

Changhun Lee

PH.D. · POST-DOCTORAL RESEARCHER · UNIST AIGS

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Education

PH.D. INDUSTRIAL ENGINEERING

2016.03 - 2023.02

- Institution: Ulsan National Institute of Science and Technology (UNIST)
- Advisor: Dr. Chiehyeon Lim
- Dissertation Title:

"Tackling Three Problems in Controlled Sequence Generations: Bridging Reinforcement Learning with Language Models"

BSc. ECONOMICS

2011.03 - 2015.02

- Institution: Ajou University

Competency

TECHNICAL & RESEARCH CAPABILITIES

- Proficient in Python, R, TensorFlow, and Keras, intermediate in PyTorch and Spark
- Expertise in sequential decision-making models (i.e., language modeling, reinforcement learning, etc.)
- Adept at translating real-world problems described in everyday language into generalized abstract logic that is mathematically formulated.

COMMUNICATION SKILLS

- Advanced level of English writing
- Intermediate level of English speaking

Research Interest

RESEARCH GOAL

- With the increasing reliance on artificial intelligence (AI) in various fields, I believe that unprincipled, or rule-of-thumb, use of AI will greatly increase the risk of out-of-control situations. In this regard, the goal of my research is to analyze the nature of controllability and use it to improve the controllability of AI.

RESEARCH OBJECTIVE

- In detail, I am interested in studying the interplay between generative models and reinforcement learning (RL) algorithms and developing controllable AI with a theoretical guarantee for its usage — especially in the context of large language models (LLMs).

Academic Keywords of Personal Interest

PARETO OPTIMALITY

- To build controllable AI, the generative model must be optimized for the likelihood and control objectives simultaneously (jointly). Given this multi-objective nature, studying controllability from the perspective of Pareto optimality can provide the theoretical foundations of controllable AI.

MAXIMUM MUTUAL INFORMATION

- In terms of Pareto optimality, the more the Pareto improvement, the higher the controllability. Since mutual information represents the joint probability of two random variables, mapping both likelihood and control objectives onto the probability space together and maximizing their mutual information will derive the Pareto improvement.

APPROXIMATION METHODS

- Computing mutual information is expensive, so it is necessary to "approximate" the maximum mutual information without estimating the exact amount of mutual information. Therefore, in my research, variational inference or perturbation techniques are the most preferred methodology and a research topic in itself.

Professional Experience

- 2023.03-
Present **Postdoctoral Researcher**, Graduate School of Artificial Intelligence, UNIST
- 2019-2022 **Principal Investigator**, Granted Research Program, Daewoong Pharmaceuticals Foundation
- 2021.11-
2021.12 **Research Advisor**, Project-based Learning Program, LG Electronics
- 2018-2019 **Co-founder**, Data Team, Smart Ship Venture Tech
- 2017.07-
2017.12 **Data Analyst**, Business Planning Department, Hyundai Mipo Dockyard
- 2016-2017 **Graduate Teaching Assistant**, Department of Industrial Engineering, UNIST

Awards, Fellowships, & Grants

- 2023 **UNIST Best Research Award**, Ulsan National Institute of Science and Technology
- 2022 **Prominent Presentation Award**, The Korean Nutrition Society
Best Oral Presentation Award, Korean Academy of Pediatric Allergy and Respiratory Disease
- 2020 **Best Poster Presentation Award**, The Korean Nutrition Society
- 2018 **Minister of Science and ICT Award**, Korea Institute of Science and Technology
Daewoong Research Scholarship Grant, Daewoong Pharmaceuticals Foundations
- 2013 **Student Best Paper Award**, Korean Association for Policy Sciences

Publications

CONFERENCE PAPERS

- Changhun, Lee.**, Chiehyeon Lim. (2023). "Theoretical Principles of Controllable Generation: Reinforcing the Levenshtein Agent Mitigates the Discrepancy Problem," *To be submitted to AAAI'24 or ICLR'24*
- Changhun, Lee.**, Chiehyeon Lim. (2023). "Analyzing the Controllability of Language Models and Improving the Control Performance with Reward Dropout," *Under Review in EMNLP'23*
- Jongkyung Shin.*, **Changhun, Lee.***, Chiehyeon Lim., Yunmo Shin., Junseok Lim. (2022). "Recommendation in Offline Stores: A Gamification Approach for Learning the Spatiotemporal Representation of Indoor Shopping," *In Proceedings of the 28th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (pp. 3878-3888)*.
- Changhun, Lee.**, Soohyeok Kim., Sehwa Jeong., Chiehyeon Lim., Jayun Kim., Yeji Kim., Minyoung Jung. (2021). "MIND dataset for diet planning and dietary healthcare with machine learning: Dataset creation using combinatorial optimization and controllable generation with domain experts," *In Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS) Datasets and Benchmarks Track (Round 2)*.
- Changhun, Lee.**, Soohyeok Kim., Chiehyeon Lim., Jayun Kim., Yeji Kim., Minyoung Jung.. (2021). "Diet Planning with Machine Learning: Teacher-forced REINFORCE for Composition Compliance with Nutrition Enhancement," *In Proceedings of the 27th ACM SIGKDD Conference on Knowledge Discovery & Data Mining (pp. 3150-3160)*.

JOURNAL PAPERS

- Changhun, Lee.**, Soohyeok Kim., Sehwa Jeong., Jayun Kim., Yeji Kim., Chiehyeon Lim., Minyoung Jung. (2023). "Artificial intelligence generates allergy-free high-nutrition diets: A first study on the real-world solution development and its evaluation," *To be submitted to Allergy*.
- Changhun, Lee.**, Soohyeok Kim., Jayun Kim., Chiehyeon Lim., Minyoung Jung. (2022). "Challenges of diet planning for children using artificial intelligence," *Nutrition Research and Practice*, 16(6), 801-812.
- Changhun, Lee.**, Chiehyeon Lim. (2021). "From technological development to social advance: A review of Industry 4.0 through machine learning," *Technological Forecasting and Social Change*, 167, 120653.

Min Jung., Chiehyeon Lim., **Changhun, Lee.**, Soohyeok Kim., Jayun Kim. (2020). "Human dietitians vs. Artificial intelligence: Which diet design do you prefer for your children?," *Journal of Allergy and Clinical Immunology*, 147(2), AB117.

Presentations

* *presenting author*; * *mentored undergraduate*

CONTRIBUTED PRESENTATIONS

Sehwa Jeong.⁺, Soohyeok Kim, **Changhun, Lee.**, Jayun Kim., Yeji Kim., Chiehyeon Lim., Minyoung Jung.* 2022. Toward the Diet Planning with Artificial Intelligence for Children with Food Allergies. Flash Talk Session: EAACI Hybrid Congress 2022, Prague, Czech Republic

Changhun, Lee.*, Soohyeok Kim., Sehwa Jeong.⁺, Chiehyeon Lim., Jayun Kim., Yeji Kim., Minyoung Jung. 2021. MIND dataset for diet planning and dietary healthcare with machine learning: Dataset creation using combinatorial optimization and controllable generation with domain experts. Best Paper Sessions: Korean Artificial Intelligence Association 2021, Virtual

Changhun, Lee., Soohyeok Kim., Jayun Kim., Chiehyeon Lim., Minyoung Jung.* 2021. Human- or Artificial Intelligence-designed Diets: Which Do You Prefer for Your Children? Poster Presentation: AAAAI 2021, Virtual

Research Project

DEVELOP AND VALIDATE A LEARNING FRAMEWORK FOR INTERACTION AND CO-EVOLUTION BETWEEN HUMANS AND AI

2021 - present

- Funding Agency: Ministry of Education

DEVELOPING INTELLIGENT BIO-OMICS ANALYSIS TECHNOLOGY

2021 - 2023

- Funding Agency: Ministry of SMEs and Startups

DEVELOP A METHODOLOGY FOR IDENTIFYING LATENT FACTORS EXPLAINING VARIABILITY IN SOCIAL SCIENCE BIG DATA

2020 - 2022

- Funding Agency: Ministry of Education

DEVELOPMENT OF A NON-FACE-TO-FACE PRECISION DIETARY AI SERVICE SYSTEM TAILORED TO THE GUT FLORA OF PEDIATRIC ATOPIC DISEASES

2020-2021

- Funding Agency: Ministry of Science and ICT

DEVELOPMENT OF A DATA REORGANIZATION AND RECOMMENDATION SYSTEM TO REDUCE THE COST OF DRUG DISCOVERY

2019 - 2022

- Funding Agency: Daewoong Pharmaceuticals Foundation

STRUCTURAL ANALYSIS OF THE PROCESS OF TECHNOLOGICAL INNOVATION IN THE FOURTH INDUSTRIAL REVOLUTION

2018 - 2021

- Funding Agency: Ministry of Education

RESEARCH ON SERVICITIZATION IN INDUSTRY 4.0 THROUGH REGIONAL INDUSTRIAL-ACADEMIC COOPERATION

2018-2019

- Funding Agency: Ministry of Science and ICT

UNDERSTAND THE KEY RESEARCH AND APPLICATION INDUSTRIES OF THE FOURTH INDUSTRIAL REVOLUTION

2017-2020

- Funding Agency: Ulsan National Institute of Science and Technology