Raul Garcia

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Education

2020–2025 **Rice University**.
PhD Computational and Applied Mathematics
Advisor: Dr. Andrew J. Schaefer

2014–2018 **University of California, Davis**.
BS Applied Mathematics
Cum laude

Interests

Mixed-integer programming formulations, stochastic optimization, mathematical software, operations research, deep learning

Experience

Fall 2022 **Research Mentor**, *Data to Knowledge Lab*, Rice University, Houston TX.
Mentor a team of students on a capstone data science project (sponsored by LivaNova) focusing on forecasting yearly battery replacements for medical devices.

Summer 2022 **Research Intern**, *MIT Lincoln Laboratory*, Lexington MA.
Group 42 - Surveillance Systems
Airborne collision avoidance logic development.

2019–2020 **Quality Product Auditor**, *Pacific Southwest Container*, Modesto CA.
Performed daily testing and data collection of products. Assisted in development of experiments for analysis of product quality. Conducted internal process audits.

2017–2018 **Reader**, *Dept. of Mathematics*, UC Davis, Davis CA.
Undergraduate grader for courses in Real Analysis and Ordinary Differential Equations.

Summer 2017 **Orientation Leader**, *Student Housing*, UC Davis, Davis CA.
Advised and mentored incoming students with course scheduling, degree requirements, campus resource navigation, and student life.

Awards and Fellowships

2022–2025 **NIH Research Supplement to Promote Diversity in Health-Related Research**, National Cancer Institute (NCI).

2022–2025 **GEM Fellowship**, MIT Lincoln Laboratory.

2022 **NSF AGEP STRIDES Scholar**.

2022 **Research Mentoring Fellowship**, *Data to Knowledge Lab*, Rice University.

2020–2024 **Computational Science and Engineering Recruiting Fellowship**, *Ken Kennedy Institute*, Rice University.

Publications

A combinatorial disjunctive constraint approach to optimal path planning.
Raul Garcia, Illya V. Hicks, Joey Huchette, Miles Olson
In preparation.

Deep object detection for waterbird monitoring using aerial imagery.
Krish Kabra, Alexander Xiong, Wenbin Li, Minxuan Luo, William Lu, Raul Garcia, Dhananjay Singh Vijay, Jiahui Yu, Maojie Tang, Tianjiao Yu, Hank Arnold, Anna Vallery, Richard Gibbons, Arko Barman
To appear in IEEE International Conference on Machine Learning and Applications 2022.

Software

Summer 2022 **Airborne Collision Avoidance System X (ACAS X)**, Software for generating airborne collision avoidance advisories for manned and unmanned aircraft. Implemented in C++, Julia and MATLAB.

- Logic formulated as a Markov decision process
- Computational strategies employed for handling large state space, including parallel computing
- Contributed visualization tool for analysis of policy evolution through the course of the value iteration algorithm
- Developed by Group 42 at MIT Lincoln Laboratory

2022–Present **Audubon_F21**, Python package for identifying and censusing various colonial waterbird species from aerial UAV imagery.

- Sponsored by Houston Audubon for their waterbird population monitoring studies
- Employs Faster R-CNN object detection model (Detectron2) with data augmentation and Bayesian optimization for hyperparameter tuning
- Led experimentation of custom implementation utilizing a DenseNet backbone
- Co-developer with various students from the Rice Data to Knowledge Lab

2021–Present **ClutteredEnvPathOpt.jl**, Julia package employing various MIP approaches to optimal path planning of robots and drones in cluttered environments.

- Formulation techniques for disjunctive constraints: 1) Independent branching scheme; 2) Big-M
- Co-developer with Joey Huchette and Miles Olson

Teaching

Rice University

Department of Computational Applied Mathematics & Operations Research

Grader, CAAM 519: Computational Science I.
Fall 2022

Grader, CAAM 378: Introduction to Operations Research and Optimization.
Spring 2022

Grader, CAAM 335/334: Matrix Analysis/Matrix Analysis for Data Science.
Fall 2021, Spring 2021, Fall 2020

University of California, Davis

Department of Mathematics

Teaching Assistant, MAT 17C: Calculus III for Bioscience Students.
Spring 2017

Teaching Assistant, MAT 17A: Calculus I for Bioscience Students.
Fall 2016

Teaching Assistant, MAT 17B: Calculus II for Bioscience Students.
Spring 2016

Presentations

"Leveraging Machine Learning to Develop Collision Avoidance Systems for Manned and Unmanned Aircraft".
- TAPIA Conference in Computing, Sep 2022

"A Combinatorial Disjunctive Constraint Approach to Optimal Path Planning".
- INFORMS Annual Meeting, Oct 2022
- MIP Workshop (poster), May 2022
- Kavraki Lab, Apr 2022

"Deep Learning for Precision Waterbird Monitoring".
- Rice D2K Showcase (poster), Apr 2021

"On the Value of Binary Expansions for General Mixed-Integer Programs", Paper Presentation.
- Rice SIAM Journal Club, Feb 2021

Service, Outreach & Activities

2020–Present **Society for Industrial and Applied Mathematics (SIAM) Student Chapter**, Rice University.
- Treasurer, 2022-2023
- Graduate Seminar Chair, 2021-2022
- Grill Master, 2020-2021

2021–Present **Julia Users of Rice Group**, Co-founder, Rice University.

Summer 2021 **Instructor**, *Tapia STEM Camp*, Rice University.
Guided high school students from underrepresented backgrounds on projects focusing on computational thinking and equity

2020–2021 **Mentor**, *Association of Women in Mathematics (AWM)*, Rice University.
Served as mentor to a group of first-year Rice students interested in mathematics

2020–Present **Rice Graduate Education for Minorities**, *Tapia Center for Excellence and Equity in Education*, Rice University.

2020–Present **Rice Latinx Graduate Students**, Rice University.

2020–Present **Graduate Student Association Soccer Club**, Rice University.
- Treasurer, 2022-2023

2015–2018 **Chicano and Latino Engineers and Scientists Society**, UC Davis.

Memberships.
- Institute for Operations Research and the Management Sciences (INFORMS)
- Society for Industrial and Applied Mathematics (SIAM)

Relevant Coursework

Linear and Integer Programming; Applied Machine Learning Projects; Stochastic Optimization; Stochastic Simulation; Intro to Machine Learning; Iterative Methods for Systems of Equations and Unconstrained Optimization; Advanced Numerical Analysis; Computational Science; Object-Oriented Programming

Programming Languages and Software

Programming & Software	Julia, Python, C++, C, Gurobi, MATLAB, Rust
Libraries	JuMP, Detectron2, PyTorch, scikit-learn

Languages

English, Spanish