# Kimia Hassibi

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## EDUCATION

**California Institute of Technology (Caltech)** Expected: **Jun. 2024**
Bachelors of Science, Major in Computer Science, Overall GPA: 4.1/4.3
Minors in Information + Data Sciences and in Control and Dynamical Systems

**Relevant Coursework:**
Computer Science: Distributed Computing, Networks, Theory of Computation, Algorithms, Machine Learning, Computing Systems, Computer Programming

Math: Mathematical Optimization, Linear Algebra, Probability, Bayesian Statistics, Statistics, Discrete Math, Abstract Algebra, Differential Equations, Multivariable Calculus

Miscellaneous: Game Theory, Economics, Feedback Control Systems, Quantum Mechanics

## RESEARCH EXPERIENCE

**Game Theory Research** - Prof. Omer Tamuz' lab (Caltech) **Jul. 2023 - Present**

- Studied quantal response dynamics, which are a solution concept in which players myopically best respond with some probability of error. This can serve to better understand human behavior, since people are fallible.
- Computationally and mathematically analyzed the stationary distribution of Markov chains with transition matrices defined by the quantal response dynamics of players in a game.
- Created classes in Python that simulate different games and used this empirical data to inform or debunk conjectures about whether or not the quantal response equilibria of these games were product measures.
- Proved that in a graphical normal-form game with a bipartite utility structure, in which the players all simultaneously quantal respond, the quantal response equilibrium is a product measure.

**CS + Testing Research** - Senior Thesis + SURF w/ Prof. Richard Murray's lab (Caltech) **Jun. 2023 - Present**

- Formalized the specifications of an autonomous system in its environment as a GR(1) winning condition, which is a set of linear temporal logic (LTL) formulas that require the autonomous system to satisfy its initial, invariant, and progress conditions if the environment satisfies its initial, invariant, and progress conditions.
- Wrote code to convert these LTL formulas into a graph of a game between the environment and autonomous system. Achieved this by altering source code in the Python library TuLiP.
- Created algorithms to calculate robustness metrics over these game graphs. Then, used these metrics to myopically find the environment action that is the hardest for the system to successfully respond to.
- Currently, working on creating hard tests for autonomous systems that take into account paths on the graph.

**Machine Learning Research** - SURF w/ Prof. Anima Anandkumar's lab (Caltech) **Jun. - Sep. 2022**

- Programmed the Fourier Neural Operator (FNO) ML model to learn solutions to the Navier-Stokes partial differential equations.
- Specifically, trained the FNO model to use the simulated air pressure measurements on an airborne plane's wing to predict the wall-normal velocity of that air. These velocity estimates can aid in real-time opposition flow control to reduce planes' skin-friction drag.
- Deployed the Weights & Biases AI developer tool to hyperparameter-tune this FNO model.

**CS + Atmospheric Chemistry Research** - SURF w/ Prof. Yuk L. Yung's lab (Caltech) **Jun. - Sep. 2021**

- Using Python, Fortran, and shell scripts, extended a model of Titan's atmosphere to include $HCN_2$.
- By analyzing the changes in compounds' mixing ratios and correlating these changes to existing chemical equations, found chemical pathways in Titan's atmosphere that create nitrogenous compounds that are precursors to life.
- Programmed a box model to constrain the rate coefficients of the $HCN_2$ reactions.

**CS Research** - High School Research w/ Prof. Chris Umans lab (Caltech) **Sep. 2018 - May 2019**

- Studied Strong Uniquely Solvable Puzzles (SUSPs) and their potential application to simplifying fast matrix multiplication.
- Wrote a program that generates thousands of SUSPs.
- Created some lemmas to characterize SUSPs.

## PROJECTS

**Proof-of-Stake Bounty System for User-Proposed Problems and Solutions** **Apr. - Jun. 2023**

- For CS 145 Networks Project class with Professor Adam Wierman.
- Resulted in a paper submitted to 2023 IEEE MIT Undergraduate Research Conference (see publication).
- Created a proof-of-stake cryptocurrency architecture in which users can propose problems and solve pre-existing ones for a bounty. In this cryptocurrency, all the work done by agents is useful and socially beneficial.

- Determined safety guarantees for this architecture. This cryptocurrency can be at least as safe as state-of-the-art proof-of-stake cryptocurrencies.

**Variational Autoencoder for Music Generation** **Apr. - Jun. 2022**

- For CS 159 Advanced Topics in Machine Learning with Professor Yisong Yue.
- Using PyTorch, implemented several models (WGAN-GP, InfoGAN, MIDI-VAE) to generate music in the style of Bach.

## PRESENTATIONS & PUBLICATIONS

### Publications

- N. Arora, S. Hashash and K. Hassibi, "Enabling Computational Democratization: A Proof-of-Stake Bounty System for User-Proposed Problems and Solutions," 2023 IEEE MIT Undergraduate Research Technology Conference (URTC), Cambridge, MA, USA, 2023, [peer-reviewed and accepted but awaiting publication] [**1st Place Winner of the Best Paper Award of the conference**] [all authors contributed equally and are listed in alphabetical order].

### Talks

- N. Arora, S. Hashash and K. Hassibi, "Enabling Computational Democratization: A Proof-of-Stake Bounty System for User-Proposed Problems and Solutions," 2023 IEEE MIT Undergraduate Research Technology Conference (URTC), Cambridge, MA, USA, 2023.
- Hassibi, K., Adams, D., Wong, M., & Yung, Y. (2021). Constraining HCN production via $HCN_2$ at Titan for applications to prebiotic chemistry. Bulletin of the AAS, 53(7). Retrieved from https://baas.aas.org/pub/2021n7i402p07

## TEACHING EXPERIENCE

**Teaching Assistant** - Algorithms (CS 38) **Apr. - Jun. 2023**

- For a class with 124 students centered around the design and analysis of algorithms, incorporating techniques such as divide-and-conquer, dynamic programming, graph traversal, and linear programming.
- Conducted weekly hour-long office hours to reteach lecture topics and to provide guidance to students facing challenges with homework assignments.
- Graded select problems from homework assignments and exams.
- Received a 5/5 on all metrics from students' teaching and quality feedback forms.

**Head Teaching Assistant** - Decidability & Tractability (CS 21) **Jan. - Mar. 2023**

- For a proof-based class with 121 students that introduces the formal foundations of computer science, including automata, decidability, reductions, and tractability.
- Managed course logistics by releasing homework assignments, tracking extension requests, and coordinating a team of 9 TAs to ensure the prompt grading of problems.
- Conducted weekly hour-long office hours to reteach lecture topics and to provide guidance to students facing challenges with homework assignments.
- Graded select problems from each homework assignment and from exams.
- Received a 5/5 on all metrics from students' teaching and quality feedback forms.

## HONORS & AWARDS

IEEE 2023 MIT Undergraduate Research Technology Conference Best Paper (1st Place) **2023**
Lynn A. Booth and Kent Kresa SURF Fellowship (a named research fellowship grant) **2023**
Doris S. Perpall SURF Speaking Competition Semi-Finalist **2021**
Karen and James Cutts SURF Fellowship (a named research fellowship grant) **2021**

## TECHNICAL SKILLS

**Languages**: C, Java, Python, MATLAB, Mathematica, R, JavaScript, HTML, CSS, Fortran, Shell Scripts, Assembly
**Packages/Frameworks**: Git, Pandas, NumPy, Anaconda, LaTex, TuLiP, CVXPY, NetworkX, SKLearn, PyTorch, Keras, Matplotlib
**Developer Tools**: VS Code, PyCharm, IntelliJ IDEA, Eclipse, AWS, Anaconda