts and new organizational processes to save 300 hours of manual tasks ($5k/year).
- Wrote *GrblGrader*, a modular feedback delivery system in JavaScript with over 1k student impressions per year.

Awards and Scholarships

Jul 2021 **CrowdStrike NextGen Cybersecurity Scholarship**
(6 selected nationwide; $7,500 scholarship)

May 2021 **(ISC)² Undergraduate Security Scholarship**
(20 selected nationwide; $1,000 scholarship)

Mar 2021 **Randy Pausch Undergraduate Research Grant**

Nov 2020 **1st Place out of 100 at Hack@Home CTF**

Selected Projects

- **Vehicle Routing Optimization:** Programmed top-performing local search solver out of 21 teams for NP-hard vehicle routing problem in graduate-level competition. In Python, with prototypes in IBM CPLEX and Java.
- **Weenix:** Wrote OS kernel in C. Based on Unix, with process management, file interfaces, and virtual memory.