

# Cyrus Cousins

Curriculum Vitae: 2024

## Personal Details

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**ORCID** 🆔 0000-0002-1691-0282    **DBLP** 📄 www.dblp.org/pid/202/6684.html

## Educational Pedigree

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<b>Doctorate of Philosophy</b> Ph.D. in Computer Science. Advised by Eli Upfal.	BROWN UNIVERSITY	2015–2021
<b>Master of Science</b> M.S. in Computer Science.	BROWN UNIVERSITY	2015–2017
<b>Baccalaureate</b> B.S. in Computer Science, Mathematics, and Biology.	TUFTS UNIVERSITY	2011–2015

## Research Interests

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### Fair Machine Learning and Fair Algorithmics

Critical study of welfare-based objectives in fair machine learning and allocation, including axiomatic analysis of fair objectives, algorithms, and statistical analysis. Problems are motivated by real-world concerns, solutions are introduced and rigorously analyzed, and theoretical models are criticized or broadened when inactionable.

### Statistical Learning Theory

Bounding the supremum deviation of function families, with applications to (fair) machine learning, sampling algorithms, and provable guarantees in data science. My work generally seeks to bound the estimation error of averages (e.g., risk) or nonlinear functions (e.g., welfare) of objectives or statistics in various settings.

### Statistical Data Science

Probabilistic approximation guarantees for various problems in data science and sampling, including frequent itemsets mining *et alia*, empirical game theoretic analysis, and generalized models of sampling, such as dependent sampling and estimation of statistics involving multiple populations or distributions.

## Selected Honors and Awards

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<b>CDS Postdoctoral Fellowship</b> Teaching and research postdoctoral fellowship, with host professor Yair Zick of the Manning College of Information and Computer Science at UMass Amherst, through the CDS Postdoctoral Fellowship Program.	<i>University of Massachusetts Amherst</i>	2022
<b>Outstanding Reviewer Award</b> Award given to the top 8% of reviewers, based on area chair and author feedback.	<i>Neural Information Processing Systems</i>	2021
<b>Dean's Faculty Fellowship</b> Teaching and research fellowship, with one year appointment as a visiting assistant professor.	<i>Brown University</i>	2021
<b>Joukowsky Outstanding Dissertation Prize</b> Doctoral dissertation, <i>Bounds and Applications of Concentration of Measure in Fair Machine Learning and Data Science</i> , won the 2021 Joukowsky prize in the physical sciences.	<i>Brown University</i>	2021

<b>Undergraduate Thesis, with Highest Honors</b>	<i>Tufts University</i>	2015
Highest honors for undergraduate thesis on anomaly detection in biological systems.		
<b>Dean's List</b>	<i>Tufts University</i>	2011–2015
Dean's list, all full-time undergraduate semesters.		
<b>COMAP Mathematical Contest in Modeling (Honorable Mention)</b>		2014
Paper, computer model, and simplified Poisson model of highway lane usage.		
<b>National Honor Society</b>		2011


## Academic Publications

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- *All authors are listed in contribution-order unless otherwise noted.*
  - *Asterisks denote equal contributions (order alphabetical, random, or otherwise arbitrary).*
- *Primary topics are specified in the margin.*






FA  ▪ *Fair Algorithmics*

DS  ▪ *Data Science*



ML  ▪ *Machine Learning*

AGT  ▪ *Algorithmic Game Theory*




### Selected Publications


- FA  1. **Cousins, Cyrus.** *An Axiomatic Theory of Provably-Fair Welfare-Centric Machine Learning* in *Advances in Neural Information Processing Systems* (2021). [www.cyruscousins.online/projects/fairness/#NeurIPS2021](http://www.cyruscousins.online/projects/fairness/#NeurIPS2021).
- FA  2. **Cousins, Cyrus,** Kumar, Indra Elizabeth, Venkatasubramanian, Suresh, *To Pool or Not To Pool: Analyzing the Regularizing Effects of Group-Fair Training on Shared Models* in *Artificial Intelligence and Statistics* (2024). [www.cyruscousins.online/projects/fairlocalization/](http://www.cyruscousins.online/projects/fairlocalization/).
- ML  3. Mazzetto\*, Alessio, **Cousins\*, Cyrus,** Sam, Dylan, Bach, Stephen H. Upfal, Eli, *Adversarial Multiclass Learning under Weak Supervision with Performance Guarantees* in *International Conference on Machine Learning* (2021). [www.cyruscousins.online/projects/adversarial/](http://www.cyruscousins.online/projects/adversarial/).
- ML  4. **Cousins, Cyrus,** Riondato, Matteo, *Sharp uniform convergence bounds through empirical centralization* in *Advances in Neural Information Processing Systems* (2020). [www.cyruscousins.online/projects/centralization/](http://www.cyruscousins.online/projects/centralization/).
- DS  5. **Cousins, Cyrus,** Wohlgemuth, Chloe, Riondato, Matteo, BAVarian: Betweenness Centrality Approximation with Variance-Aware Rademacher Averages. *ACM Transactions on Knowledge Discovery from Data* **17**, 1–47. ISSN: 1556-4681 (2023). [www.cyruscousins.online/projects/rademacherdata/](http://www.cyruscousins.online/projects/rademacherdata/).

### Other Journal Publications








- DS  1. Pellegrina, Leonardo, **Cousins, Cyrus,** Vandin, Fabio, Riondato, Matteo, MCRapper: Monte-Carlo Rademacher Averages for POSET Families and Approximate Pattern Mining. *ACM Transactions on Knowledge Discovery from Data* **16** (2022).
- ML  2. **Cousins, Cyrus,** Riondato, Matteo, CaDET: Interpretable parametric conditional density estimation with decision trees and forests. *Machine Learning* **108**, 1613–1634 (2019).

### Other Conference Publications

- ML  1. **Cousins\*, Cyrus,** Lobo\*, Elita, Petrik\*, Marek, Zick\*, Yair, *Percentile Criterion Optimization in Offline Reinforcement Learning* in *Advances in Neural Information Processing Systems* (2023).
- FA  2. **Cousins\*, Cyrus,** Viswanathan\*, Vignesh, Zick\*, Yair, *Dividing Good and Better Items Among Agents with Submodular Valuations* in *International Conference on Web and Internet Economics* (2023).
- FA  3. **Cousins\*, Cyrus,** Viswanathan\*, Vignesh, Zick\*, Yair, *The Good, the Bad and the Submodular: Fairly Allocating Mixed Manna Under Order-Neutral Submodular Preferences* in *International Conference on Web and Internet Economics* (2023).



- AGT  4. **Cousins\***, **Cyrus**, Payan\*, Justin, Zick\*, Yair, *Into the Unknown: Assigning Reviewers to Papers with Uncertain Affinities* in *Proceedings of the 16th International Symposium on Algorithmic Game Theory* (2023).
5. **Cousins, Cyrus**. *Revisiting Fair-PAC Learning and the Axioms of Cardinal Welfare in Artificial Intelligence and Statistics* (2023).
- AGT  6. **Cousins, Cyrus**, Mishra, Bhaskar, Viqueira, Enrique Areyan, Greenwald, Amy, *Learning Properties in Simulation-Based Games* in *Proceedings of the 22nd International Conference on Autonomous Agents and MultiAgent Systems* (2023).
- FA  7. **Cousins, Cyrus**. *Uncertainty and the Social Planner’s Problem: Why Sample Complexity Matters* in *Proceedings of the 2022 ACM Conference on Fairness, Accountability, and Transparency* (2022).
- ML  8. **Cousins\***, **Cyrus**, Haddadan\*, Shahrzad, Zhuang\*, Yue, Upfal, Eli, *Fast Doubly-Adaptive MCMC to Estimate the Gibbs Partition Function with Weak Mixing Time Bounds* in *Advances in Neural Information Processing Systems* (2021).
- DS  9. **Cousins, Cyrus**, Wohlgenuth, Chloe, Riondato, Matteo, *BAVarian: Betweenness Centrality Approximation with Variance-Aware Rademacher Averages* in *Proceedings of the 27th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining* (2021).
- DS  10. Pellegrina, Leonardo, **Cousins, Cyrus**, Vandin, Fabio, Riondato, Matteo, *MCRapper: Monte-Carlo Rademacher Averages for POSET Families and Approximate Pattern Mining* in *Proceedings of the 26th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining* (2020), 2165–2174.
- AGT  11. Viqueira, Enrique Areyan, **Cousins, Cyrus**, Greenwald, Amy, *Improved Algorithms for Learning Equilibria in Simulation-Based Games* in *Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems* (2020), 79–87.
- AGT  12. Viqueira, Enrique Areyan, **Cousins, Cyrus**, Mohammad, Yasser, Greenwald, Amy, *Empirical mechanism design: Designing mechanisms from data* in *Uncertainty in Artificial Intelligence* (2020), 1094–1104.
- AGT  13. Viqueira, Enrique Areyan, **Cousins, Cyrus**, Greenwald, Amy, *Learning Simulation-Based Games from Data* in *18th International Conference on Autonomous Agents and MultiAgent Systems* (2019).
- ML  14. **Cousins, Cyrus**, Upfal, Eli, *The  $k$ -Nearest Representatives Classifier: A Distance-Based Classifier with Strong Generalization Bounds* in *4th International Conference on Data Science and Advanced Analytics* (2017).

## Workshop Papers and Extended Abstracts

- FA  1. Navarrete\*, Paula, **Cousins\***, **Cyrus**, Zick\*, Yair, Viswanathan\*, Vignesh, *Efficient Yankee Swap for Fairly Allocating Courses to Students* in *Columbia Workshop on Fairness in Operations and AI* (2023).
- FA  2. **Cousins\***, **Cyrus**, Lobo\*, Elita, Payan\*, Justin, Zick\*, Yair, *Fair Resource Allocation under Uncertainty in Columbia Workshop on Fairness in Operations and AI* (2023).
- FA  3. **Cousins, Cyrus**. *Algorithms and Analysis for Optimizing Robust Objectives in Fair Machine Learning in Columbia Workshop on Fairness in Operations and AI* (2023).
- ML  4. **Cousins\***, **Cyrus**, Lobo\*, Elita, Petrik\*, Marek, Zick\*, Yair, *Percentile Criterion Optimization in Offline Reinforcement Learning* in *16th European Workshop on Reinforcement Learning* (2023).
- FA  5. Dong, Evan, **Cousins, Cyrus**, *Decentering Imputation: Fair Learning at the Margins of Demographics in Queer in AI Workshop @ ICML* (2022).
- FA  6. **Cousins, Cyrus**, Asadi, Kavosh, Littman, Michael L. *Fair  $E^3$ : Efficient Welfare-Centric Fair Reinforcement Learning* in *5th Multidisciplinary Conference on Reinforcement Learning and Decision Making* (2022).
- AGT  7. Viqueira, Enrique Areyan, **Cousins, Cyrus**, Greenwald, Amy, *Learning Competitive Equilibria in Noisy Combinatorial Markets* in *Proceedings of the 20th International Conference on Autonomous Agents and MultiAgent Systems* (2021).
- ML  8. Binnig\*, Carsten, Buratti\*, Benedetto, Chung\*, Yeounoh, **Cousins\***, **Cyrus**, Kraska\*, Tim, Shang\*, Zeyuan, Upfal\*, Eli, Zeleznik\*, Robert, Zraggen\*, Emanuel, *Towards interactive curation & automatic tuning of ML pipelines in Proceedings of the Second Workshop on Data Management for End-To-End Machine Learning* (2018).
- DS  9. Binnig, Carsten, Basık, Fuat, Buratti, Benedetto, Cetintemel, Ugur, Chung, Yeounoh, Crotty, Andrew, **Cousins, Cyrus**, Ebert, Dylan, Eichmann, Philipp, Galakatos, Alex, Hättasch, Benjamin, Ilkhechi, Amir, Kraska, Tim, Shang, Zeyuan, Tromba, Isabella, Usta, Arif, Utama, Prasetya, Upfal, Eli, Wang, Linnan, Weir, Nathaniel, Zeleznik, Robert, Zraggen, Emanuel, *Towards interactive data exploration in Real-Time Business Intelligence and Analytics* (2017), 177–190.

DS <sup>01000100</sup><sub>01110011</sub> 10. **Cousins, Cyrus**, Pietras, Christopher M, Slonim, Donna K, *Scalable FRaC Variants: Anomaly Detection for Precision Medicine in International Parallel and Distributed Processing Symposium Workshops* (2017).

## Notable Preprints and Working Papers

- AGT  1. Mishra, Bhaskar, **Cousins, Cyrus**, Greenwald, Amy, Regret Pruning for Learning Equilibria in Simulation-Based Games. *arXiv:2211.16670* (2022).
- AGT  2. **Cousins, Cyrus**, Mishra, Bhaskar, Viqueira, Enrique Areyan, Greenwald, Amy, Computational and Data Requirements for Learning Generic Properties of Simulation-Based Games. *arXiv:2208.06400* (2022).
- DS <sup>01000100</sup><sub>01110011</sub> 3. **Cousins, Cyrus**, Haddadan, Shahrzad, Upfal, Eli, Making mean-estimation more efficient using an MCMC trace variance approach: DynaMITE. *arXiv:2011.11129* (2020).
- DS <sup>01000100</sup><sub>01110011</sub> 4. Sanford, Clayton, **Cousins, Cyrus**, Upfal, Eli, Uniform Convergence Bounds for Codec Selection. *arXiv:1812.07568* (2018).

## Research Experience

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- Postdoctoral Fellow** *Host Professor Yair Zick (UMass Amherst)* 2022–2024  
Research in interpretability and fairness in machine learning, data science, and beyond.
- Visiting Assistant Professor** *Brown University Dept. of Computer Science* Fall–Spr. 2021–22  
Research in randomized algorithms, statistical data science, and theoretical machine learning.
- Postdoctoral Scholar** *Professor Eli Upfal (BIGDATA Group @ Brown University)* Summer 2021  
Continued research in machine learning and sampling algorithms, with theoretical guarantees.
- Research Assistant** *Professor Donna Slonim (BCB Group @ Tufts University)* 2014–2017  
Algorithms for anomaly detection in high-dimensional small-sample biological systems. This work led to the publication of *Scalable FRaC Variants: Anomaly Detection for Precision Medicine*

## Teaching Experience

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- Visiting Assistant Professor** *Brown University Dept. of Computer Science* Fall 2021  
Teaching CS1450: Advanced Introduction to Probability for Computing and Data Science.
- Graduate Teaching Assistant** *Eli Upfal @ Brown University* Spring 2020  
Assignments, grading, and lecturing for a graduate-level CS course in probabilistic methods.
- Graduate Teaching Assistant** *Eli Upfal @ Brown University* Fall 2018  
Recitations, course, and assignment design for an introductory probability course in computer science.
- Graduate Teaching Assistant** *Eli Upfal & Dan Potter @ Brown University* Spring 2018  
Lecturing, course, and assignment design in machine learning, statistical inference, and data science.
- Graduate Teaching Assistant** *Sorin Istrail @ Brown University* Fall 2016  
Office Hours, lecture notes, assignment creation, and grading for introductory computational biology.
- Undergraduate Teaching Assistant** *Greg Aloupis @ Tufts University* 2013–2015  
Grading and office hours for algorithms and computational geometry courses.
- Undergraduate Teaching Assistant** *Donna Slonim @ Tufts University* 2013–2015  
Lab administration, assignment creation, project development, and office hours for comp. bio. courses.

## Mentorship Experience

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- Master's Student Summer Research Project** *UMass Amherst* Summer 2023  
Supervision of master's student Chang Zeng on provably-efficient human fairness concept elicitation.
- Undergraduate and Master's Student Research Projects** *UMass Amherst* Spring 2023  
Mentorship and guided for-credit research projects with seven undergraduate and master's students.
- Doctoral Student Mentorship and Collaboration** *UMass Amherst* 2022–Present  
Collaboration and mentorship of several of Yair Zick's graduate students (as a postdoctoral scholar), including Justin Payan, Elita Lobo, and Vignesh Viswanathan, with publications *Into the Unknown: Assigning Reviewers to Papers with Uncertain Affinities*, *Percentile Criterion Optimization in Offline Reinforcement Learning*, *Dividing Good and Better Items Among Agents with Submodular Valuations*, and *The Good, the Bad and the Submodular: Fairly Allocating Mixed Manna under Order-Neutral Submodular Preferences*.
- Reading Group Discussion Leader** *UMass Amherst* 2022–2023  
Lead reading group discussions for the *Fair and Explainable Decision-Making* lab at UMass Amherst.
- Pregraduate Student Summer Research Project** *Brown University* Summer 2022  
Supervision of Brown graduate Evan Dong (now pursuing a Ph.D. at Cornell) on adversarial fair learning, leading to the publication of *Decentering Imputation: Fair Learning at the Margins of Demographics*.
- Undergraduate Student Summer Research Project** *Brown University* Summer 2022  
Cosupervision (with Amy Greenwald) of University of Florida undergraduate Bhaskar Mishra (now pursuing a Ph.D. at Berkeley) on empirical game theoretic analysis, leading to the publication of *Learning Properties in Simulation-Based Games* (and several working papers).
- Coorganizer and Discussion Leader** *Brown University* 2020–2022  
Coorganizer, speaker, and discussion leader in the open multidisciplinary *Data Science for Social Good* reading group.
- Undergraduate, Master's, and Pre-Graduate Students** *Brown University* 2017–2022  
Mentorship and guided research projects with undergraduate and master's students in computer science, economics, and applied mathematics. Notable projects include one undergraduate (Clayton Sanford) and one master's thesis (Siteng Kang), both mentees now pursuing Ph.Ds, and the publication *Fast Doubly-Adaptive MCMC to Estimate the Gibbs Partition Function* with Yue (Sophia) Zhuang, now an ML engineer at TikTok.
- Graduate Student Mentor** *Brown CS Ph.D. Mentorship Program* 2019–2020  
Mentorship of first-year Brown University doctoral students in computer science.

## Industry Experience

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- Research Intern** *Doctor Larry Rudolph (Two Sigma Labs)* Summer 2019  
Research in game-theoretic multi-agent neural reinforcement learning. This work could not be submitted for publication due to its value as private corporate IP.
- Research Intern** *Doctor Matteo Riondato (Two Sigma Labs)* Summer 2018  
Research in statistical significance and statistical modeling techniques, leading to the publication of *CaDET: Interpretable parametric conditional density estimation with decision trees and forests*. As part of my work, I discussed methods and applications with relevant experts in the company, learning how statistical methods are applied in real-world economics, finance, and actuarial analysis problems.
- Software Developer Intern** *Microsoft Corporation* Summer 2014  
Software for personally identifiable information filtration, summary statistic generation, visualization, and characterization of petabyte-scale cloud log streams with proprietary distributed computing technology.
- Test Engineer Intern** *Microsoft Corporation* Summer 2013

Development of client-server cloud-scale web service to schedule test-execution and virtual machine allocation.

### **Embedded Systems Test Engineer Intern**

*BBN Technologies*

Summer 2012

Design, creation, and maintenance of a regression test suite for distributed embedded sensor and signal-processing systems. Investigation, documentation, and extermination of various software and hardware bugs.

## **Academic Service**

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### **Academic Conference Program Committee Member**

AutoML 2018, UAI 2019.

### **Academic Conference Reviewer**

ICML 2019, NeurIPS 2019&2021, AISTats 2022.

### **Academic Conference Sub-Reviewer**

CIKM 2019, Latin 2020, TheWebConf 2021, SODA 2022.

### **Pre-Release Textbook Feedback and Review**

Previewed and provided feedback on early drafts of Norman Ramsey's *Programming Languages: Build, Prove, and Compare* (full text), and Eli Upfal's *Probability and Computing: Randomization and Probabilistic Techniques in Algorithms and Data Analysis*, second edition (Chapter 14).

## **Other Skills**

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### *Natural Languages*

**Native:** English **Proficient:** Spanish **Basic:** French, Hindi, Japanese.

### *Programming Languages*

**Fluent:** PYTHON, C, C++, C#, JAVA, HASKELL, METALANGUAGE (SML).  
**Familiar:** R, JULIA, MATLAB, GO, F#, RACKET (LISP), PROLOG, SQL, GLSL, PERL, OPENS CAD, JAVASCRIPT, ACTIONSCRIPT3, X86 ASM.

### *Miscellaneous Artistry*

Musical composition and performance, various forms of dance and pageantry, digital animation, technical 3D modeling and printing.