

# Christian Kroer | Curriculum Vitae

📞 +1 (412) 667 0870 • ✉ christian.kroer@columbia.edu  
🌐 www.christiankroer.com • in chrkroer • 🌐 ChrKroer  
US green card holder

## Research interests

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**Fields:** artificial intelligence, optimization, game theory.

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

## Education

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<b>Carnegie Mellon University</b> <i>Ph.D. in computer science, PA, USA</i>	<b>Pittsburgh</b> 2012–2018
<b>IT University of Copenhagen</b> <i>M.Sc. IT - software development and technology, Denmark</i>	<b>Copenhagen</b> 2009–2012
<b>Aalborg University</b> <i>B.A. human-centered informatics, Denmark</i>	<b>Aalborg</b> 2006–2009

## Employment and Internships

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<b>Assistant Professor</b> <i>Columbia University</i>	2019–
<b>Postdoc</b> <i>Facebook, Core Data Science</i>	2018–2019
<b>Research Assistant</b> <i>Carnegie Mellon University</i>	2012–2018
<b>Research Scientist (part-time position)</b> <i>Facebook, Core Data Science</i>	2016–2018
<b>Research Intern</b> <i>Facebook, Core Data Science</i>	Summer 2016
<b>Research Intern</b> <i>Microsoft Research New York City</i>	Summer 2015
<b>Research Assistant (short-term contractor position)</b> <i>Aalborg University</i>	2012
<b>Teaching Assistant</b> <i>IT University of Copenhagen</i>	2011–2012
<b>Systems Developer</b> <i>Netmester A/S</i>	2010–2011

## Honors and Awards

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**2016 - 2018:** Facebook Fellowship in economics and computation. One given worldwide per year. Full tuition, fees, stipend, and travel grant for two years, \$183,168.

**2017:** Runner-up in the Informs Computing Society Student Paper Competition

## Publications

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Published papers.....

- [1] Riley Murray, Christian Kroer, Alex Peysakhovich, and Parikshit Shah. Robust market equilibria with uncertain preferences. In *AAAI (oral presentation)*, 2020.
- [2] Christian Kroer and Tuomas Sandholm. Limited lookahead in imperfect-information games. *Artificial Intelligence Journal*, 2020.
- [3] Alex Peysakhovich, Christian Kroer, and Adam Lerer. Robust multi-agent counterfactual prediction. In *NeurIPS*, 2019.
- [4] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Optimistic regret minimization for extensive-form games via dilated distance-generating functions. In *NeurIPS*, 2019.
- [5] Christian Kroer, Alexander Peysakhovich, Eric Sodomka, and Nicolas E Stier-Moses. Computing large market equilibria using abstractions. In *EC*, 2019.
- [6] 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.
- [7] Gabriele Farina, Christian Kroer, Noam Brown, and Tuomas Sandholm. Regret circuits: Composability of regret minimizers. In *ICML*, 2019.
- [8] Gabriele Farina, Christian Kroer, Noam Brown, and Tuomas Sandholm. Stable-predictive optimistic counterfactual regret minimization. In *ICML*, 2019.
- [9] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Online convex optimization for sequential decision processes and extensive-form games. In *AAAI*, 2019.
- [10] Alberto Marchesi, Gabriele Farina, Christian Kroer, Nicola Gatti, and Tuomas Sandholm. Quasi-perfect stackelberg equilibrium. In *AAAI*, 2019.
- [11] 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*, accepted 2018.
- [12] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Solving large sequential games with the excessive gap technique. In *NeurIPS (spotlight presentation)*, 2018.
- [13] Christian Kroer and Tuomas Sandholm. A unified framework for extensive-form game abstraction with bounds. In *NeurIPS*, 2018.
- [14] Vincent Conitzer, Christian Kroer, Eric Sodomka, and Nicolas E. Stier-Moses. Multiplicative pacing equilibria in auction markets. In *WINE*, 2018.

- [15] Gabriele Farina, Alberto Marchesi, Christian Kroer, Nicola Gatti, and Tuomas Sandholm. Trembling-hand perfection in extensive-form games with commitment. In *IJCAI*, 2018.
- [16] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Robust stackelberg equilibria in extensive-form games and extension to limited lookahead. In *AAAI*, 2018.
- [17] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret minimization in behaviorally-constrained zero-sum games. In *ICML*, 2017.
- [18] Christian Kroer, Kevin Waugh, Fatma Kılınç-Karzan, and Tuomas Sandholm. Theoretical and practical advances on smoothing for extensive-form games. In *EC*, 2017.
- [19] Christian Kroer, Gabriele Farina, and Tuomas Sandholm. Smoothing method for approximate extensive-form perfect equilibrium. In *IJCAI*, 2017.
- [20] Noam Brown, Christian Kroer, and Tuomas Sandholm. Dynamic thresholding and pruning for regret minimization. In *AAAI*, 2017.
- [21] Christian Kroer and Tuomas Sandholm. Imperfect-recall abstractions with bounds in games. In *EC*, 2016.
- [22] Christian Kroer, Miroslav Dudík, Sébastien Lahaie, and Sivaraman Balakrishnan. Arbitrage-free combinatorial market making via integer programming. In *EC*, 2016.
- [23] Christian Kroer and Tuomas Sandholm. Sequential planning for steering immune system adaptation. In *IJCAI*, 2016.
- [24] Christian Kroer, Kevin Waugh, Fatma Kılınç-Karzan, and Tuomas Sandholm. Faster first-order methods for extensive-form game solving. In *EC*, 2015.
- [25] Christian Kroer and Tuomas Sandholm. Limited lookahead in imperfect-information games. In *IJCAI*, 2015.
- [26] Christian Kroer and Tuomas Sandholm. Discretization of continuous action spaces in extensive-form games. In *AAMAS*, 2015.
- [27] Christian Kroer and Tuomas Sandholm. Computational bundling for auctions. In *AAMAS*, 2015.
- [28] Christian Kroer and Tuomas Sandholm. Extensive-form game abstraction with bounds. In *EC*, 2014.
- [29] 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.
- [30] Christian Kroer, Martin Kjær Svendsen, Rune M Jensen, Joseph Kiniry, and Eilif Leknes. Symbolic configuration for interactive container ship stowage planning. *Computational Intelligence*, 2014.
- [31] Paolo Viappiani and Christian Kroer. Robust optimization of recommendation sets with the maximin utility criterion. In *ADT*, 2013.

- [32] 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.
- [33] Christian Kroer and Yuri Malitsky. Feature filtering for instance-specific algorithm configuration. In *ICTAI*, 2011.

Workshop papers.....

- [1] 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.
- [2] 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.
- [3] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Composability of regret minimizers. In *AAAI-20 Workshop on Reinforcement Learning in Games*, 2020.
- [4] 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.
- [5] Alexander Peysakhovich and Christian Kroer. Fair division without disparate impact. In *3rd Workshop on Mechanism Design for Social Good at EC*, 2019.
- [6] 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.
- [7] 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.
- [8] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret circuits: Composability of regret minimizers. In *AAAI-19 Workshop on Reinforcement Learning in Games*, 2019.
- [9] 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.
- [10] 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.
- [11] 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.
- [12] Christian Kroer and Tuomas Sandholm. A unified framework for extensive-form game abstraction with bounds. In *AI<sup>3</sup> workshop at IJCAI*, 2018.
- [13] Christian Kroer, Nam Ho-Nguyen, George Lu, and Fatma Kılınc-Karzan. Performance evaluation of iterative methods for solving robust convex quadratic problems. In *Optimization for Machine Learning Workshop*, 2017.

- [14] 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.
- [15] Gabriele Farina, Christian Kroer, and Tuomas Sandholm. Regret minimization in behaviorally-constrained zero-sum games. In *Algorithmic Game Theory Workshop at IJCAI*, 2017.
- [16] Noam Brown, Christian Kroer, and Tuomas Sandholm. Dynamic thresholding and pruning for regret minimization. In *Algorithmic Game Theory Workshop at IJCAI*, 2016.
- [17] Christian Kroer and Tuomas Sandholm. Imperfect-recall abstractions with bounds. In *Algorithmic Game Theory Workshop at IJCAI*, 2015.
- [18] Christian Kroer and Tuomas Sandholm. Extensive-form game abstraction with bounds. In *Workshop on Computer Poker and Imperfect Information at AAAI*, 2015.

## Invited talks

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- 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.

## Other talks

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- 2016:** First-Order Methods for Extensive-Form Game Solving. CMU AI Seminar.
- 2016:** Faster First-Order Methods for Extensive-Form Game Solving. INFORMS Annual Conference.
- 2016:** Arbitrage-Free Combinatorial Market Making via Integer Programming. Facebook Operations, Economics and Computation group.
- 2016:** Abstraction and convex optimization in sequential game solving. CMU graduate AI class.
- 2015:** Discretization of Continuous Action Spaces in Extensive-Form Games. INFORMS Annual Conference.
- 2014:** Sequential game solving overview. CMU undergrad AI class.
- 2014:** Extensive-Form Game Abstraction with Bounds. CMU theory lunch.
- 2014:** Extensive-Form Game Abstraction with Bounds. CMU open house.

## Teaching

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<b>IEOR E8100 Optimization, AI, and Economics</b> <i>PhD class, Professor</i>	<b>Columbia University</b> <i>2020 Spring</i>
<b>IEOR E4004 Optimization Models and Methods</b> <i>MS class, Professor</i>	<b>Columbia University</b> <i>2019 Fall</i>
<b>Electronic Negotiation</b> <i>MS class, Vertical mentor</i>	<b>Carnegie Mellon University</b> <i>2017</i>
<b>Electronic Negotiation</b> <i>MS class, Vertical mentor</i>	<b>Carnegie Mellon University</b> <i>2016</i>
<b>Graduate Artificial Intelligence</b> <i>PhD class, TA</i>	<b>Carnegie Mellon University</b> <i>2016</i>
<b>Electronic Negotiation</b> <i>MS class, Vertical mentor</i>	<b>Carnegie Mellon University</b> <i>2015</i>
<b>Artificial Intelligence</b> <i>BS class, TA, Nominated for TA award</i>	<b>Carnegie Mellon University</b> <i>2015</i>
<b>Electronic Negotiation</b> <i>MS class, Vertical mentor</i>	<b>Carnegie Mellon University</b> <i>2014</i>
<b>Intelligent Systems Programming</b> <i>MS class, TA</i>	<b>IT University of Copenhagen</b> <i>2012</i>
<b>Algorithm Design</b> <i>MS class, TA</i>	<b>IT University of Copenhagen</b> <i>2011</i>

## Service

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**Thesis committee/review:** Andrea Celli, Information Technology at Politecnico di Milano, 2019,

**Senior Program Committee:** AAAI 2020 Main Track, AAAI 2020 Social Impact Track

**Program Committee:** AAAI 2019, DAI 2019, EC 2019, 2020, IJCAI 2016, 2018, 2019, WEB 2020, Computer Poker Workshop at AAAI 2017

**Reviewing:** AAAI 2017, ACM Transactions on Economics and Computation, 2013, 2014, 2016, 2018, AISTATS 2017, Artificial Intelligence 2018, EC 2017, ICML 2016, IJCAI 2016, 2018, Imperfect-Information Games Workshop 2018, Operations Research 2018, JAAMAS 2015, 2016, TARK 2017, Transactions on Computational Intelligence and AI in Games 2014, 2015, WINE 2015, 2019

**Societies:** INFORMS, AAAI, ACM

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

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

**2013:** CMU CSD Immigration Course coordinator

## Programming

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

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

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

## Frameworks

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

**Version control:** Git, SVN, Mercurial.

**Optimization:** CPLEX, Gurobi, NumPy, CVXPY.

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