

Arnav Hiray

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EDUCATION

Georgia Institute of Technology

B.S in Industrial Engineering (Advanced Studies in Operations Research and Statistics)

B.S in Mathematics (Probability and Statistics)

Atlanta, Georgia

August 2021 - May 2025

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RELEVANT COURSEWORK

Graduate Classes: Simulation, Stochastic Processes I/II, Nonlinear Optimization, Machine Learning I, Derivative Securities

Upper-Level Undergraduate Classes: Real Analysis, Probability Theory, Mathematical Foundations of Data Science, Applied Combinatorics, A Second Course in Linear Algebra, Numerical Analysis, Regression and Forecasting

PUBLICATIONS

“CoCoHD: Congress Committee Hearing Dataset”

*Arnav Hiray**, Yunsong Liu*, Mingxiao Song*, Agam Shah, Sudheer Chava

In Findings of the Association for Computational Linguistics (EMNLP), 2024.

“Numerical Claim Detection in Finance: A New Financial Dataset, Weak-Supervision Model, and Market Analysis”

Agam Shah*, *Arnav Hiray**, Pratvi Shah, Arkaprabha Banerjee, Anushka Singh, Dheeraj Eidnani, Sahasra Chava, Bhaskar Chaudhury, Sudheer Chava

In Proceedings of the Seventh Fact Extraction and VERification Workshop (FEVER), EMNLP 2024

**Denotes equal contribution.*

CONFERENCE PRESENTATIONS

“The Crowning Crypto: Identifying Influential Cryptocurrencies through Network Science”

*Arnav Hiray**, Vishwa Shah, Pratvi Shah, Agam Shah, Sudheer Chava, and Mukesh Tiwari

- American Mathematical Society (AMS) Spring Southeastern Sectional Meeting 2023
- 17th Annual Georgia Tech Undergraduate Research Spring Symposium - 1st Place Oral Presentation (Scheller College of Business)

RESEARCH EXPERIENCE

H. Milton Stewart School of Industrial and Systems Engineering

Summer 2023 - Present

Graphical Allocations (Balls and Bins)

Summer 2023

- Researched under Dr. Debankur Mukherjee (ISYE) funded under NSF CCF grant 2113027.
- Researched “Balls and Bins on Graphs,” extending classic load-balancing models by incorporating graph structures to model edge-based dependencies.
- Studied the “Power of D-Choices” framework on finite graphs, learning how large deviation principles are used to bound probabilities in maximum bin load and the “ $(1 + \beta)$ choice and weighted balls” framework learning about potential functions and stochastic drift.
- Developed simulation software in C++ with Python interfaces to model Balls and Bins on Graphs, enabling experiments with customizable graph structures and algorithm settings as well as metrics for bin-load distribution and path-based measures to analyze load-balancing performance.
- Observed that the “left bin” tie-breaking rule reduces autocorrelation in load among adjacent bins, promoting more uniform load distribution and stability, particularly in regular and scale-free graph topologies.
- Demonstrated improved load-balancing performance with algorithms that dynamically weight edge sampling based on bin loads.

SIRS Process (Interacting Particle Processes)

August 2023 - Present

- Researching the SIRS process, a variant of the Contact Process (SIS) under Dr. Debankur Mukherjee (ISYE) and Dr. Souvik Dhara (Purdue, School of Industrial Engineering) funded under NSF CCF grant 2113027.
- Studied key results of the Contact Process, studying applications of Martingale Theory, Coupling, and Monotonicity properties to analyze interacting particle systems.
- Constructed a coupling demonstrating stochastic monotonicity with respect to recovery rates on finite graphs, requiring a redefinition of partial ordering and the application of Vasershtein Coupling.
- Demonstrated through simulations that the SIRS process is stochastically dominated by the contact process, with drastically shorter infection survival times.

Georgia Tech Financial Services Innovation Lab (FSIL)

Fall 2021 - Present

Analysis of Bitcoin Transaction Network

Aug 2021 - July 2022

- Researched under Dr. Sudheer Chava methods of modeling Bitcoin Transaction network and relevant techniques including graph reduction methods and network properties.
- Designed a Java pipeline to retrieve Bitcoin block data via **Tatum** API and store it as a transaction network in **ArangoDB**.
- Implemented Bitcoin “Address Clustering” algorithms to group addresses and create entity-graph.
- Investigated small-world properties in Bitcoin networks (2020–2021) using **BlockSci** and Python, implementing “Small-World Propensity” metric from neuroscience literature.
- Re-wrote local clustering calculations to use ego graphs instead of adjacency matrices (**NNGT**), improving scalability for large network analysis.

Crowning Crypto: Identifying Influential Cryptocurrencies Through Networks

September 2022 - Present

- Analyzed rolling correlation networks of 229 cryptocurrencies (2016–2022) using hourly data with Kendall’s Tau correlation and Planar Maximally Filtered Graphs for network construction under Dr. Sudheer Chava.
- Created a framework for evaluating the stability and similarity of network construction methods using network centrality and Rank-Biased Overlap (RBO).
- Compared the day-to-day stability of traditional network constructions (Pearson Correlation, Minimum Spanning Tree), revealing significant and unexplained fluctuations in influential rankings, indicating irregularities.
- Demonstrated that hourly-resolution networks differ significantly from daily-resolution networks, highlighting role of data granularity.
- Observed Bitcoin’s diminishing influence post-2021 bull run, with Ethereum emerging as the leader. Additionally, identified qualitative evidence of FTT’s significant drop in influence preceding its collapse.
- Used Granger Causality test show increased volatility of day-to-day RBO-measure precedes overall market volatility.

Southeast Center for Mathematics and Biology

Summer Modeling Associate

Summer 2022

- Selected as one of 13 undergraduates in a summer program at the Southeast Center for Mathematics and Biology (SCMB), an NSF-Simons MathBioSys center, focused on theoretical and computational math-bio modeling under Dr. Michael Lavigne.
- Researched hyper-tumors and their efficacy in hindering cancer spread, developing a mathematical model to simulate tumor growth and hypertumor formation, incorporating factors like angiogenesis rate, blood vessel atrophy, division rate, and hypoxia-induced cell death.
- Modeled tumor growth and decay using **NetLogo** to evaluate the strengths and weaknesses of hypertumors in various settings.

Georgia Tech Vertically Integrated Project: Peace Engineering

Student/Researcher

January 2022 - May 2022

- Mentored by Dr. Khatereh Hadi and Mr. Kevin Caravati of Georgia Tech Institute Research.
- Responsible for researching the development and implementation of Social Impact Bonds in the US, leveraging blockchain-based contracts to enhance collaboration between organizations and reduce systematic risk.
- Conducted exploratory analysis on approximately 270 previous contracts and identified critical bottlenecks which hinder the progress of Social Impact Bonds and informed recommendations for addressing these challenges
- Presented work to a panel of Georgia Tech Research Institute Scientists, and discussed our work with the Oxford University Government Outcomes Lab.

AWARDS AND ACHIEVEMENTS

Fintech Fellow, Georgia Tech Financial Services Innovation Lab

Georgia Tech Undergraduate Opportunitites Program (UROP) Featured Researcher

17th Annual Georgia Tech Undergraduate Research Spring Symposium - 1st Place Oral Presentation (Scheller College of Business)

9th Place, 2019 National Speech and Debate Association Tournament (Lincoln-Douglas Debate)

UNDERGRADUATE TEACHING ASSISTANT

ISYE 3233: Stochastic Manufacturing and Service Systems

ISYE 4045: Advanced Simulation

ISYE 3133: Engineering Optimization

ISYE 3025: Essentials of Engineering Economy

Fall 2024

Spring 2024

Spring 2023, Fall 2023

Summer 2022

ORGANIZATIONS AND ACTIVITIES

Georgia Tech Finance Society

President, Head of Education

Aug 2021 – Present

- Student Chapter of Financial Management Association.
- As President (2021–2022), focused on growing the chapter and planning events/speakers for exposure to financial careers.
- As Head of Education (2022–2024), started “FinTalks,” weekly financial market discussions for undergraduate students.
- Planned personal finance events/seminars for the Georgia Tech community.

School of Mathematics Directed Reading Program

Participant

Jan 2023 – May 2024

- Spring 2023: Studied Graph Neural Networks at the level of *Graph Representation Learning* by William L. Hamilton.
- Fall 2023: Explored *Computational Optimal Transport* by Gabriel Peyré and Marco Cuturi.
- Spring 2024: Investigating *Distributionally Robust Mean-Variance Portfolio Selection with Wasserstein Distances* by Jose Blanchet, Lin Chen, and Xun Yu Zhou.

INVITED TALKS

Artificial Intelligence at Georgia Tech

AI in Finance: Research Perspectives and Industry Applications

Georgia Tech Vertically Integrated Projects: Machine Learning for Financial Markets

How to Be An Undergraduate Researcher

PROFESSIONAL SERVICES

Reviewer, 2023 Empirical Methods for Natural Language Processing (EMNLP)

Submission Tracks: Efficient Methods for NLP, NLP Applications