

# Vikram Kher

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[github.com/vikram-kher](https://github.com/vikram-kher)

SENIOR UNDERGRADUATE, COMPUTER SCIENCE & APPLIED MATH, USC VITERBI SCHOOL OF ENGINEERING

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**EDUCATION**      **University of Southern California**, Los Angeles, California  
*Bachelor of Science*, Computer Science, *Summa Cum Laude*, Aug 2018 - May 2022  
*Bachelor of Arts*, Applied and Computational Mathematics, Aug 2018 - Dec 2022 (Expected)  
**Overall GPA: 3.99**  
**Number of PhD/Graduate Courses Taken: 5**

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**RESEARCH INTERESTS**      Algorithm Design, Algorithmic Game Theory,  
Auction Theory, Computational Social Choice

**PUBLICATIONS**      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>

**MANUSCRIPTS**      Sepehr Assadi, **Vikram Kher**, George Li, Ariel Schwartzman. Fine-Grained Buy-Many Mechanisms Are Not Much Better Than Bundling. In preparation for submission to EC 2023. [arXiv:2205.14312](https://arxiv.org/abs/2205.14312)

Matthew Ferland, **Vikram Kher**. NP-Hardness of a 2D, a 2.5D, and a 3D Puzzle Game. (2022). [arXiv:2202.10529](https://arxiv.org/abs/2202.10529)

**Vikram Kher**, Kameron Shahabi, Derek Jones, Sina Shaham. Social Choice Distortion Analysis Using Optimization Techniques. (2022). [Class Project Report](#).

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**RESEARCH EXPERIENCE**      **Exploring Fine-Grained Buy-Many Mechanisms**  
*Advisor : Dr. Ariel Schwartzman, 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: PhD 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, Introduction to Algorithms and the Theory of Computing	<i>Fall 2020, Fall 2022</i>
	<ul style="list-style-type: none"> <li>- Held weekly office hours to help reinforce algorithmic concepts like Greedy, Divide and Conquer, and Dynamic Programming.</li> <li>- Graded students' exams and homework and additionally monitored online Piazza forum.</li> </ul>	

TALKS AND PRESENTATIONS	USC Computer Science Theory Group, Fine-Grained Buy-Many Mechanisms Are Not Much Better Than Bundling, <a href="#">Slides</a>	<i>Oct 2022</i>
	Sprouts Combinatorial Game Theory Undergraduate Conference, NP-Hardness of a 2D, a 2.5D, and a 3D Puzzle Game	<i>Apr 2022</i>

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AWARDS & ACHIEVEMENTS	<ul style="list-style-type: none"> <li>- Semi-finalist for USC's 2022 Valedictorian/Salutatorian(s)</li> <li>- The Honor Society of Phi Kappa Phi's 2021 Summer Research Scholarship (\$1,000)</li> <li>- Best Presentation at Viterbi Summer 2020 Research Showcase (Voted by Faculty)</li> <li>- Viterbi Dean's List (2018-2022)</li> <li>- Dornsife Dean's List (2020-2022)</li> <li>- USC Academic Achievement Award (2020)</li> </ul>
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COURSES & SKILLS	<b>Courses:</b> Advanced Analysis of Algorithms (PhD Level), Complexity Theory (Graduate Level), Boolean Function Analysis (PhD Level), Convex and Combinatorial Optimization (PhD Level), Combinatorial Analysis (Graduate level), Real Analysis I (In progress), Applied Combinatorics, Probability Theory, Numerical Methods (In progress), Calculus I-III, Linear Algebra <b>Languages:</b> C, C++, Python, Java, L <sup>A</sup> T <sub>E</sub> X
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STUDENT ACTIVITIES	<b>Code the Change</b> <i>USC Club</i>	<i>Aug 2019 - Present</i>
	<ul style="list-style-type: none"> <li>- Partnered with non-profits to develop pro-bono software for them.</li> <li>- Developed app for career mentorship non-profit Gladeo to help connect high schoolers with young professionals (<a href="#">code</a>).</li> <li>- Worked with non-profit Humans Against Trafficking to use machine learning algorithms to read Instagram bios and determine predatory account behavior.</li> </ul>	

### 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.

### **Intern at City Year Seattle**

*Non-profit Organization*

*July 2019 - Aug 2019*

- Organization focused on improving public school resources through the creation of after-school programming taught by Americorp members.
- Interned in fundraising department to help bring in donations to fund additional activities and services.

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### **INTERESTS & CLUBS**

**Interests:** Russian Literature, Pocket Billiards, Art History

**Clubs:** Code the Change (Developer Position), Association of Computing Machinery