# Vikram Kher

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PH.D. STUDENT, COMPUTER SCIENCE, YALE UNIVERSITY

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EDUCATION

**Yale University**
*Ph.D.*, Computer Science,                                                    *Aug 2023 - Present*

**University of Southern California**
*Bachelor of Science*, Computer Science,                                      *Aug 2018 - May 2022*
*Bachelor of Arts*, Applied and Computational Mathematics,                    *Aug 2018 - Dec 2022*
**Overall GPA: 3.99, *Summa Cum Laude***

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RESEARCH
INTERESTS

Algorithm Design, Algorithmic Game Theory,
Auction Theory, Computational Social Choice

PUBLICATIONS

Sepehr Assadi, **Vikram Kher**, George Li, Ariel Schvartzman. Fine-Grained Buy-Many Mechanisms Are Not Much Better Than Bundling. To appear in EC 2023. arXiv:2205.14312

Dhruv Patel, **Vikram Kher**, Bhushan Desai, et al. Machine learning based predictors for COVID-19 disease severity. Sci Rep 11, 4673 (2021).https://doi.org/10.1038/s41598-021-83967-7

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RESEARCH
EXPERIENCE

**Exploring Fine-Grained Buy-Many Mechanisms**
*Advisor : Dr. Ariel Schvartzman, DIMACS REU*                                 *June 2022 - Sept 2022*

- Investigated revenue properties of buy-$k$ mechanisms, a new class of auctions where a buyer can purchase any multi-set of at most $k$ menu options.
- Proved that bundling, a simple mechanism, can achieve within an exponential factor of the revenue of optimal buy-$n$ mechanism for buyers with monotone valuations (no known bound previously).
- Conjectured and partially proved that there exist distributions over item valuations that witness a strict separation in revenue between the optimal buy-$k$ and buy-$(k+1)$ mechanism.
- Experimentally validated conjecture using code to compute revenue-optimal mechanisms for particular distributions, files available here.

**Distortion-Based Analysis of Single Transferable Vote (STV) Mechanism and Investigating Committee Elections**
*Advisor : Prof. David Kempe, USC*                                            *Jan 2021 - Present*

- Utilized LP-duality framework and network flow techniques to conduct worst-case analysis of Single Transferable Vote mechanism (code written for empirical testing available here).
- Developed a new, streamlined proof using flow techniques that recover STV's known distortion upper bound of $O(\ln)$.
- Designed new, fairer notion of committee cost to prevent low-cost committees from succumbing to "tyranny of the majority."
- Proven a linear-time algorithm on the line that always selects a committee with a cost within a constant factor of the optimum.

**Modeling ICU and Ventilation Outcomes for COVID-19 Patients**
*Advisor : Prof. Assad Oberai, USC*                                          *May 2020 - Dec 2020*

- Developed predictive modeling systems to determine ICU and mechanical ventilation outcomes for COVID-19 patients based on demographic, clinical, and blood draw data.
- Demonstrated that Random Forest Classifier performed best of algorithms tested (AUC=0.80).
- Showed that reducing data from 72 features to 5 features allowed for comparable accuracy (AUC=0.78) with reduced model complexity.
- Discovered that elevated levels of certain proteins like CRP and D-Dimer significantly influence ICU classification.

**NP-Hardness in Popular Online Puzzle Games**

*Mentor: Ph.D. Candidate Matthew Ferland, USC*        *Jan 2020 - Dec 2021*

- Designed 3-SAT reductions to in-game maps for the three popular puzzle games: **Baba Is You**, **Fez**, and **Catherine**.
- Emphasized in manuscript the potential educational value of the reductions in an undergraduate algorithms class.

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### TEACHING

Undergraduate Teaching Assistant,        *Fall 2020, Fall 2022*
Introduction to Algorithms and the Theory of Computing

- Held weekly office hours to help reinforce algorithmic concepts like Greedy, Divide and Conquer, and Dynamic Programming.
- Graded students' exams and homework and additionally monitored online Piazza forum.

### TALKS AND PRESENTATIONS

USC Computer Science Theory Group,        *Oct 2022*
Fine-Grained Buy-Many Mechanisms Are Not Much Better Than Bundling,
Slides

Sprouts Combinatorial Game Theory Undergraduate Conference,        *Apr 2022*
NP-Hardness of a 2D, a 2.5D, and a 3D Puzzle Game

### AWARDS & ACHIEVEMENTS

- The Honor Society of Phi Kappa Phi's 2021 Summer Research Scholarship ($1,000)
- Best Presentation at Viterbi Summer 2020 Research Showcase (Voted by Faculty)
- Viterbi Dean's List (2018-2022)
- Dornsife Dean's List (2020-2022)
- USC Academic Achievement Award (2020)

### COURSES & SKILLS

**Graduate Courses**: Advanced Analysis of Algorithms, Complexity Theory, Boolean Function Analysis, Convex and Combinatorial Optimization, Combinatorial Analysis
**Languages**: C, C++, Python, Java, LaTeX

### STUDENT ACTIVITIES

**Code the Change**
*USC Club*        *Aug 2019 - Dec 2022*

- Partnered with non-profits to develop pro-bono software for them.
- Developed app for career mentorship non-profit Gladeo to help connect high schoolers with young professionals (code).
- Worked with non-profit Humans Against Trafficking to use machine learning algorithms to read Instagram bios and determine predatory account behavior.

**Volunteer at The Coding School**
*Non-profit Organization*        *Aug 2019 - May 2020*

- Held free weekly online lessons with local L.A. middle schoolers to learn the basics of Python.
- Created lesson plans and sample projects for students to complete on weekly basis.

### INTERESTS & CLUBS

**Interests**: Russian Literature, Pocket Billiards, Art History
**Clubs**: Code the Change (Developer Position), Association of Computing Machinery