Rahul Swamy, Ph.D.

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Google Scholar | LinkedIn | GitHub

Operations Research and Data Science Professional

Expert in developing machine learning and mathematical optimization algorithms, with 8+ years of research experience and 4 years of industry practice. Skilled in designing creative, reusable, and scalable architectures.

Summary of Work Experience

- **Senior Data Scientist,** Walmart Centroid, New York, NY — Oct 2023 – present (1 yr 5 mos)
- **Data Scientist,** Gurobi Optimization, Chicago, IL — June 2022 – Aug 2023 (1 yr 3 mos)
- **Research Assistant,** University of Illinois at Urbana-Champaign, IL — July 2016 – May 2022 (6 yrs)
- **Data Science Fellow**, Atlanta Data Science for Social Good, Atlanta, GA — June 2015 – Aug 2015 (3 mos)
- **Optimization Analyst**, KPMG India, Business Consulting, Mumbai, India — June 2013 – May 2014 (1 yr)

Education

- Ph.D. Operations Research, University of Illinois at Urbana-Champaign; GPA: 3.95/4 — 2023
- M.S. Operations Research, State University of New York at Buffalo; GPA: 3.89/4 — 2016
- B.Tech. Engineering Physics, Indian Institute of Technology Madras — 2013

Skills

- **Analytics:** Reinforcement Learning, Machine Learning, Integer Programming, Graph Algorithms, Graph Neural Networks, Large Language Models, Recommendation Systems, A/B Testing
- **Programming languages:** Python (advanced), SQL (advanced), C++, R, MATLAB
- **Tools:** Google Cloud Platform, MongoDB, Tableau, DBeaver, Gurobi, CPLEX, Xpress Solver, OpenAI API
- **Libraries**: Gym, PyTorch, Pandas, TensorFlow, Seaborn, SciPy, Pyspark, Keras, Statsmodels, LightFm

Relevant Projects

- **Senior Data Scientist,** Walmart Centroid — Oct 2023 – present
  Network Optimization Data Science | Python, SQL, C++, Gurobi
  - Developed an **optimization** and **reinforcement learning** pipeline to reduce Walmart's transportation cost-to-serve through cost-optimal routing, staffing, and scheduling
  - Independently owned the yard space optimization workstream to initiate and develop an ML-based **simulation engine** to predict the future space needed for freight trucks at distribution centers
  - Interfaced with business partners, engineering, and finance teams to fine-tune prescriptive models within operational and business constraints, unlocking **6% savings** over 20 years
  - Formulated an optimization model to internalize freight from third parties, resulting in a **9%** reduction in cost-per-case-shipped
  - Engineered an **LLM chatbot** for stakeholders to interact with optimization outputs, thereby improving the explainability, interpretability and adaptability of the results

- **Data Scientist**, Gurobi Optimization — June 2022 – Aug 2023
  Integrating machine learning and optimization at Gurobi | Python, Gurobi, Sklearn
  - Designed novel data science pipelines that integrate ML and mathematical optimization such as,
    - **revenue optimization** with demand-elasticity via regression and quadratic program (Link)
    - **recommendation system** with collaborative filtering and integer programming (Link)
    - **detecting text similarity** using linear programming (Link)
  - Contributed to **product development**: new tools that integrate ML functionalities into Gurobi such as modeling with Pandas integration, and regression functions as optimization inputs

- **Research Assistant**, University of Illinois at Urbana-Champaign July 2016 – May 2022
  Multi-criteria optimization framework for fair political redistricting | Python, CPLEX, Gurobi
  - Formulated a **multi-objective** mixed integer linear program (MILP) to model *fair* political redistricting
  - Executed an efficient **graph-contraction** heuristic that solves MILPs using a branch-and-cut method to produce congressional redistricting maps that are Pareto-optimal to the parties and the voters
  - Provided **optimized district maps** to the Arizona Independent Redistricting Commission to assist in drawing Arizona's 2023-2033 nine congressional districts affecting a population of 7+ million
  - Created **Optimap**: a publicly accessible **web application** using Streamlit+Python

- **Research Assistant**, State University of New York at Buffalo June 2015 – Aug 2015
  Optimal location and routing of portable stations in a bike-sharing system | Python, Gurobi, C++
  - Formulated a MILP for optimizing the **location and routing** of portable stations with the objective to minimize the rebalancing load in a bike-sharing system
  - Accelerated the solution strategy with an efficient implementation of **Benders' decomposition**

- **Data Science Fellow**, Data Science for Social Good, Georgia Tech. June 2015 – July 2015
  Inferring mobility patterns using Wi-Fi logs | Python, SQL, Unix
  - Programmed a pipeline using Python and SQL to transform **large-scale Wi-Fi log data** (~1 TB) into spatial mobility patterns to obtain optimal location of commercial services

Awards and Honors

- **First Place** (out of 51 submissions), INFORMS Service Science Best Paper Award 2019
- **Finalist** (4 out of 39 submissions), INFORMS Public Sector Operations Research Best Paper Award 2018
- **First Place** (out of 30 posters), Poster Competition Award 2018, INFORMS Annual Meeting, Phoenix, AZ
- **Recipient**, UIUC ISE Graduate Service Awards for the years 2016-2017 and 2017-18
- **Recipient**, SUNY Buffalo Thomas-Drury Industrial Engineering Scholarship 2014 -15
- **Ranked** in the top 99.7% percentile in the Indian Institute of Technology Joint Entrance Exam 2009

Select Journal Publications

- **Swamy, R.,** King, D.M. and Jacobson, S.H., 2024. "Highly Connected Graph Partitioning: Exact Formulation and A Cutting Planes Approach," *Naval Research Logistics.*
- **Swamy, R.,** King, D.M. and Jacobson, S.H., 2023. "Multi-Objective Optimization for Politically Fair Districting: A Scalable Multilevel Approach." *Operations Research*.
- **Swamy, R.** and Murray, T., 2020. "Computing Equilibrium in Network Utility-Sharing and Discrete Election Games." *Journal of Combinatorial Optimization.*
- Dobbs, K., **Swamy, R.,** King, D.M., Ludden I.G., and Jacobson, S.H., 2023. "An Optimization Case Study in Analyzing Missouri Redistricting." *INFORMS Journal on Applied Analytics*.
- Ludden I., **Swamy, R.,** King, D.M. and Jacobson, S.H., 2022. "A bisection protocol for political redistricting." *INFORMS Journal on Optimization*.
- **Swamy, R.,** King, D.M., Ludden, I., Dobbs, K., and Jacobson, S.H., 2024. "A practical optimization framework for political redistricting: A case study in Arizona." *Socio-Economic Planning Sciences*.
- **Swamy, R.,** Kang, J.E., Batta, R. and Chung, Y., 2017. "Hurricane Evacuation Planning Using Public Transportation." *Socio-Economic Planning Sciences.*

Press Releases and Media Articles

- INFORMS (2022) "New research develops a model that optimizes political fairness for political redistricting"
- UIUC (2022), "New political redistricting procedure prevent gerrymandering by forcing parties to act fairly"
- INFORMS OR/MS Today (2019), "Political Redistricting and O.R.: A Map for the Future"