Sanghack Lee, Ph.D.

Contact Information

Graduate School of Data Science
Seoul National University
Seoul, Republic of Korea

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sanghack.lee@gmail.com

Research Interests

Causal inference (identification and estimation) and causal discovery in diverse settings including tabular, relational, and (non-)stationary time series. Sequential decision making problems from the aspect of causality. Practical causal modeling for common sense. Incorporating concepts from human behavior (e.g., irrationality) into a causal framework.

Affiliation

Graduate School of Data Science (assistant professor)
Artificial Intelligence Institute (adjunct professor)

Employment

Seoul National University, Seoul
Assistant Professor, Graduate School of Data Science **Mar. 2021–present**

Columbia University, New York
Associate Research Scientist, Computer Science **Jul. 2019–Feb. 2021**

Investigating ranges of causality problems from classical causal inference to its application to sequential decision making.

Purdue University, West Lafayette
Postdoctoral Research Associate, Computer Science **Apr. 2018–Jun. 2019**
Advisor: Prof. Elias Bareinboim

Education

Pennsylvania State University, University Park
Ph.D., College of Information Sciences and Technology **2018**
Advisor: Prof. Vasant G. Honavar

Sogang University, Seoul, Republic of Korea
MS., Computer Science and Engineering **2006**
BE., Computer Science and Engineering, *Cum Laude* **2004**

Publications

✉ for corresponding authors (since 2021).

Chanhui Lee*, Juhyeon Kim*, YongJun Jeong, Yeom Yoon Seok, Juhyun Lyu, Jung-Hee Kim, Sangmin Lee, Sangjun Han, Hyeokjun Choe, Soyeon Park, Woohyung Lim, Kyunghoon Bae, Sungbin Lim✉, **Sanghack Lee**✉ (2024) On Incorporating Prior Knowledge Extracted from Pretrained Language Models into Causal Discovery In *First Workshop on Causality and Large Model at NeurIPS 2024 (non-archival)*

Sujin Jeon, Inwoo Hwang, **Sanghack Lee**✉, Byoung-Tak Zhang✉ (2024) Locality-aware Concept Bottleneck Model In *UniReps: 2nd Edition of the Workshop on Unifying Representations in Neural Models at NeurIPS 2024 (non-archival)*

Yonghan Jung✉, Min Woo Park, **Sanghack Lee**✉ (2024) Complete Graphical Criterion for Sequential Covariate Adjustment in Causal Inference In *Advances in Neural Information Processing Systems 37 (NeurIPS 2024)*

Ryan Carey, **Sanghack Lee**, Robin J. Evans (2024) Toward a Complete Criterion for Value of Information in Insoluble Decision Problems. *arXiv preprint*.

Inwoo Hwang, Yunhyeok Kwak, Suhyung Choi, Byoung-Tak Zhang✉, **Sanghack Lee**✉ (2024) Fine-Grained Causal Dynamics Learning with Quantization for Improving Robustness in Reinforcement Learning. In *Proceedings of the 41st International Conference on Machine Learning (ICML 2024)*

{Inwoo Hwang, Yesong Choe}, Yeahoon Kwon, **Sanghack Lee**✉ On Positivity Condition for Causal Inference. In *Proceedings of the 41st International Conference on Machine Learning (ICML 2024)*

Jonghwan Kim, Inwoo Hwang, **Sanghack Lee**✉ (2024) Causal Discovery with Deductive Reasoning: One Less Problem. In *Proceedings of the 40th Conference on Uncertainty in Artificial Intelligence (UAI 2024)*

Yunhyeok Kwak, Inwoo Hwang, Dooyoung Kim, **Sanghack Lee**✉, Byoung-Tak Zhang✉ (2024) Efficient Monte Carlo Tree Search via On-the-Fly State-Conditioned Action Abstraction. In *Proceedings of the 40th Conference on Uncertainty in Artificial Intelligence (UAI 2024)*

Soheun Yi, **Sanghack Lee**✉ (2024) Filter, Rank, and Prune: Learning Linear Cyclic Gaussian Graphical Models. In *Proceedings of the 27th International Conference on Artificial Intelligence and Statistics (AISTATS 2024)*

Inwoo Hwang, Yunhyeok Kwak, Suhyung Choi, Byoung-Tak Zhang, **Sanghack Lee**✉ (2023) Quantized Local Independence Discovery for Fine-Grained Causal Dynamics Learning in Reinforcement Learning. In *GenPlan 2023: Seventh Workshop on Generalization in Planning at NeurIPS 2023 (non-archival)*

Dong Kyu Cho, **Sanghack Lee**✉ (2023) Learning to ignore: Single Source Domain Generalization via Oracle Regularization. In *Causal Representation Learning Workshop at NeurIPS 2023 (non-archival)*

Inwoo Hwang, Yunhyeok Kwak, Suhyung Choi, Byoung-Tak Zhang, **Sanghack Lee**✉ (2023) Causal Dynamics Learning with Quantized Local Independence Discovery. In *Second Workshop on Spurious Correlations, Invariance and Stability at ICML 2023 (non-archival)*

Inwoo Hwang, Yunhyeok Kwak, Yeon-Ji Song, Byoung-Tak Zhang, **Sanghack Lee**✉ (2023) On Discovery of Local Independence over Continuous Variables via Neural Contextual Decomposition. In *Proceedings of the 2nd Conference on Causal Learning and Reasoning (CLeaR 2023)*

Juhyeon Kim, Yesong Choe, **Sanghack Lee**✉ (2022). Detecting Causality by Data Augmentation via Part-of-Speech tagging. In *CASE: The 5th Workshop on Challenges and Applications of Automated Extraction of Socio-political Events from Text at EMNLP (2022)*

Juan D. Correa, **Sanghack Lee** and Elias Bareinboim (2022). Counterfactual Transportability: A Formal Approach. In *Proceedings of the 39th International Conference on Machine Learning (ICML 2022)*

Inwoo Hwang, Byoung-Tak Zhang, **Sanghack Lee**✉ (2021). Partition-based Local Independence Discovery. Workshop "Causal Inference Challenges in Sequential Decision Making: Bridging Theory and Practice" at NeurIPS 2021.

Juan D. Correa, **Sanghack Lee**, and Elias Bareinboim (2021). Nested Counterfactual Identification from Arbitrary Surrogate Experiments. In *Advances in Neural Information Processing Systems 34 (NeurIPS 2021)*

Sanghack Lee and Elias Bareinboim (2021). Causal Identification with Matrix Equations. In *Advances in Neural Information Processing Systems 34 (NeurIPS 2021)*

— before affiliated at Seoul National University —

Sanghack Lee and Elias Bareinboim (2020). Characterizing Optimal Mixed Policies: Where to Intervene and What to Observe. In *Advances in Neural Information Processing Systems 33 (NeurIPS 2020)*

Sanghack Lee and Elias Bareinboim (2020). Causal Effect Identifiability under Partial Observability. In *Proceedings of the 37th International Conference on Machine Learning (ICML 2020)*

Sanghack Lee, Juan D. Correa, and Elias Bareinboim (2020). General Transportability — Synthesizing Observations and Experiments from Heterogeneous Domains. In *Proceedings of Thirty-fourth Conference on AAAI Conference on Artificial Intelligence (AAAI 2020)*

Sanghack Lee, Juan D. Correa, and Elias Bareinboim (2020). Identifiability from a Combination of Observations and Experiments. In *Proceedings of Thirty-fourth Conference on AAAI Conference on Artificial Intelligence (AAAI 2020)*

Sanghack Lee, Juan D. Correa, and Elias Bareinboim (2019). General Identifiability with Arbitrary Surrogate Experiments. In *Proceedings of Thirty-fifth Conference on Uncertainty in Artificial Intelligence (UAI 2019)* Best Paper Award

Sanghack Lee and Vasant Honavar (2019). Towards Robust Relational Causal Discovery . In *Proceedings of Thirty-fifth Conference on Uncertainty in Artificial Intelligence (UAI 2019)*

Aria Khademi, **Sanghack Lee**, David Foley, Vasant Honavar (2019). Fairness in Algorithmic Decision Making: An Excursion Through the Lens of Causality. In *Proceedings of 2019 International Conference on World-Wide Web (WWW 2019)*

Sanghack Lee and Elias Bareinboim (2019). Structural Causal Bandits with Non-manipulable Variables. In *Proceedings of Thirty-third AAAI Conference on Artificial Intelligence (AAAI 2019)*

Sanghack Lee and Elias Bareinboim (2018). Structural Causal Bandits: Where to Intervene?. *In Advances in Neural Information Processing Systems 31 (NeurIPS 2018)*

Sanghack Lee and Vasant Honavar (2017). Self-Discrepancy Conditional Independence Test. In *Proceedings of Thirty-third Conference on Uncertainty in Artificial Intelligence (UAI 2017)*

Sanghack Lee and Vasant Honavar (2017). A Kernel Conditional Independence Test for Relational Data. In *Proceedings of Thirty-third Conference on Uncertainty in Artificial Intelligence (UAI 2017)*

Sanghack Lee and Vasant Honavar (2016). A Characterization of Markov Equivalence Classes of Relational Causal Models under Path Semantics. In *Proceedings of Thirty-second Conference on Uncertainty in Artificial Intelligence (UAI 2016)*

Kyungsik Han, **Sanghack Lee**, Jin Yea Jang, Yong Jung, and Dongwon Lee (2016). "Teens are from Mars, Adults are from Venus": Analyzing and Predicting Age Groups with Behavioral Characteristics in Instagram. In *Proceedings of Eighth International ACM Web Science Conference 2016 (WebSci 2016)*

Sanghack Lee and Vasant Honavar (2016). On Learning Causal Models for Relational Data. In *Proceedings of Thirtieth Conference on Artificial Intelligence (AAAI 2016)*

Sanghack Lee and Vasant Honavar (2015). Lifted Representation of Relational Causal Models Revisited: Implications for Reasoning and Structure Learning. In *Proceedings of the UAI 2015 Workshop on Advances in Causal Inference co-located with the 31st Conference on Uncertainty in Artificial Intelligence (UAI 2015)*

{Elias Bareinboim, **Sanghack Lee**}, Vasant Honavar, and Judea Pearl (2013). Transportability from Multiple Environments with Limited Experiments. In *Advances in Neural Information Processing 26 (NeurIPS 2013)*

Sanghack Lee and Vasant Honavar (2013). m-Transportability: Transportability of a Causal Effect from Multiple Environments. In *Proceedings of the Twenty-seventh Conference on Artificial Intelligence (AAAI 2013)*

Sanghack Lee and Vasant Honavar (2013). Causal Transportability of Experiments on Controllable Subsets of Variables: z-Transportability. In *Proceedings of the Twenty-ninth Conference on Uncertainty in Artificial Intelligence (UAI 2013)*

{Harris Lin, **Sanghack Lee**, Ngot Bui} and Vasant Honavar (2013). Learning Classifiers from Distributional Data. In *IEEE Second International Congress on Big Data*

Sanghack Lee, Jihoon Yang and Sungyong Park (2006). A New Polynomial Time Algorithm for Bayesian Network Structure Learning. In *Advanced Data Mining and Applications (ADMA 2006)*

Sanghack Lee, Jihoon Yang and Sung-Yong Park (2004). Discovery of Hidden Similarity on Collaborative Filtering to Overcome Sparsity Problem. In *Discovery Science 2004 (DS 2004)*

Talks, Tutorials, Posters

- DS+ Tutorial Series, Causal Inference in the Age of AI, Korea University (Aug, 2024), invited tutorial
- Recent Advances in Causal Inference, Korean AI Association (Aug, 2024), invited talk
- KUBIG Korea University (Dec, 2023), invited talk
- BK21 Big Data Science Seminar, Yonsei University (Nov, 2023), invited talk
- Digital Convergence Branch, The Korean Neurosurgical Society (Nov, 2023), invited talk
- Recent Trends in Causal Inference, Korean Society of Artificial Intelligence in Medicine (Oct, 2023), invited talk
- On the Role of Causal Inference in Artificial Intelligence, SNU AI.MED Talks Series (Project Group for Education and Research in Medical AI) (Sep, 2023), invited talk
- Tutorial on Causal Inference, Korean AI Association (July, 2023), invited tutorial
- AI Seminar, Samsung Electronics, Device Solution (June, 2023), invited talk
- Tutorial on Causal Inference, Korean AI Association (Jan, 2023), invited tutorial
- Seminar at Integrated Major in Innovative Medical Science, College of Medicine, Seoul National University (Nov, 2022), invited talk
- Artificial Intelligence Graduate School (AIGS), Ulsan National Institute of Science and Technology (UNIST) (Nov, 2022), invited talk
- 2022 Korea Summer Workshop on Causal Inference Program / Korean AI Association (Jul, 2022), invited talk
- Korean Society of Epidemiology (Jul, 2022), invited tutorial
- The Korean Statistical Society (Jun, 2022), invited talk
- Statistics Department Seminar, Seoul National University (Jun, 2022), invited talk
- Seminar, Samsung Advanced Institute for Health Sciences & Technology (May, 2022), invited talk
- GSDS Seminar, Seoul National University (Mar, 2022), invited talk
- Institute of Economic Research, Seoul National University (Dec, 2021), invited talk
- Preventive Medicine, College of Medicine, Yonsei University (Dec, 2021), invited talk
- Amazon Research at Tübingen Germany (Aug, 2021), invited talk
- Applied BigData Engineering Seminar at Sogang University (Jun, 2021), invited talk
- NeurIPS'2020 (Virtual), poster
- Summer AI Seminar Series at POSTECH (Aug, 2020) (Pohang, South Korea), invited talk
- ICML'2020 (Virtual), poster
- AAAI'2020 (New York, NY), talk
- AAAI'2020 (New York, NY), invited talk
- UAI'2019 (Tel Aviv, Israel), talk (*)
- IJCAI'2019 (Macau), "Causal Reinforcement Learning", tutorial (*)
- ISysE Seminar at KAIST (Apr, 2019) (Daejeon, South Korea), invited talk

- AAAI'2019 (Hawaii), talk
- NeurIPS'2018 (Montreal, Canada), poster
- Causality workshop at UAI'2017 (Sydney, Australia), talk
- UAI'2017 (Sydney, Australia), two posters
- UAI'2016 (Jersey City, NJ), talk
- AAAI'2016 (Phoenix, AZ), talk
- Causality workshop at UAI'2015 (Amsterdam, Netherlands), poster
- AAAI'2013 (Bellevue, WA), talk
- UAI'2013 (Bellevue, WA), poster

* someone else substituted for me.

Professional Service

Board Member

- Korean Artificial Intelligence Association (2023, 2024)
- KIISE Artificial Intelligence Society (2024)

Program Committee / Reviewers (* as an external reviewer)

- 2025 AAAI, KDD, ICLR, AISTATS, CLeaR
- 2024 ICLR, CLeaR, JMLR, ICML, UAI, NeurIPS (Area Chair), ARR June, ECAI, CI4TS@UAI
- 2023 UAI, JMLR, NeurIPS (Top Reviewer),
- 2022 ICLR (Highlighted Reviewer), AAAI, AISTATS, CLeaR, ICML, Journal of Causal Inference (JCI), UAI (Top Reviewer), NeurIPS*
- 2021 ICLR, AAAI, AISTATS, ICML, UAI, NeurIPS, Journal of Artificial Intelligence Research (JAIR), NeurIPS 2021 Workshop on 'Causal Inference & Machine Learning: Why now?'
- 2020 NeurIPS, UAI, ICML (Top Reviewer Award), AAAI, AISTATS, IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), Journal of Artificial Intelligence (AIJ), Journal of Causal Inference (JCI), NeurIPS Workshop on Causal Discovery and Causality-Inspired Machine Learning (CDML, Area Chair), ACM-IMS Foundations of Data Science Conference (FODS)*, Statistical Science*
- 2019 NeurIPS (Best Reviewer Award), Journal of Machine Learning Research (JMLR), WHY conference (AAAI Spring Symposium), ICML*, IJCAI*
- 2018 NeurIPS*
- 2017 Causality Workshop at UAI
- 2016 ACM CHI Conference on Human Factors in Computing Systems
- 2014 ACM Transactions on Intelligent Systems and Technology (TIST)

Industrial Experience

Senior Engineer at **Diquest, inc.**, Seoul, South Korea — **Feb. 2006 to Jun. 2009**
Development and maintenance of an enterprise search engine

Research Experience

Associate Research Scientist, Columbia University — **Jul. 2019–Feb. 2021**

Post-doctoral Research Associate, Purdue University — **2018–Jun. 2019**

Research Assistant, Pennsylvania State University — **2013–2014, 2015–2018**

Research Assistant, Iowa State University — **2011–2013**

Research Assistant, Sogang University — **2005**

Teaching Experience

Lecture, Seoul National University

- Causal Inference for Artificial Intelligence (Fall 2024)
- Causal Inference for Data Science (Fall 2021, Spring 2023, Spring 2024, Fall 2024)
- Machine Learning and Deep Learning for Data Science II (Fall 2022, Spring 2023, Fall 2023, Spring 2024, Fall 2024 co-taught w/ Prof. Taesup Kim)
- Project for Data Science (Spring 2023)
- Big Data and Knowledge-based System II (Fall 2022, Spring 2023, co-taught w/ Prof. Wen-Syan Li)
- Introduction to Artificial Intelligence (Spring 2022)
- Introduction to Big Data* (Spring 2022, planned, co-taught by GSDS professors)
- Computing Foundations for Data Science (Winter Bootcamp 2022, 300+ students, co-taught with Prof. Joonseok Lee)
- Principles and Application of Data Science (Fall 2021, together with other professors)
- Foundations of Data Science (Summer 2021, co-taught by GSDS professors)

Guest Lecture, Purdue University

Structural Causal Bandits (Advanced Machine Learning, Spring 2019), Counterfactual Bandits (Advanced Machine Learning, Spring 2019)

Guest Lecture, Columbia University

Structural Causal Bandits (Causal Inference II, Spring 2021 and Spring 2022)

Graduate Teaching Assistant

(Pennsylvania State University): Discrete Mathematics, Principles of Artificial Intelligence.

(Iowa State University): Design and Analysis of Algorithms (2 times), Principles of Artificial Intelligence, Machine Learning, Object-Oriented Analysis and Design.

(Sogang University): Java Language Programming, Personal Computer Laboratory I, Discrete Structures.

Advisee

Ph.D. students

Kim, Jung Soo	(Sep 2024–)
Kim, Jonghwan	(Sep 2024–)
Lim, Byeonghui	(July 2024–)
Yeha Kim	(Jan 2024–)
Yeo Dong Youn	(Jan 2024–)
Kim, Juhyeon	(Mar 2023–)
Park, Min Woo	(Jan 2023–)
Choe, Yesong	(July 2021–)
Kwon, Yeahoon	(July 2021–)
Hwang, Inwoo	(Mar 2021–)

Mater students

Sangyeon Cho	(Sep 2024–)
Min Young Cho	(Sep 2024–)
Sujeong Oh	(July 2024–)
Daehui Park	(July 2024–)
Younsuk Yeom	(July 2024–)

Eunseo Lee	(July 2024–)
Sumin Cho	(July 2024–)
Jihae Chung	(Jan 2024–)
Hyeonji Kim	(Jan 2024–)
Kim, Kwon Ho	(Jun 2023–)
Choi, Jin A	(Jun 2023–)
Park, Soungmin	(Jun 2023–)
Kwon, Oh Yoon	(Jun 2023–)
Park, Hyunwoo	(Jun 2023–)
Choi, Heejin	(Jan 2023–)
Jeoung, Jaeho	(Jan 2023–)
Kim, Taehan	(July 2021–)

Alumni

Song, Kyung A	(Jan 2023–Aug 2024)
Yim, Dahhee	(July 2022–Aug 2024)
Park, Jeongsup	(July 2022–Feb 2024)
Moon, Jeong Ha	(July 2022–Feb 2024)
Soheun Yi	(Mar 2022–Aug 2023, undergraduate)
Cho, Dong Kyu	(July 2021–Jun 2023)
Chung, Chaeyoung	(July 2021–Jun 2023)
Kang, Jewon	(July 2021–Feb 2023)

Grants

Deep Generative Models for Causal Reasoning, LG AI Research (PI, 2024–2025)
Causal Discovery for Time Series Data Guided by Data-driven Causal Knowledge, LG AI Research (PI, 2023–2024)
Causal Machine Learning, NRF, (PI, 2023–2027)
Self-Directed Artificial Intelligence, IITP, (co-PI, 2022–2026)
Center for Optimizing Hyperscale AI Models and Platforms, NRF, (co-PI, 2023–2030)
MFDS, (3 years, co-PI, 2023–2025)
Algorithmic Characterization of Matrix-based Causal Inference, SNU, (PI, 2021–2024)

References

Prof. Vasant Honavar
Professor
Information Sciences and Technology,
Pennsylvania State University, USA
vhonavar@psu.edu

Prof. Elias Bareinboim
Associate Professor
Computer Science,
Columbia University, USA
eb@cs.columbia.edu

Prof. Jihoon Yang
Professor
Computer Science and Engineering,
Sogang University, South Korea
yangjh@sogang.ac.kr

Prof. Jin Tian
Associate Professor
Computer Science,
Iowa State University, USA
jtian@iastate.edu

Last updated: October 31, 2024