

Jay-Yoon Lee

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RESEARCH INTEREST

- Injecting *knowledge as constraints* into neural models.
- Making ML models, especially LLMs, more *coherent*, *interpretable*, and *controllable*.
- Automatically capturing implicit constraints using *energy-based models*.
- Reflecting scientific knowledge into scientific AI models.
- **Keywords:** NLP, Constraint injection, Structured Prediction, Energy-based models, Multi-task & Transfer learning, Domain adaptation, Logical reasoning, ScienceAI, and better representation learning for the aforementioned topics.

EMPLOYMENT

Sept 2022 – current **Assistant Professor** Director of SKI-ML lab
Graduate School of Data Science, Seoul National University, Seoul, Republic of Korea

EDUCATION AND TRAINING

08/2013 **Computer Science Department, School of computer science,**
- 07/2020 **Carnegie Mellon University**
Ph.D. in Computer Science. Advisor: Jaime Carbonell
Ph.D. thesis: INJECTING OUTPUT CONSTRAINTS TO NEURAL NLP MODELS, 2020
Committee: Jaime Carbonell, William Cohen, Graham Neubig, Yulia Tsvetkov, Dan Roth.

08/2011 **Language Technology Institute & Lane Center for Computational Biology,**
- 05/2013 **School of computer science, Carnegie Mellon University**
M.S. in Computer Science. Transferred to PhD program at the end without completing.

03/2003 **Korea Advanced Institute of Science and Technology (KAIST)**
- 05/2008 *B.S., Summa Cum Laude, in Electrical Engineering*
Undergrad thesis: ROBUST SPEECH RECOGNITION USING PREDICTION METHODS BASED ON ARTIFICIAL NEURAL NETWORKS, 2007
Thesis advisor: Chulhoon Park.

EXPERIENCE

July 2020 – July 2022 **Postdoctoral associate** under Professor Andrew McCallum
University of Massachusetts Amherst, Amherst, MA
Served as a research mentor for 7 PhD students and supervised research projects for 20 masters students, including projects with IBM and Facebook.

Oct 2015 – July 2020 **Research Assistant** under Professor Jaime Carbonell
Carnegie Mellon University, Pittsburgh, PA
Injecting output constraints into the neural NLP models for low-resource, domain adaptation.;
Part-forecasting, price prediction project (Boeing sponsored).

June 2012 – Oct 2015 **Research Assistant** under Professor Christos Faloutsos
Carnegie Mellon University, Pittsburgh, PA
Anomaly detection algorithm on large graphs (DARPA ADAMS project).

Oct 2019 – Jan 2020 **Research Internship** at Language and Speech Group
Google AI, New York, NY

June – Aug 2017 ,2019 Tag-constrained Transformer for text normalization.
Research Internship at Information and Data Sciences & Deep Learning Group
Microsoft Research, Redmond, WA
 Improving dialogue model using multiple non-differentiable metrics.
 Task-oriented dialogue when action is defined on the combinatorially space.

June 2016 – Aug 2016 **Research Internship** at Machine Learning Research Group
Oracle Labs, Burlington, MA
 Injecting hard-constraints to sequence-to-sequence model for syntactic parsing. (Patent published)

SELECTED PUBLICATIONS

Asterix () denotes joint first author, i.e., equal contribution. Paper titles are linked to the pdf file.*

- [1] **Latent Self-Consistency for Reliable Majority-Set Selection in Short- and Long-Answer Reasoning.**
 In *AAAI*, 2026.
 Oh, Jeong-seok and **Lee, Jay-Yoon**.
- [2] **T-SCAPE: T cell immunogenicity scoring via cross-domain aided predictive engine.**
Science Advances, 2025.
 Kim, Jeonghyeon and Jung, Nuri and **Lee, Jay-Yoon** and Cho, Nam-Hyuk and Noh, Jinsung and Seok, Chaok.
- [3] **A survey on large language models in biology and chemistry.**
Experimental Molecular Medicine, 2025.
 Kim, Jeonghyeon and Noh, Jinsung and **Lee, Jay-Yoon** and others.
- [4] **Stop-RAG: Value-Based Retrieval Control for Iterative RAG.**
 In *NeurIPS workshop*, 2025.
 Park, Jaewan and Cho, Solbee and **Lee, Jay-Yoon**.
- [5] **GraphCheck: Multi-Path Fact-Checking with Entity-Relationship Graphs.**
 In *Findings of EMNLP*, 2025.
 Jeon, Hyewon and **Lee, Jay-Yoon**.
- [6] **SEAL-Pose: Enhancing 3D Human Pose Estimation through Trainable Loss Function.**
 In *ICCV workshop*, 2025.
 Do, Junggeun and **Lee, Jay-Yoon**.
- [7] **Introducing Verification Task of Set Consistency with Set-Consistency Energy Networks .**
 In *ACL oral*, 2025.
 Song, Moocho and Son, Hye ryung and **Lee, Jay-Yoon**.
- [8] **BridG MT: Enhancing LLMs’ Machine Translation Capabilities with Sentence Bridging and Gradual MT .**
 In *ACL-findings*, 2025.
 Choi, Seung-Woo and Yoo, Gahyun and **Lee, Jay-Yoon**.
- [9] **CoMRes: Semi-Supervised Time Series Forecasting Utilizing Consensus Promotion of Multi-Resolution .**
 In *ICLR*, 2025.
 Cho, Yunju and **Lee, Jay-Yoon**.
- [10] **Improving NMT models by REtrofitting Quality Estimators into Trainable Energy Loss .**
 In *COLING oral*, 2025.
 Yoo, Gahyun and **Lee, Jay-Yoon**.

- [11] **RE-RAG: Improving Open-Domain QA Performance and Interpretability with Relevance Estimator in Retrieval-Augmented Generation .**
In *EMNLP*, 2024.
Kim, Kiseung and **Lee, Jay-Yoon**.
- [12] **Comparing Neighbors Together Makes it Easy: Jointly Comparing Multiple Candidates for Efficient and Effective Retrieval .**
In *EMNLP*, 2024.
Song, Jonghyun and Jin, Cheyon and Zhao, Wenlong and **Lee, Jay-Yoon**.
- [13] **Toward Robust RALMs: Revealing the Impact of Imperfect Retrieval on Retrieval-Augmented Language Models.**
In *TACL (EMNLP Oral)*, 2024.
Park, Seong-Il and **Lee, Jay-Yoon**.
- [14] **Towards Efficient Visual-Language Alignment of the Q-Former for Visual Reasoning Tasks.**
In *Findings of EMNLP*, 2024.
Kim, Sungkyung and Lee, Adam and Park, Junyoung and Oh, Jusang and **Lee, Jay-Yoon**.
- [15] **An Analysis under a Unified Formulation of Learning Algorithms with Output Constraints.**
In *ACL student workshop*, 2024.
Song, Moocho and Lee, Jay-Yoon and **Lee, Jay-Yoon**.
- [16] **Multistage Collaborative Knowledge Distillation from a Large Language Model for Semi-Supervised Sequence Generation.**
In *arXiv preprint arXiv:2410.08642*, 2025.
Zhao, Jiachen and Zhao, Wenlong and Rozonoyer, Benjamin and Sultan, Arafat and **Lee, Jay-Yoon** and Iyer, Mohit and McCallum, Andrew.
- [17] **Machine Reading Comprehension using Case-based Reasoning.**
In *Finding of EMNLP*, 2023.
Thai, Dung and Agarwal, Dhruv and Chaudhary, Mudit and Zhao, Wenlong and Das, Rajarshi and **Lee, Jay-Yoon** and Zaheer, Manzil and Hajishirzi, Hannaneh and McCallum, Andrew.
- [18] **Parameter-Efficient fine-tuning of InstructBLIP for Visual Reasoning Tasks.**
In *NeurIPS workshop (ENLSP)*, 2023.
Kim, Sungkyung and Lee, Adam and Park, Junyoung and Chung, Sounho and Oh, Jusang and **Lee, Jay-Yoon**.
- [19] **Learning from a Friend: Improving Event Extraction via Self-Training with Feedback from Abstract Meaning Representation.**
In *Findings of EMNLP*, 2023.
Zu, Zhiyang and **Lee, Jay-Yoon** and Huang, Lifu.
- [20] **Structured Energy Network As a Loss .**
In *NeurIPS*, 2022.
Lee, Jay-Yoon and Patel, Dhruvesh and Goyal, Purujit and McCallum, Andrew.
- [21] **Meta-adapter: Parameter efficient few-shot fine-tuning through meta-learning.**
In *First Conference on Automated Machine Learning (Main Track)*, 2022.
Bansal, Trapit and Alzubi, Salaheddin and Wang, Tong and **Lee, Jay-Yoon** and McCallum, Andrew.
- [22] **Event-Event Relation Extraction using Probabilistic Box Embedding.**
In *ACL (Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics)*, 2022.
Hwang, Eunjeong and **Lee, Jay-Yoon** and Yang, Tianyi and Patel, Dhruvesh and Zhang, Dongxu and McCallum, Andrew.

- [23] **Modeling Label Space Interactions in Multi-label Classification using Box Embeddings.**
In *ICLR (International Conference on Learning Representations)*, 2022.
Patel, Dhruvesh and Dangati, Pavitra and **Lee, Jay-Yoon** and Boratko, Michael and McCallum, Andrew.
- [24] **Improved Latent Tree Induction with Distant Supervision via Span Constraints.**
In *EMNLP (Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing)*, 2021.
Xu, Zhiyang and Drozdov, Andrew and **Lee, Jay-Yoon** and O’Gorman, Tim and Rongali, Subendhu and Finkbeiner, Dylan and Suresh, Shilpa and Iyyer, Mohit and McCallum, Andrew.
- [25] **Case-based Reasoning for Natural Language Queries over Knowledge Bases.**
In *EMNLP (Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing)*, 2021.
Das, Rajarshi and Zaheer, Manzil and Thai, Dung and Godbole, Ameya and Perez, Ethan and **Lee, Jay-Yoon** and Tan, Lizhen and Polymenakos, Lazaros and McCallum, Andrew.
- [26] **StructSum: Summarization via Structured Representations.**
In *EACL (Proceedings of the 16th Conference of the European Chapter of the Association for Computational Linguistics: Main Volume)*, pages 2575–2585, 2021.
Balachandran, Vidhisha and Pagnoni, Artidoro and **Lee, Jay-Yoon** and Rajagopal, Dheeraj and Carbonell, Jaime G and Tsvetkov, Yulia.
- [27] **Semi-supervised learning on meta structure: Multi-task tagging and parsing in low-resource scenarios.**
In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 34, pages 8344–8351, 2020.
Lee*, Jay-Yoon and Lim*, KyungTae and Carbonell, Jaime and Poibeau, Thierry.
- [28] **Gradient-based inference for networks with output constraints.**
In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 33, pages 4147–4154, 2019.
Lee, Jay-Yoon and Mehta, Sanket Vaibhav and Wick, Michael and Tristan, Jean-Baptiste and Carbonell, Jaime.
- [29] **Towards Semi-Supervised Learning for Deep Semantic Role Labeling.**
In *EMNLP (Proceedings of the 2018 Conference on Empirical Methods in Natural Language Processing)*, pages 4958–4963, 2018.
Lee*, Jay-Yoon and Mehta*, Sanket Vaibhav and Carbonell, Jaime G.
- [30] **Enforcing Output Constraints via SGD: A Step Towards Neural Lagrangian Relaxation.**
In *AKBC@NIPS*, 2017.
Lee, Jay Yoon and Wick, Michael L. and Tristan, Jean-Baptiste and Carbonell, Jaime G.
- [31] **Preferential attachment in graphs with affinities.**
In *AISTATS (Artificial Intelligence and Statistics)*, pages 571–580. PMLR, 2015.
Lee*, Jay-Yoon and Zaheer*, Manzil and Günnemann, Stephan and Smola, Alex.
- [32] **Net-ray: Visualizing and mining billion-scale graphs.**
In *PAKDD (Pacific-Asia Conference on Knowledge Discovery and Data Mining)*, pages 348–361. Springer, 2014.
Kang, U and **Lee, Jay-Yoon** and Koutra, Danai and Faloutsos, Christos.
- [33] **Influence propagation: Patterns, model and a case study.**
In *PAKDD (Pacific-Asia Conference on Knowledge Discovery and Data Mining)*, pages 386–397. Springer, 2014.
Lin, Yibin and Raza, Agha Ali and **Lee, Jay-Yoon** and Koutra, Danai and Rosenfeld, Roni and Faloutsos, Christos.
- [34] **Detecting insider threats in a real corporate database of computer usage activity.**
In *KDD (Proceedings of the 19th ACM SIGKDD international conference on Knowledge discovery and data mining)*, pages 1393–1401, 2013.

Senator, Ted E and Henry, G and Goldberg, Alex Memory and Young, William T and Rees, Brad and Pierce, Robert and Huang, Daniel and Reardon, Matthew and **Lee, Jay-Yoon** and Koutra, Danai and others.

[35] **Fast anomaly detection despite the duplicates (Poster).**

In *WWW (Proceedings of the 22nd International Conference on World Wide Web)*, pages 195–196, 2013.

Lee, Jay-Yoon and Kang, U and Koutra, Danai and Faloutsos, Christos.

GRANTS

RS-2023-00280883 (NRF of Korea) July 2023-Feb 2028

- "Injecting human knowledge into energy-based models for NLP applications" (PI: JY Lee)

P25004 (Korea Institute of Science and Technology Information (KISTI)) May 2025-Nov 2025

- "Tool-augmented LLM for science research" (PI: JY Lee)

RS-2023-00222663 (NRF of Korea) June 2023-Feb 2027

- "Large-scale AI Model & Platform Optimization Center " (Subcontract PI: JY Lee)

DY0002261554 (Ministry of Food and Drug Safety) Feb 2025-Nov 2026

- "Injecting human knowledge into energy-based models for NLP applications" (Subcontract PI: JY Lee)

RS-2025-25457239 (Ministry of Health and Welfare) Feb 2025-Dec 2027

- "Injecting human knowledge into energy-based models for NLP applications" (Subcontract PI: JY Lee)

RS-2025-25443692 (Information and Communications Technology Planning and Evaluation (IITP) of Korea) July 2025-Feb 2029

- "Self-improving multi-agents with domain-adaptation capability" (Subcontract PI: JY Lee)

RS-2025-25443692 (Information and Communications Technology Planning and Evaluation (IITP) of Korea) July 2025-Feb 2029

- "Development of Core Technologies for AGI Capable of Autonomous Decision-Making " (Subcontract PI: JY Lee)

PATENTS PUBLISHED

[US20180121807A1] **When output units must obey hard constraints** May 3, 2018

- Gradient-based inference searches over continuous model-weight space to produce constraint-satisfying output.

RESEARCH EXPERIENCE

LLM alignment under retrieval-augmented generation (RAG) 2023 – current
Assistant Professor SNU

- Analyzed hallucination problems under RAG settings (TACL2025).
- Proposed confidence estimation model for regulating relevant retrieval to prevent LLM hallucination (EMNLP2025).

Tool alignment under retrieval-augmented generation 2024 – current
Assistant Professor SNU

- Expanding the work of retrieval regularization in RAG toward tool augmentation.
- Building a tool dataset for math data.

Fast and scalable retrieval models 2022 – current
Assistant Professor SNU

- Proposed retrieval model, that is both light and scalable, that compares multiple candidates jointly (EMNLP2024).
- Extending this work toward a scalable *set retriever rather than a single candidate retriever*.

Structured Energy network as A Loss (SEAL)

2021 – current

During Assistant Professor & Postdoctoral associate

SNU & UMass Amherst

- Proposed SEAL framework that utilizes structured energy network as a trainable loss function (*loss-net*) that can teach the standard discriminative network (*task-net*).
- Successfully applied the idea in the Machine Translation (COLING2025), in the human pose estimation (SEAL-pose, ICCV2025 workshop), and in controllable generation.
- The energy network, loss-net, can learn dependencies in the output space and thus can distill this information to task-net.
- Proposed dynamic loss-net-learning framework that can adapt to task-net distribution in training time.
- Built framework for SEAL on top of allenNLP that supports independent optimizers and schedulers for loss-net and task-net.
- One conference paper submission (under review).
- The paper showed notable improvements for multi-label classification (MLC) task, for both feature- and text-based MLC, without providing any prior dependencies between labels.

Probabilistic box embeddings for capturing constraints automatically

2020 – 2022

Postdoctoral associate

UMass Amherst

- Previous works have shown that spatial box embeddings can represent asymmetric relationship such as parent-child relationships very well whereas vector embeddings often fail in representing them.
- In ICLR22 [23], with an application of multi-label classification, we showed that box embeddings can capture label taxonomy automatically and perform better than vector embeddings. The paper further showed that it can perform on par with a model that utilizes the true taxonomy.
- In ACL22 [22], we showed that box representations can model event-event relations more logically where symmetry, transitivity, and conjunctive constraints are much well enforced compared to vector-representation models.
- Two papers [23, 22] published at **ICLR** and **ACL**.

Case-based reasoning (CBR) for QA and KBQA

2020 – 2022

Postdoctoral associate

UMass Amherst

- By using semi-parametric modeling, CBR learns to refer to known (labeled) question-answer cases rather than memorizing all the information of training data in the parameter space.
- CBR approach showed the state-of-the-art performance in Knowledge-Based Question Answering (KBQA) [25].
- CBR approach especially showed its strength when new examples from unseen entities, relations were provided.
- One paper has been published in **EMNLP** and additional research paper on QA with natural texts is in progress.

Semi-supervised learning with output constraints for neural NLP model

2017 – 2023

Research Assistant, Postdoctoral associate

Carnegie Mellon University & UMass Amherst

- This approach showed a significant improvements in low-resource and also showed on par or better performance on top of state-of-the-art models [29, 27].
- In [29], syntactic constraint from parse tree was applied to semantic role labeling (SRL).
- In [27], coherence (agreement constraint) was promoted between multi-view models, thus called Co-meta, using unlabeled dataset.
- During postdoc, I have extended this research toward distant supervision on unsupervised syntactic parsing model [24] where easy-to-gather span constraints are injected as a constraint to parsing tasks.
- Currently working on injecting constraint that the output of two similar tasks, abstract meaning representation (AMR) and information extraction (IE), have to be consistent utilizing unlabeled data. This showed better performance than the state-of-the-art model and is being prepared for publication.
- Three papers [29, 27, 24] have been published in **AAAI** and **EMNLP** and additional research on Question-Answering (QA) with natural texts is in progress.

Gradient-based inference using output constraints

2017 – 2019

Research Assistant

Carnegie Mellon University

- Most of the sequence-prediction tasks such as sequence generation and sequence tagging requires combinatorial search in exponential search in order to enforce global constraints on the sequence.
- Instead of conducting “discrete” combinatorial search, this project proposes to conduct gradient-based inference on “continuous” model parameters which produces output.

- This approach showed better and faster performance than combinatorial search on several tasks: transducer with arbitrary constraints, syntactic parsing with structural constraints, and SRL with syntactic constraints.
- This approach was also useful for *low-resource problem* and *domain-adaptation*.
- One conference paper [28] (**AAAI**), workshop paper[30] (**AKBC**), and one patent (US20180121807A1) got published.

Part forecasting and price prediction for airplane parts

2015 – 2020

Research Assistant

Carnegie Mellon University

- This was part of Boeing project which had a sponsorship of \$15m between 2015-2021.
- Part forecasting had several regression task: predicting part longevity, part price, and part inventory.
- This resulted in significant amount of profit for Boeing (unable to disclose the amount).

Detecting anomalies in large-scale graphs

2012 – 2015

Research Assistant

Carnegie Mellon University

- Funding was provided by the U.S. Army Research Office (ARO) and Defense Advanced Research Projects Agency (DARPA) under Contract Number W911NF-11-C-0088.
- Given a billion-scale graph, inspecting this enormous graph for an outlier requires novel data structures and scalable analysis tools.
- Published two conference papers in **KDD**, **PAKDD** and one poster at **WWW**.

TEACHING EXPERIENCE

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|--------------------------------|--|
| Fall 2022, 2023, 2024, 2025 | Instructor , <i>Neural Networks for NLP (graduate level)</i> , Seoul National University |
| Spring, Fall 2024 | Instructor , <i>Machine Learning & Deep Learning 1 (graduate level)</i> , Seoul National University |
| Spring 2022 - Fall 2023 | Instructor , <i>Foundations of Math and Statistics for Data Science (graduate level)</i> , Seoul National University |
| Spring 2022 | Project mentor , <i>Industry Mentorship Program course.</i> , UMass Amherst |
| Spring 2021 | Ph.D. evaluator , <i>Industry Mentorship Program course.</i> , UMass Amherst |
| Spring 2015 | Teaching Assistant , <i>Machine Learning (Ph.D. level)</i> , Carnegie Mellon University |
| Fall 2014 | Teaching Assistant , <i>Multimedia Databases and Data Mining</i> , Carnegie Mellon University |

RESEARCH MENTOR EXPERIENCE

I was fortunate to mentor and collaborate with various Ph.D. and MS students during my Ph.D & postdoctoral role. I currently mentor approximately 20 graduate students.

PROFESSIONAL SERVICE

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|--------------|--|
| 2019-2025 | Reviewer , <i>ICML, ICLR, NeurIPS, ACL and EMNLP</i> |
| 2023-current | Area Chair , <i>NeurIPS, EMNLP, ARR, COLING, COLM, CIKM</i> |

HONORS AND AWARDS

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|---------------------|---|
| Dec 2023 | Selected as “ Best Area chair ” for Machine Learning track at EMNLP 2023 |
| Apr 2022, May 2025 | Selected as “ Highlighted Reviewer ” at ICLR 2022 & “ Top Reviewer ” at ICML 2025 . |
| Mar 2003 - Feb 2008 | Scholarship in Science & Technology , Korea Student Foundation |
| Mar 2005 - Feb 2008 | Scholarship in Mathematics , Korea Foundation for Advanced Studies |
| Aug 2016 | Best Presenter (\$3k prize) , Global Top Talent Forum, Hyundai Motor Group, San Diego, CA |
| June 2016 | 1st place (\$5k team prize) , Qualcomm NeuroHackathon, Carnegie Mellon University, PA |

TECHNICAL SKILLS

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|-----------------------------|--|
| Major Language | Python, Java, MATLAB, C++, SQL |
| Library & Others | Pytorch, Tensorflow, AllenNLP, Weights & Bias , Keras, Git, LaTeX |