Christian Kroer | Curriculum Vitae

christian.kroer@columbia.edu • www.christiankroer.com
chrkroer • ChrKroer • US green card holder

Research interests

Fields: artificial intelligence, optimization, game theory.

Specific: equilibrium computation, market design, auctions, first-order methods, online learning, machine learning, robust optimization, prediction markets.

Education

Carnegie Mellon University — **Pittsburgh**
Ph.D. in computer science, PA, USA — *2012–2018*

IT University of Copenhagen — **Copenhagen**
M.Sc. IT - software development and technology, Denmark — *2009–2012*

Aalborg University — **Aalborg**
B.A. human-centered informatics, Denmark — *2006–2009*

Employment and Internships

Assistant Professor
Columbia University — *2019–*

Research Scientist (1 day per week)
Facebook, Core Data Science — *2019–2020*

Postdoc
Facebook, Core Data Science — *2018–2019*

Research Assistant
Carnegie Mellon University — *2012–2018*

Research Scientist (part-time position)
Facebook, Core Data Science — *2016–2018*

Research Intern
Facebook, Core Data Science — *Summer 2016*

Research Intern
Microsoft Research New York City — *Summer 2015*

Research Assistant (short-term contractor position)
Aalborg University — *2012*

Teaching Assistant
IT University of Copenhagen — *2011–2012*

Systems Developer
Netmester A/S *2010–2011*

Honors and Awards

Office of Naval Research Young Investigator Award, 2022

Facebook Fellowship in economics and computation, 2016 - 2018

Informs Computing Society Student Paper Competition, runner-up 2017

Publications

Journal papers in progress

[1] Yuan Gao and Christian Kroer. Infinite-dimensional fisher markets and tractable fair division. *Operations Research (minor revision)*, 2021.

[2] Santiago Balseiro, Christian Kroer, and Rachitesh Kumar. Contextual first-price auctions with budgets. *Management Science (reject and resubmit)*, 2022.

[3] Xi Chen, Christian Kroer, and Rachitesh Kumar. The complexity of pacing for second-price auctions. *Mathematics of Operations Research (under submission)*, 2021.

[4] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Better regularization for sequential decision spaces: Fast convergence rates for nash, correlated, and team equilibria. *Operations Research (major revision)*, 2021.

Published papers

[1] Andrea Celli, Riccardo Colini Baldeschi, Christian Kroer, and Eric Sodomka. The parity ray regularizer for pacing in auction markets. In *TheWebConf*, 2022.

[2] Vincent Conitzer, Christian Kroer, Debmalya Panigrahi, Okke Schrijvers, Eric Sodomka, Nicolas E Stier-Moses, and Chris Wilkens. Pacing equilibrium in first-price auction markets. *Management Science (to appear)*, 2022.

[3] Vincent Conitzer, Christian Kroer, Eric Sodomka, and Nicolas E. Stier-Moses. Multiplicative pacing equilibria in auction markets. *Operations Research*, 2022.

[4] Christian Kroer, Alexander Peysakhovich, Eric Sodomka, and Nicolas E Stier-Moses. Computing large market equilibria using abstractions. *Operations Research*, 2022.

[5] Yuan Gao, Alex Peysakhovich, and Christian Kroer. Online market equilibrium with application to fair division. In *NeurIPS*, 2021.

[6] Julien Grand-Clément and Christian Kroer. Conic blackwell algorithm: Parameter-free convex-concave saddle-point solving. In *NeurIPS*, 2021.

[7] Chung-Wei Lee, Christian Kroer, and Haipeng Luo. Last-iterate convergence in extensive-form games. In *NeurIPS*, 2021.

[8] Xi Chen, Christian Kroer, and Rachitesh Kumar. Throttling equilibria in auction markets. In *WINE*, 2021.

[9] Xi Chen, Christian Kroer, and Rachitesh Kumar. The complexity of pacing for second-price auctions. In *EC*, 2021.

[10] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Better regularization for sequential decision spaces: Fast convergence rates for nash, correlated, and team equilibria. In *EC*, 2021.

[11] Julien Grand-Clément and Christian Kroer. First-order methods for wasserstein distributionally robust mdp. In *ICML*, 2021.

[12] Steven Yin, Shatian Wang, Lingyi Zhang, and Christian Kroer. Dominant resource fairness with meta-types. In *IJCAI*, 2021.

[13] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Faster game solving via predictive Blackwell approachability: Connecting regret matching and mirror descent. In *AAAI*, 2021.

[14] Julien Grand-Clément and Christian Kroer. Scalable first-order methods for robust MDPs. In *AAAI*, 2021.

[15] Yuan Gao, Christian Kroer, and Donald Goldfarb. Increasing iterate averaging for solving saddle-point problems. In *AAAI*, 2021.

[16] Yuan Gao and Christian Kroer. Infinite-dimensional Fisher markets: Equilibrium, duality and optimization. In *AAAI*, 2021.

[17] Yuan Gao and Christian Kroer. First-order methods for large-scale market equilibrium computation. In *NeurIPS*, 2020.

[18] Tom Yan, Christian Kroer, and Alexander Peysakhovich. Evaluating and rewarding teamwork using cooperative game abstractions. In *NeurIPS*, 2020.

[19] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Stochastic regret minimization in extensive-form games. In *ICML*, 2020.

[20] Duncan Mcelfresh, Christian Kroer, Sergey Pupyrev, Karthik Sankararaman, Zack Chauvin, Neil Dexter, Eric Sodomka, and John Dickerson. Matching algorithms for blood donation. In *EC*, 2020.

[21] Riley Murray, Christian Kroer, Alex Peysakhovich, and Parikshit Shah. Robust market equilibria with uncertain preferences. In *AAAI (oral presentation)*, 2020. oral presentation.

[22] Christian Kroer and Tuomas Sandholm. Limited lookahead in imperfect-information games. *Artificial Intelligence Journal*, 2020.

[23] Christian Kroer, Kevin Waugh, Fatma Kılınç-Karzan, and Tuomas Sandholm. Faster algorithms for extensive-form game solving via improved smoothing functions. *Mathematical Programming Series A*, 2020.

[24] Alex Peysakhovich, Christian Kroer, and Adam Lerer. Robust multi-agent counterfactual prediction. In *NeurIPS*, 2019.

[25] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Optimistic regret minimization for extensive-form games via dilated distance-generating functions. In *NeurIPS*, 2019.

[26] Christian Kroer, Alexander Peysakhovich, Eric Sodomka, and Nicolas E Stier-Moses. Computing large market equilibria using abstractions. In *EC*, 2019.

[27] Vincent Conitzer, Christian Kroer, Debmalya Panigrahi, Okke Schrijvers, Eric Sodomka, Nicolas E Stier-Moses, and Chris Wilkens. Pacing equilibrium in first-price auction markets. In *EC*, 2019.

[28] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret circuits: Composability of regret minimizers. In *ICML (long oral)*, 2019.

[29] Gabriele Farina, Christian Kroer, Noam Brown, and Tuomas Sandholm. Stable-predictive optimistic counterfactual regret minimization. In *ICML*, 2019.

[30] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Online convex optimization for sequential decision processes and extensive-form games. In *AAAI*, 2019.

[31] Alberto Marchesi, Gabriele Farina, Christian Kroer, Nicola Gatti, and Tuomas Sandholm. Quasi-perfect stackelberg equilibrium. In *AAAI*, 2019.

[32] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Solving large sequential games with the excessive gap technique. In *NeurIPS (spotlight presentation)*, 2018.

[33] Christian Kroer and Tuomas Sandholm. A unified framework for extensive-form game abstraction with bounds. In *NeurIPS*, 2018.

[34] Vincent Conitzer, Christian Kroer, Eric Sodomka, and Nicolas E. Stier-Moses. Multiplicative pacing equilibria in auction markets. In *WINE*, 2018.

[35] Gabriele Farina, Alberto Marchesi, Christian Kroer, Nicola Gatti, and Tuomas Sandholm. Trembling-hand perfection in extensive-form games with commitment. In *IJCAI*, 2018.

[36] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Robust stackelberg equilibria in extensive-form games and extension to limited lookahead. In *AAAI*, 2018.

[37] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret minimization in behaviorally-constrained zero-sum games. In *ICML*, 2017.

[38] Christian Kroer, Kevin Waugh, Fatma Kılınç-Karzan, and Tuomas Sandholm. Theoretical and practical advances on smoothing for extensive-form games. In *EC*, 2017.

[39] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Smoothing method for approximate extensive-form perfect equilibrium. In *IJCAI*, 2017.

[40] Noam Brown, Christian Kroer, and Tuomas Sandholm. Dynamic thresholding and pruning for regret minimization. In *AAAI*, 2017.

[41] Christian Kroer and Tuomas Sandholm. Imperfect-recall abstractions with bounds in games. In *EC*, 2016.

[42] Christian Kroer, Miroslav Dudík, Sébastien Lahaie, and Sivaraman Balakrishnan. Arbitrage-free combinatorial market making via integer programming. In *EC*, 2016.

[43] Christian Kroer and Tuomas Sandholm. Sequential planning for steering immune system adaptation. In *IJCAI*, 2016.

[44] Christian Kroer, Kevin Waugh, Fatma Kılınç-Karzan, and Tuomas Sandholm. Faster first-order methods for extensive-form game solving. In *EC*, 2015.

[45] Christian Kroer and Tuomas Sandholm. Limited lookahead in imperfect-information games. In *IJCAI*, 2015.

[46] Christian Kroer and Tuomas Sandholm. Discretization of continuous action spaces in extensive-form games. In *AAMAS*, 2015.

[47] Christian Kroer and Tuomas Sandholm. Computational bundling for auctions. In *AAMAS*, 2015.

[48] Christian Kroer and Tuomas Sandholm. Extensive-form game abstraction with bounds. In *EC*, 2014.

[49] Bruce DeBruhl, Christian Kroer, Anupam Datta, Tuomas Sandholm, and Patrick Tague. Power napping with loud neighbors: optimal energy-constrained jamming and anti-jamming. In *WiSec*, 2014.

[50] Christian Kroer, Martin Kjær Svendsen, Rune M Jensen, Joseph Kiniry, and Eilif Leknes. Symbolic configuration for interactive container ship stowage planning. *Computational Intelligence*, 2014.

[51] Paolo Viappiani and Christian Kroer. Robust optimization of recommendation sets with the maximin utility criterion. In *ADT*, 2013.

[52] Kevin Tierney, Amanda Jane Coles, Andrew Coles, Christian Kroer, Adam M Britt, and Rune Møller Jensen. Automated planning for liner shipping fleet repositioning. In *ICAPS*, 2012.

[53] Christian Kroer and Yuri Malitsky. Feature filtering for instance-specific algorithm configuration. In *ICTAI*, 2011.

Workshop papers

[1] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Faster game solving via predictive blackwell approachability: Connecting regret matching and mirror descent. In *AAAI-21 Workshop on Reinforcement Learning in Games*, 2021.

[2] Gabriele Farina, Christian Kroer, Noam Brown, and Tuomas Sandholm. Stable-predictive optimistic counterfactual regret minimization. In *AAAI-20 Workshop on Reinforcement Learning in Games*, 2020.

[3] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Optimistic regret minimization for extensive-form games via dilated distance-generating functions. In *AAAI-20 Workshop on Reinforcement Learning in Games*, 2020.

[4] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Composability of regret minimizers. In *AAAI-20 Workshop on Reinforcement Learning in Games*, 2020.

[5] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Optimistic regret minimization for extensive-form games via dilated distance-generating functions. In *7th International Workshop on Strategic Reasoning (SR 2019) at IJCAI*, 2019.

[6] Alexander Peysakhovich and Christian Kroer. Fair division without disparate impact. In *3rd Workshop on Mechanism Design for Social Good at EC*, 2019.

[7] Duncan Mcelfresh, Christian Kroer, Sergey Pupyrev, Eric Sodomka, and John Dickerson. Matching algorithms for blood donation. In *3rd Workshop on Mechanism Design for Social Good at EC*, 2019.

[8] Duncan Mcelfresh, Christian Kroer, Sergey Pupyrev, Eric Sodomka, and John Dickerson. Matching algorithms for blood donation. In *AI for Social Good at IJCAI 2019*, 2019.

[9] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret circuits: Composability of regret minimizers. In *AAAI-19 Workshop on Reinforcement Learning in Games*, 2019.

[10] Alberto Marchesi, Gabriele Farina, Christian Kroer, Nicola Gatti, and Tuomas Sandholm. Quasi-perfect stackelberg equilibrium. In *AAAI-19 Workshop on Reinforcement Learning in Games*, 2019.

[11] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Online convex optimization for sequential decision processes and extensive-form games. In *AAAI-19 Workshop on Reinforcement Learning in Games*, 2019.

[12] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Solving large sequential games with the excessive gap technique. In *AAAI-19 Workshop on Reinforcement Learning in Games*, 2019.

[13] Christian Kroer and Tuomas Sandholm. A unified framework for extensive-form game abstraction with bounds. In *AI^3 workshop at IJCAI*, 2018.

[14] Christian Kroer, Nam Ho-Nguyen, George Lu, and Fatma Kılınç-Karzan. Performance evaluation of iterative methods for solving robust convex quadratic problems. In *Optimization for Machine Learning Workshop*, 2017.

[15] Vincent Conitzer, Christian Kroer, Eric Sodomka, and Nicolas E. Stier-Moses. Multiplicative pacing equilibria in auction markets. In *Workshop on Algorithmic Game Theory and Data Science at EC*, 2017.

[16] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret minimization in behaviorally-constrained zero-sum games. In *Algorithmic Game Theory Workshop at IJCAI*, 2017.

[17] Noam Brown, Christian Kroer, and Tuomas Sandholm. Dynamic thresholding and pruning for regret minimization. In *Algorithmic Game Theory Workshop at IJCAI*, 2016.

[18] Christian Kroer and Tuomas Sandholm. Imperfect-recall abstractions with bounds. In *Algorithmic Game Theory Workshop at IJCAI*, 2015.

[19] Christian Kroer and Tuomas Sandholm. Extensive-form game abstraction with bounds. In *Workshop on Computer Poker and Imperfect Information at AAAI*, 2015.

Invited talks

2022: Amazon Advertising Research Seminar 2022

2022: Invited Speaker, Mixed Integer Programming Workshop 2022

2021: UMD CS Theory Seminar

2022: Spotify Tech Research Seminar Series

2021: RPI Computer Science Colloquium

2021: University of Illinois Urbana Champagin ISE Seminar

2021: Aarhus University Invited Talk

2021: Plenary speaker, Workshop on Reinforcement Learning Theory @ ICML'21

2021: A Computational Lens on Auction Markets with Budgets. NYU Stern Operations Management Research Seminar

2019: Computing Large Market Equilibria using Abstractions. INFORMS Annual Conference

2019: Competitive Equilibrium without Disparate Impact. INFORMS Annual Conference

2019: AI and ML methods for Market Equilibrium. Machine Learning for Science and Engineering (MLSE)

2017: Multiplicative Pacing Equilibria in Auction Markets. INFORMS Annual Conference

2017: Multiplicative Pacing Equilibria in Auction Markets. Duke University CS-ECON Seminar

2016: Arbitrage-Free Combinatorial Market Making via Integer Programming. INFORMS Annual Conference.

2015: Faster First-Order Methods for Extensive-Form Game Solving. INFORMS Annual Conference.

2015: Faster First-Order Methods for Extensive-Form Game Solving. 22nd International Symposium on Mathematical Programming (ISMP).

2013: Computational Bundling for Auctions. INFORMS Annual Conference.

Teaching

IEOR E4530 AI, Games, and Markets — **Columbia University**
BS+MS class, Professor — *2022 Spring*

IEOR E4525 Machine Learning for OR & FE — **Columbia University**
BS+MS class, Professor — *2020 Fall, 2021 Spring+Fall, 2022 Spring*

IEOR E8100 Economics, AI, and Optimization — **Columbia University**
PhD class, Professor — *2020 Spring*

IEOR E4004 Optimization Models and Methods — **Columbia University**
MS class, Professor — *2019 Fall*

Electronic Negotiation — **Carnegie Mellon University**
MS class, Vertical mentor — *2017*

Electronic Negotiation — **Carnegie Mellon University**
MS class, Vertical mentor — *2016*

Graduate Artificial Intelligence — **Carnegie Mellon University**
PhD class, TA — *2016*

Electronic Negotiation — **Carnegie Mellon University**
MS class, Vertical mentor — *2015*

Artificial Intelligence — **Carnegie Mellon University**
BS class, TA, Nominated for TA award — *2015*

Electronic Negotiation — **Carnegie Mellon University**
MS class, Vertical mentor — *2014*

Intelligent Systems Programming — **IT University of Copenhagen**
MS class, TA — *2012*

Algorithm Design — **IT University of Copenhagen**
MS class, TA — *2011*

Ph.D. Advising

Darshan Chakrabarti — **IEOR, Columbia University**
2021-

Luofeng Liao — **IEOR, Columbia University**
2019-

Yuan Gao — **IEOR, Columbia University**
2019-2022

Rachitesh Kumar — **IEOR, Columbia University**
Co-advised with Santiago Balseiro — *2019-*

Awards Won by Students

Awards below were won by students that I advise for our joint research projects.
2021: Yuan Gao, Cheung-Kong Innovation Doctoral Fellowship. One year of full support.

Service

Thesis committee/review:
- IEOR at Columbia University: Jalaj Bhandari, Yunhao Tang, Yi Ren, Sai Mali Ananth
- Andrea Celli, Information Technology at Politecnico di Milano, 2019,

Area Chair: NeurIPS ('21)

Senior Program Committee: AAAI ('20, '21, '22), AAAI Social Impact Track ('20)

Program Committee: AAAI ('19), DAI ('19), EC ('19, '20, '21, '22), IJCAI ('16, '18, '19), NeurIPS ('20), WEB ('20), Computer Poker Workshop at AAAI ('17)

Reviewing: AAAI ('17), ACM Transactions on Economics and Computation ('13, '14, '16, '18), AISTATS ('17), Artificial Intelligence ('18, '19), EC ('17), Games and Economic Behavior ('21), ICML ('16), IJCAI ('16, '18), Imperfect-Information Games Workshop ('18), Information Systems Research ('21), IPCO (2020), Management Science ('20, '21), Operations Research ('18, '19, '20, '21), JAAMAS ('15, '16), TARK ('17), Transactions on Computational Intelligence and AI in Games ('14, '15), WINE ('15, '19, '21)

Session Chair: EC ('21) INFORMS ('17, '21)

Societies: INFORMS, AAAI, ACM

2020 - : Columbia IEOR Ph.D. admissions committee member

2017 - **2018**: Member of the CMU CSD Speakers Club

2014 - **2016**: CMU CS Ph.D. admissions committee member

2013: CMU CSD Immigration Course coordinator

External Funding

2022-2025: Fast Iterative Methods for Large-Scale Game-Theoretic Problems and Beyond. Office of Naval Research Young Investigator Award. Sole PI. $510,000

2022-2025: FAI: AI Algorithms for Fair Auctions, Pricing, and Marketing. NSF and Amazon. Co-PI. $628,000 (my share: $125,600)

Programming

Strong experience: Java, Python, C++, C#

Medium experience: R, SQL, C, HTML, CSS

Familiar with: Matlab, Scala, XSLT, Ruby, Javascript

Frameworks

Statistics/ML: pandas, scikit-learn, tidyverse.

Version control: Git, SVN, Mercurial.

Optimization: CPLEX, Gurobi, NumPy, CVXPY.

Web: ASP.NET, React, Bootstrap, Flask.