# Murat Kocaoglu

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## Current Position

**Assistant Professor** — Jan. 1, 2021 – present

School of Electrical and Computer Engineering
Purdue University
*I conduct research on causal machine learning, causal structure discovery, deep generative models and information theory.*

## Teaching Experience

**Instructor** — Fall 2023

ECE695-230: Probabilistic Causal Inference
School of Electrical and Computer Engineering, Purdue University
*Causal graphs, inference and discovery methods. Enrollment: 10 students.*

**Instructor** — Spring 2023

ECE20875: Python for Data Science
School of Electrical and Computer Engineering, Purdue University
*Basics of data science and statistics, and Python. Enrollment: 90 students.*

**Instructor** — Fall 2022

ECE642: Information Theory and Source Coding
School of Electrical and Computer Engineering, Purdue University
*Encoding/decoding and transmission of information. Entropy, channel capacity, and source compression algorithms. Enrollment: 15.*

**Instructor** — Spring 2022

ECE20875: Python for Data Science
School of Electrical and Computer Engineering, Purdue University
*Basics of data science and statistics, and Python. Enrollment: 132 students.*

**Instructor** — Fall 2021

ECE695-230: Probabilistic Causal Inference
School of Electrical and Computer Engineering, Purdue University
*Causal graphs, inference and discovery methods. Enrollment: 15 students.*

**Co-Instructor** — Spring 2021

ECE302: Probabilistic Methods in Electrical and Computer Eng.
School of Electrical and Computer Engineering, Purdue University
*Co-taught with Prof. Saul Gelfand. Enrollment: 261 students.*

## Education

**The University of Texas at Austin**, — Sept. 2013 – Aug. 2018
PhD, Electrical and Computer Engineering.
Thesis: Causality: From Learning to Generative Models
Co-advisor: *Prof. Alexandros Dimakis*
Co-advisor: *Prof. Sriram Vishwanath*

**Koc University**, Istanbul, Turkey — Sept. 2010 – Aug. 2012
Master of Science, Electrical Engineering.
Thesis: Minimum Energy Channel and Network Coding with Applications in Nanoscale Communications
Advisor: *Prof. Ozgur B. Akan*

**Middle East Technical University**, Ankara, Turkey — Sept. 2006 – Jun. 2010
Major: Bachelor of Science, Electrical and Electronics Engineering.
Graduated with High-honors
Minor: Physics

## Prev. Positions

**Research Staff Member**, MIT-IBM Watson AI Lab, — Sept. 2018 – Dec. 2020
IBM Research MA, USA
*I conducted research on causal inference and discovery, learning theory, deep generative models and information theory.*

**Research Assistant**, Wireless Networking and Communications Group, — Sept. 2013 – Aug. 2018
The University of Texas at Austin, Austin. USA.
*I conducted research on causal discovery from observational data using information-theoretic methods, as well as causal discovery using interventions. I also worked on learning theory and online algorithms.*

**Research Assistant**, Next-generation and Wireless Communications, — Sept. 2010 – Aug. 2013
Laboratory, Koc University, Istanbul, Turkey.
*I conducted research on energy-efficient channel and network coding, nanoscale communications, wireless networks, and green communications.*

## Current Research Interests

- Fundamentals of Causal Inference and Discovery
- Causal Machine Learning
- Deep Generative Models
- Information Theory

## Grants

Adobe Research — Sept. 2023 - Aug. 2024
*Root cause detection in cloud services.*
*Amount: 25k$*

NSF CAREER — Jan. 2023
*Optimism in Causal Reasoning via Information-theoretic Methods*
*Amount: 599,893.96$*

Adobe Data Science Research Award — Mar. 2022
*Causal Discovery for Root Cause Analysis*
*Amount: 50k$*

Elmore Family Blue Ocean Initiative — April 2022 - April 2023
Co-PIs: Murat Kocaoglu, Mahsa Ghassemi
*Causality Driven Safe AI Systems.*
*Amount: 50k$*

Adobe Research — Sept. 2021 - Aug. 2022
Co-PIs: Saurabh Bagchi, Murat Kocaoglu
*Applying causal discovery methods for root-cause detection in cloud services.*
*Total Amount: 40k$, Co-PI Share: 10k$*

## Post-Doc Researchers

Lai Wei — Fall 2022 - Summer 2023

## PhD Students

| | |
|---|---|
| Md. Musfiqur Rahman | Fall 2021 - current |
| Kenneth Lee | Fall 2021 - current |
| Ziwei Jiang | Fall 2022 - current |
| Shanyun Gao | Fall 2022 - current |

| | | |
|---|---|---|
| | Qasim Elahi | Fall 2022 - current |
| | Zihan Zhou | Fall 2023 - current |
| Visiting Researchers | Suyeong Park | July - August 2021 |

Publications
*Machine Learning, AI*

1. M. Kocaoglu, "Characterization and Learning of Causal Graphs with Small Conditioning Sets", in **Proc. of NeurIPS'23**, New Orleans, LA, USA, 2023.
2. S. Gao, R. Addanki, T. Yu, R. A. Rossi, M. Kocaoglu, "Causal Discovery in Semi-Stationary Time Series," in **Proc. of NeurIPS'23**, New Orleans, LA, USA, 2023.
3. L. Wei, M. Q. Elahi, M. Ghasemi, M. Kocaoglu, "Approximate Allocation Matching for Structural Causal Bandits with Unobserved Confounders," in **Proc. of NeurIPS'23**, New Orleans, LA, USA, 2023.
4. A. Shah, K. Shanmugam, M. Kocaoglu, "Front-door Adjustment Beyond Markov Equivalence with Limited Graph Knowledge", in **Proc. of NeurIPS'23**, New Orleans, LA, USA, 2023.
5. K, Lee, M. Rahman, M. Kocaoglu, "Finding Invariant Predictors Efficiently via Causal Structure", in **Proc. of UAI'23**, Pittsburgh, Mar. 2023.
6. Z. Jiang, L. Wei, M. Kocaoglu, "Approximate Causal Effect Identification under Weak Confounding", in **Proc. of ICML'23**, Feb. 2023.
7. S. Compton, D. Katz, B. Qi, K. Greenewald, M. Kocaoglu, "Minimum-Entropy Coupling Approximation Guarantees Beyond the Majorization Barrier," in **Proc. of AISTATS'23**, Valencia, Spain, Apr. 2023.
8. M. A. Ikram, S. Chakraborty, S. Mitra, S. Saini, S. Bagchi, M. Kocaoglu, "Root Cause Analysis of Failures in Microservices through Causal Discovery," in **Proc. of NeurIPS'22**, Dec. 2022.
9. S. Compton, K. Greenewald, D. Katz, M. Kocaoglu, "Entropic Causal Inference: Graph Identifiability", in **Proc. of ICML'22**, Baltimore, USA, July 2022.
10. S. Compton, M. Kocaoglu, K. Greenewald, D. Katz, "Entropic Causal Inference: Identifiability for Trees and Complete Graphs", in **ITR3 Workshop at ICML-21**, Online, July 2021.
11. K. Ahuja, P. Sattigeri, K. Shanmugam, D. Wei, K. N. Ramamurthy, M. Kocaoglu, "Conditionally Independent Data Generation", in **Proc. of UAI'21**, Online, July 2021.
12. M. Kocaoglu, S. Shakkottai, A. G. Dimakis, C. Caramanis, S. Vishwanath, "Applications of Common Entropy for Causal Inference," in **Proc. of NeurIPS'20**, Online, Dec. 2020.
13. S. Compton, M. Kocaoglu, K. Greenewald, D. Katz, "Entropic Causality: Identifiability and Finite Sample Results," in **Proc. of NeurIPS'20**, Online, Dec. 2020.
14. A. Jaber, M. Kocaoglu, K. Shanmugam, E. Bareinboim, "Causal Discovery from Soft Interventions with Unknown Targets: Characterization and Learning," in **Proc. of NeurIPS'20**, Online, Dec. 2020.
15. C. Squires, S. Magliacane, K. Greenewald, D. Katz, M. Kocaoglu, K. Shanmugam, "Active Structure Learning of Causal DAGs via Directed Clique Trees," in **Proc. of NeurIPS'20**, Online, Dec. 2020.
16. M. Kocaoglu*, A. Jaber*, K. Shanmugam*, E. Bareinboim, "Characterization and Learning of Causal Graphs with Latent Variables from Soft Interventions," in **Proc. of NeurIPS'19**, Vancouver, Canada, Dec. 2019.
17. K. Greenewald, D. Katz, K. Shanmugam, S. Magliacane, M. Kocaoglu, E. B. Adsera, G. Bresler, "Sample Efficient Active Learning of Causal Trees," in **Proc. of NeurIPS'19**, Vancouver, Canada, Dec. 2019.
18. E. Lindgren, M. Kocaoglu, A. G. Dimakis, S. Vishwanath, "Minimum Cost Intervention Design and Connections to Submodularity," in **Proc. of NeurIPS'18**, Montreal, Canada, Dec. 2018.
19. M. Kocaoglu*, C. Snyder*, A. G. Dimakis, S.Vishwanath, "CausalGAN: Learning Causal Implicit Generative Models with Adversarial Training," in **Proc. of ICLR'18**, Vancouver, May 2018.

20. E. Lindgren, M. Kocaoglu, A. G. Dimakis, S. Vishwanath, "Submodularity and Minimum Cost Intervention Design for Learning Causal Graphs," in **DISCML'17 Workshop, NIPS'17**, Dec. 2017.
21. M. Kocaoglu*, K. Shanmugam*, E. Bareinboim, "Experimental Design for Learning Causal Graphs with Latent Variables," in **Proc. of NIPS'17**, Dec. 2017.
22. M. Kocaoglu, A. G. Dimakis, S. Vishwanath, "Cost-Optimal Learning of Causal Graphs," in **Proc. of ICML'17**, 2017.
23. M. Kocaoglu, A. G. Dimakis, S. Vishwanath, B. Hassibi, "Entropic Causality and Greedy Minimum Entropy Coupling," in **Proc. of ISIT'17**, 2017.
24. R. Sen, K. Shanmugam, M. Kocaoglu, A. G. Dimakis, S. Shakkottai, "Contextual Bandits with Latent Confounders: An NMF Approach," in **Proc. of AISTATS'17**, Fort Lauderdale, USA, Apr. 2017.
25. M. Kocaoglu, A. G. Dimakis, S. Vishwanath, B. Hassibi, "Entropic Causal Inference," in **Proc. of AAAI'17**, San Francisco, USA, Feb. 2017.
26. M. Kocaoglu, A. G. Dimakis, S. Vishwanath, "Learning Causal Graphs with Constraints," in **NIPS'16 Workshop**: What If? Inference and Learning of Hypothetical and Counterfactual Interventions in Complex Systems, Barcelona, Spain, Dec. 2016.
27. K. Shanmugam*, M. Kocaoglu*, A. G. Dimakis, S. Vishwanath, "Learning Causal Graphs with Small Interventions," in **Proc. of NIPS'15**, Montreal, Canada, Dec. 2015.
28. M. Kocaoglu*, K. Shanmugam*, A. G. Dimakis, A. Klivans, "Sparse Polynomial Learning and Graph Sketching," in **Proc. of NIPS'14 (Oral)**, Montreal, Canada, Dec. 2014.

## Publications

*Communications, Coding Theory*

1. M. Kocaoglu, O. B. Akan, "Energy Minimization with Network Coding," **IEEE Systems Journal**, Special Issue on Green Comm., Comp. and Sys., vol. 11, no. 2, pp. 696-705, June 2017.
2. M. Kocaoglu, B. Gulbahar, O. B. Akan, "Stochastic Resonance in Graphene Bi-layer Optical Nanoreceivers," **IEEE Transactions on Nanotechnology**, vol. 13, no. 6, pp. 1107-1117, Nov. 2014.
3. D. Malak, M. Kocaoglu, O. B. Akan, "Communication Theoretic Analysis of Synaptic Channel for Cortical Neurons," **Nano Communication Networks Journal**, vol. 4, no. 3, pp. 131-141, Sept. 2013.
4. M. Kocaoglu, C. Oksuz, O. B. Akan, "Effect of Channel Conditions on Inventory Database Update in Supply Chains." in **Proc. IEEE BlackSeaCom'13**, May 2013.
5. M. Kocaoglu, O. B. Akan, "Minimum Energy Channel Codes for Nanoscale Wireless Communications," **IEEE Transactions on Wireless Communications**, vol. 12, no. 4, pp. 1492-1500, April 2013.
6. M. Kocaoglu, D. Malak, O.B. Akan, "Fundamentals of Green Communications and Computing: Modeling and Simulation," **IEEE Computer**, vol. 45, no. 9, pp. 40-46, Sept. 2012.
7. M. Kocaoglu, D. Malak, "On the Node Density Limits and Rate-Delay-Energy Tradeoffs in Ad Hoc Nanonetworks with Minimum Energy Coding," in **Proc. IEEE MoNaCom 2012 (in IEEE ICC 2012)**, Ottawa, Canada, Jun. 2012.
8. M. Kocaoglu, O. B. Akan, "Minimum Energy Coding for Wireless NanoSensor Networks," in **Proc. IEEE INFOCOM'12** Mini Conference, Orlando, FL, 2012.

## Invited Talks & Activities

*Invited Talk on "Causal Discovery via Common Entropy" at the Causal Inference & Quantum Foundations Workshop, Perimeter Institute, Waterloo, ON, Canada, Apr. 2023.*

*Invited Talk on "Entropic Causal Inference and Approximate Minimum Entropy Coupling", Information Theory Applications Workshop (ITA), San Diego, CA, Feb. 2023.*

*TILOS Seminar Series Invited Talk on "Causal Discovery for Root-cause Analysis," [Online], Jan. 2023.*

*Guest Editor for the Special Issue on "Information-theoretic Methods for Causal Inference and Discovery", Entropy, MDPI, 2023.*

*ICON Weekly Seminar on "Causal Discovery for Root-cause Analysis", Purdue University, October 2022.*

*Pacific Northwest National Laboratory (PNNL) Research Seminar on "Causal Discovery for Root-cause Analysis", July 2022.*

*Purdue ML Reading Group Talk on "Cost-Optimal Experimental Design for Causal Discovery", April 2022.*

*Invited Participant at Simons Institute Causality Workshop*, UC Berkeley, February 2022.

*General chair for The AAAI-22 Workshop on Information-Theoretic Methods for Causal Inference and Discovery (ITCI'22)*, Vancouver, Canada, February 2022.

*Session Chair for ICERM Workshop on Advances in Theory and Algorithms for Deep Reinforcement Learning*, [Online], Aug. 2, 2021.

*Discussant in Causality Session at UAI'21* [Online], July 27, 2021.

*Mentorship Circles at ICLR'21* [Online], March 3, 2021.

*Purdue ECE Talk: Entropic Methods for Causal Discovery*, Online talk for graduate students and the faculty, Mar. 4, 2021.

*Session chair for IJCAI'20* [Machine Learning] Learning Generative Models, Jan. 2021.

*Lightning Talk in Young Researchers Workshop on CausalGAN*, ORIE, Cornell University, Ithaca, NY, Oct. 2019.

*Co-organized "Bridging Causal Inference, Reinforcement Learning and Transfer Learning Workshop"* in IBM AI Research Week, 2019.

*Invited Talk in AAAI-WHY19 Spring Symposium on CausalGAN*, Stanford, CA, March 25-27, 2019.

*Shannon Channel Talk: Entropic Methods for Causal Discovery*, Online talk hosted by Salim El Rouayheb, Mar. 1st, 2019.

*Hands-on machine learning workshop (jointly with Alex Dimakis)*, 2018 North American School of Information Theory, Texas A&M University, May 20-23, 2018.

*Invited Talk in Los Alamos National Laboratories (LANL) on Causality*, Los Alamos, NM, Aug. 2017.

*Organized student seminar series in machine learning* in WNCG, UT Austin, 2015-2016.

**Area Chair, Senior PC, Meta-reviewer For**
NeurIPS (since 2023),
AAAI (since 2021),
ICLR (since 2023),
AISTATS (since 2023),
UAI (since 2023),
ACML (since 2022),
IJCAI (2020-2021).

**Reviewer For**
NeurIPS (2016 - 2022), ICML (since 2018), ICLR, AAAI (2020), AISTATS (2019-2022), IJCAI (2019), UAI, COLT, ISIT, CLeaR (since 2021) and many others.
Journal of Machine Learning Research (JMLR), IEEE Transactions on Information Theory,

IEEE Journal on Selected Areas in Information Theory (JSAIT), Neural Networks (ACM), Annals of Statistics, Artificial Intelligence (Elsevier).

PhD/MS Advisory Committee Member

William Stephen Richards (MS Degree)
*Advisor: Stylianos Chatzidakis*

Teng-Hui Huang (PhD Candidate)
*Advisor: Aly El Gamal*

Antesh Antesh (MS Candidate)
*Advisor: Abolfazl Hashemi*

Awards & Recognitions

**NSF CAREER Award** *July 2023*

**Adobe Data Science Research Award** *Mar. 2022*

**Reviewer Award for NeurIPS 2022** *Nov. 2022*
Top Reviewer

**Reviewer Award for UAI 2022** *July 2022*
Top Reviewer

**Reviewer Award for ICLR 2022** *April 2022*
*Highlighted Reviewer*

**Program Committee Board Member of IJCAI** *2022-2024*

**Reviewer Award for UAI 2021** *May 2021*
Amongst Top 5% of Reviewers

**Reviewer Award for ICLR 2021** *Mar. 2021*
Outstanding Reviewer

**Reviewer Award for ICML 2020** *Sept. 2020*
Amongst Top 33% of Reviewers

**Reviewer Award for NeurIPS 2019** *Sept. 2019*
Amongst Top 50% of Reviewers

**Reviewer Award for NeurIPS 2018** *Sept. 2018*
Amongst Top 218 Reviewers

**Student Travel Award for ICLR 2018** *Mar. 2018*

**Student Travel Award for NIPS 2017** *Oct. 2017*

**Student Travel Award for ICML 2017** *June 2017*

**Student Travel Grant for ISIT 2017** *Apr. 2017*

**Short Course Travel Support** *May. 2016*
Center for Causal Discovery (CCD), Pittsburgh

**Student Travel Award for NIPS 2015** *Oct. 2015*

**Best Senior Design Project**, Dept. of Electrical and Electronics Engineering — *Spring, 2010*
Middle East Technical University, Ankara, Turkey.
*A wireless helmet design to detect user's head movements and facial gestures to accomplish certain tasks on the computer.*

**Bulent Kerim Altay Award**, Dept. of Electrical and Electronics Engineering. — *Spring, 2009*
Middle East Technical University, Ankara, Turkey.
*Ranked 1st in the Department of Electrical and Electronics Engineering*

**Ranked Top 100 in National University Selection Exam of Turkey**, — *Jun. 2006*
Among more than 1.5 million students nation-wide

## Outreach

Engineering Academic Career Club Academic Mentor — Summer 2021, 2022
*Biweekly mentorship meetings with 8 students interested in an academic career from a wide range of demographics, including several URM students.*

Mentorship Session — *2022*
*The AAAI-22 Workshop on Information-theoretic Causal Inference and Discovery*

## Teaching Assistant

**Teaching Assistant**, Dept. of Electrical and Computer Engineering, — 2013 – 2014
The University of Texas at Austin *EE313: Linear Systems and Signals, Problem solving and review sessions, homework grading, office hours.*

**Teaching Assistant**, Dept. of Electrical and Computer Engineering, — 2013 – 2014
Koc University, Istanbul, Turkey. *ELEC513: Information Theory, ELEC201: Signals and Systems, ELEC100: Introduction to Electrical and Electronics Engineering, COMP110: Introduction to Programming with MATLAB.*

## Society Member

IEEE, Member
IEEE Information Theory Society, Member