

# Raul Garcia

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## Education

- 2020–2025 **Rice University.**  
PhD Computational and Applied Mathematics  
Advisor: Dr. Illya V. Hicks
- 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

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

## 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  
*Submitted to 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 multilinear interpolation and parallel computing
  - Contributed visualization tool for analysis of policy evolution over iterations of 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

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## Teaching

### Rice University

Department of Computational Applied Mathematics & Operations Research

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

Spring 2022

**Grader**, CAAM 335: Matrix Analysis.

Fall 2021, Fall 2020

**Grader**, CAAM 334: Matrix Analysis for Data Science.

Spring 2021

### 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

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## Presentations

**"Leveraging Machine Learning to Develop Collision Avoidance Systems for Manned and Unmanned Aircraft".**

- TAPIA Conference in Computing, Sep 2022 (*Scheduled*)

### **"A Combinatorial Disjunctive Constraint Approach to Optimal Path Planning".**

- INFORMS Annual Meeting, Oct 2022 (*Scheduled*)
- MIP Workshop (poster), May 2022
- Kavraki Lab, Apr 2022
- Rice CMOR Dept. Graduate Seminar, Sep 2021

### **"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

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## Awards and Fellowships

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

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

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## Service, Outreach & Activities

2020–Present **Society for Industrial and Applied Mathematics (SIAM) Student Chapter**, Rice University.

- 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)

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## Relevant Coursework

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

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## Programming Languages and Software

Programming & Software

Julia, Python, C++, C, Gurobi, MATLAB, Rust

Libraries

JuMP, Detectron2, PyTorch, scikit-learn

## Languages

English, Spanish