Oswaldo Ramirez

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Education

Carnegie Mellon University, Pittsburgh, PA, USA **September 2021-May 2025**
Bachelor of Science in Computer Science with an Additional Major in Mathematical Sciences
Specialization: Algorithms and Complexity

Presentations

First-Generation Graduation Celebration **May 2025**
Opening Speaker
Delivered opening remarks to students, faculty, and families at CMU's annual celebration honoring first-generation graduates. Reflected on personal journey, community involvement with FirstTogether, the first generation organization at CMU, and national representation at the 1vyG conference

Proving Hopf's Umlaufsatz using Algebraic Topology **Spring 2025**
Lecturer for Course Project in Differential Geometry of Curves and Surfaces
Presented the proof of the homotopy invariance of degree using covering space theory and homotopy lifting; motivated by applications in Hopf's Umlaufsatz

Cut Sparsifiers in the Streaming Model **Spring 2025**
Lecturer for Course Project in Algorithms for Big Data
Presented state-of-the-art results on computing cut sparsifiers for undirected graphs. Proposed research directions, including proving that computing the balancedness of a directed graph requires at least m^2 space (where m is the number of edges in graph G), and exploring the construction of directed sparsifiers for balanced directed graphs in the semi-streaming model

A Dive into Pell's Equation **Spring 2024**
Lecturer for Course Project in Number Theory
Exploration of Pell's Equation, its solutions via continued fractions, and the characterization of irrational quadratics through periodic expansions solutions

Importance of Mentorship in College as First-Generation **Fall 2024**
Co-Presenter at 1vyG National Conference, Brown University
Discussed the role of mentorship and peer networks in supporting first-generation college students. Shared personal experiences and best practices from FirstTogether

Research Experience

CMU Theory **Summer 2025**
Research Mentors: Professor David Woodruff & PhD student Honghao Lin

- Developed a turnstile streaming algorithm for β-balanced directed graphs , enabling optimal-size cut sparsifiers for large graphs; work submitted to **ITCS 26**
- Developed sketch-based algorithms to compute maximum spanning forest indices in the turnstile streaming model

CMU RI AirLab **September 2023-Present**
Research Mentor: Dr. Brady Moon

- Optimized **C++** algorithm for informed pathfinding by improving runtime of root-finding in a complex equation, achieving a **100x** speedup in computation
- Developed an algorithm for solving curve-curve-curve trochoid path problem, leveraging 2D Newton-Raphson
- Created an animated visualization using Manim to illustrate trochoid curves.

CMU RI AirLab **Spring 2023-Fall 2023**
Research Mentor: Master's (now PhD!) student Andrew Jong

- Developed realistic thermal imaging for a wildfire simulation using Unreal Engine
- Created a black-and-white gradient base with dynamic materials to simulate thermal visuals
- Enhanced realism by incorporating thermal blurriness effects commonly seen in real infrared footage
- Implemented data analysis tools (PSNR and SSIM) to compare simulation output with real-world thermal data for calibration and refinement

Projects

Distributed Bitcoin Miner **Fall 2024**
Implemented a bitcoin miner using a client-server model in **Golang**. Coordinated how to chunk the work and distribute it to available miners

Flappy Bird AI Solver **Spring 2024**
Trained an agent via deep reinforcement learning to autonomously play Flappy Bird and receive a high score consistently. Explored different design decisions such as reward model and kind of learning (e.g., Q-learning)

PageRank and HITS Algorithm **Fall 2022**
Examined and created algorithms in Julia from real-world datasets to assess popularity of a website based on various factors such as link popularity and damping factor. Used Markov chains and random walks to implement a page rank and HITS algorithm to produce "search results"

T-shirt Website and Discord Bot **Summer 2022**
Implemented in Python using Flask framework a fictional e-commerce website for selling custom t-shirts. Programmed a music bot in Python using Discord API, allowing users to request and play music in server channels

Remake of Binding of Isaac **Fall 2021**
Programmed a version of the old game, *The Binding of Isaac*, in Python with the use of A* path finding algorithm and graphics from Tkinter, providing a challenging and entertaining gameplay experience

Industry Experience

FLIP National **Summer 2024**
Technology Fellow

- Redesigned and developed FLIP National's website using **React** and **Tailwind CSS**
- Implemented a mailing list component integrated with HubSpot, managing **100+** subscriptions and streamlining communication
- Created a contact page to enhance user engagement and facilitate inquiries
- Built a secure donation page with PayPal and Stripe APIs, enabling seamless transaction processing

Other Experiences

CMU StuCo Introduction to Freestyle Rap 98-303, TA → Co-Instructor **Fall 2022 - Fall 2023**
ACM@CMU Algorithms with a Purpose Hackathon **Spring 2023**
Cornell Summer of Networking and Computing (SoNIC) **Summer 2022**
CMU Tartan Hacks Hackathon **Spring 2022**
William Putnam Competition **2021 - 2024**
MIT MITES (formerly MOSTEC) **Summer 2020**

Awards

Jorndt Scholarship **$35,000**
Awarded to only 5 students out of a class of approximately 250; disbursed over 4 years. **2021-2025**

Hispanic Scholarship Fund Scholar **$15,000**
Nationally competitive scholarship with roughly **10%** acceptance rate. **2023-2025**

GEAR UP Scholarship **$6,500**
Awarded through federally funded college access program. **2021-2023**

Community Involvement

FirstTogether **2021–2025**
First-generation student organization supporting mentorship, community, and professional development

Tartan Scholars **2021–2025**
Selective cohort program for limited-resource and first-gen students at CMU

Theory Lunch **2023–2025**
Weekly informal research discussion group for students interested in theoretical computer science

Catholic Church **2021–Present**
Participate in weekly services