Jaeheun Jung

Bridging Algebraic Geometry and Practical Deep Learning

My research = (Mathematical rigor)+(Algorithmic simplicity)+(Practical impact)

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Employment

Korea University

Since 2026 Postdoctoral Researcher (Mentor: Donghun Lee)

Education

Ph.D in Mathematics

Korea University

2020-2026 Artificial Intelligence, Advisor: Donghun Lee

- Dissertation title: “Bypass and Beyond: Extension–Contraction Paradigm for Escaping Stationary Points and Compressing Neural Networks”

2019-2020 Algebraic geometry, Advisor: Euisung Park

B.S. in Mathematics

2013-2018 Korea University

Research Interests

- Geometric Deep Learning: Investigating the loss landscapes and parameter spaces of neural networks through the lens of Algebraic Geometry and Topology.
- Deep learning methods:
  - Trustworthy & Reliable AI: Developing robust Machine Unlearning and Model Editing frameworks with theoretical guarantees.
  - Efficiency & Optimization: Structural pruning and optimization strategies based on algebraic geometry with landscape extension.
- Deep learning applications:
  - Scientific AI & Engineering Optimization: Applying deep learning to complex physical systems, including Seismic Modeling and Kinematic Synthesis (Linkage Design), bridging the gap between mathematical theory and engineering practice.
  - Mathematical Frameworks for Multi-modal Data: Vision, NLP, signal processing, speech, tabular and automatic machine design.

Publications

(*): equal contribution

Peer-Reviewed Journal Articles

[J2] **Jaeheun Jung** and Donghun Lee. 2024. “Bypassing Stationary Points in Training Deep Learning Models,” in **IEEE Transactions on Neural Networks and Learning Systems**, vol. 35, no. 12, pp. 18859-18871, Dec. 2024, doi: 10.1109/TNNLS.2024.3411020.

[J1] **Jaeheun Jung** and Euisung Park. 2024. “On Completely Decomposable Defining Equations of Finite Sets in Pn.” Communications in Algebra 52, no. 6 (2024): 2527–33. doi:10.1080/00927872.2024.2302084.

Peer-Reviewed Conference Proceedings

[C3] (Accepted) Inseo Jung, Dabin Seo, Sukyung Baek, **Jaeheun Jung**, Donghun Lee, and Jinkyu Kim. “HyperUn: Controlling Uncertainty in Hyperbolic Space for Machine Unlearning”, Proceedings of the 28th International Conference on Pattern Recognition (**ICPR 2026**), 2026.

[C2] **Jaeheun Jung***, Jaehyuk Lee*, Chang-Hae Jung, Hanyoung Kim, Bosung Jung and Donghun Lee, 2024, “Broadband Ground Motion Synthesis by Diffusion Model with Minimal Condition”, In the 42nd International Conference on Machine Learning (**ICML 2025**), 2025.

[C1] Taehun Cha*, **Jaeheun Jung*** and Donghun Lee. 2022. “Noun-MWP: Math Word Problems Meet Noun Answers.” In Proceedings of the 29th International Conference on Computational Linguistics (**COLING 2022**), 3847–57. Gyeongju, Republic of Korea: International Committee on Computational Linguistics.

Preprints (Under Review)

[P4] **Jaeheun Jung**, Bosung Jung, Suhyun Bae and Donghun Lee. “OPC: One-Point-Contraction Unlearning Toward Deep Feature Forgetting”, Arxiv preprint 2025, url: https://arxiv.org/abs/2507.07754

[P3] **Jaeheun Jung***, Jaehyuk Lee*, Yeajin Lee and Donghun Lee, “IPPRO: Importance-based Pruning with PRojective Offset for Magnitude-indifferent Structural Pruning”, Arxiv preprint 2025, url: https://arxiv.org/abs/2507.14171

[P2] **Jaeheun Jung** and Donghun Lee, “Catalyst: Structured Pruning with Robust Bifurcation Dynamics”, Arxiv preprint 2025, url: https://arxiv.org/abs/2507.14170

[P1] **Jaeheun Jung***,Woonryong Kim*,Jeongun Ha, Donghun Lee, Jaekyung Shim “Data-Driven Dimensional Synthesis of Diverse Planar Four-bar Function Generation Mechanism via Direct Parameterization”, Arxiv preprint 2025, url:https://arxiv.org/abs/2507.08269.

Conference Workshop Papers (Peer-Reviewed, Non-Archival)

[W5,P3] **Jaeheun Jung***, Jaehyuk Lee*, Yeajin Lee and Donghun Lee, “IPPRO: Importance-based Pruning with PRojective Offset for Magnitude-indifferent Structural Pruning”, In **ICCV 2025 workshop** - 2nd Workshop and Challenge on Unlearning and Model Editing (U&ME), 2025

[W4,P4] **Jaeheun Jung**, Bosung Jung, Suhyun bae and Donghun Lee, “OPC: One-Point-Contraction Unlearning Toward Deep Feature Forgetting”, In **ICCV 2025 workshop** - 2nd Workshop and Challenge on Unlearning and Model Editing (U&ME), 2025

[W3] **Jaeheun Jung***, Jaehyuk Lee*, Hanyoung Kim*, Changhae Jung and Donghun Lee, “Enhancing Generative Seismic Modeling via Paired Dataset Construction Method”, In **ICML 2025 workshop** TerraBytes, 2025.

[W2] Jaehyuk Lee*, **Jaeheun Jung***, Yeajin Lee*, Changhae Jung and Donghun Lee, “Broadband Ground Motion Synthesis by Diffusion Model with Minimal Condition”, **In ICML 2025 workshop** Machine Learning for Audio, 2025.

[W1,P2] **Jaeheun Jung** and Donghun Lee, “Catalyst: Structured Pruning with Robust Bifurcation Dynamics”, In **ICML 2025 Workshop** - 3rd Workshop on High-dimensional Learning Dynamics (HiLD), 2025.

Patents

[PT1] **Jaeheun Jung** and Donghun Lee, “Method for overcoming artificial neural network learning failure through local minima bypass and artificial neural network learning apparatus for performing the same”, KR patent registered 10-2789913-0000, filed Oct 25, 2021, issued Mar 27, 2025.

[PT2] **Jaeheun Jung**, Jaehyuk Lee, Changhae Jung and Donghun Lee, “Artificial neural network simulation device based on condition latent diffusion model for virtual seismic wave synthesis”, KR10-2024-0185214, Patent pending.

[PT3] **Jaeheun Jung** and Donghun Lee, “Artificial neural network structured pruning apparatus and method”, KR10-2024-0145553, Patent pending.

[PT4] **Jaeheun Jung**, Woonryong Kim, Jungun Ha, Donghun Lee and Jaekyung Shim, “Training method for dimensional synthesis of function generation mechanism in linkage apparatus and apparatus thereof”, KR10-2025-0083085, Patent pending.

[PT5] **Jaeheun Jung**, Woonryong Kim, Jungun Ha, Donghun Lee and Jaekyung Shim, “Training method for dimensional synthesis of function generation mechanism in slider-crank apparatus and apparatus thereof”, KR10-2025-0083095, Patent pending.

[PT6] **Jaeheun Jung**, Jaehyuk Lee, Yeajin Lee and Donghun Lee, “Apparatus and method for structured pruning of neural networks based on filter importance assessment using projective geometry”, KR10-2025-0087784, Patent pending.

[PT7] **Jaeheun Jung**, Bosung Jung and Donghun Lee, “Apparatus and method for neural network unlearning based on one-point contraction”, KR10-2025-0092132, Patent pending.

[PT8] **Jaeheun Jung**, Bosung Jung, Suhyun Bae and Donghun Lee, “Apparatus and method for recovering and evaluating machine unlearned neural networks”, KR10-2025-0092136, Patent pending.

- 12 more registered patents (related to old projects, non-ML) can be found with `IN=[420090360374]` in KIPRIS
  - Demonstrating long-standing expertise in practical engineering and problem-solving

Grants and Contracts

(accepted) National Research Foundation (NRF), Republic of Korea, Post-Doc. Research for Growth Program, “Geometric Analysis of Structured L0 Optimization for Theoretically Grounded Lossless Neural Network Pruning,” KRW 180,000,000, June 1, 2026 - May 31, 2029.

(accepted) Ministry of Science&ICT and Ministry of Education, Republic of Korea, Laboratory-Specialized Start-up Leading University Program, “On-site AI Evolution Platform using Online Lightweighting Techniques for Neural Networks” , KRW 65,000,000, March 1, 2026 - December 31, 2026.

Korea University, Academic Research Society Support Program, “The Synthesis of Function Generation Mechanism based on Machine Learning”, KRW 2,000,000, April 1, 2024 - December 31, 2024.

(non-ML) Ministry of SMEs and Startups, Republic of Korea, Support Program for Tech-Based Startups, “Reinforced wrap-spring clutch device for household use with gravity compensation” , KRW 82,000,000, August 1, 2018 - May 31, 2019.

Invited Talks

- Natural language processing using the Pretrained Language Model and solving a math word problem, Artificial intelligence symposium, GWNU (Gangneung-Wonju national university) Natural Science Research Institute, 2023

- Bypass and Beyond: Extension–Contraction Strategies for Escaping Training Stagnation and Achieving Lossless Prunings, AI and Natural Sciences Seminar, Korea Institute for Advanced Study (KIAS), 2025
- (Poster) Catalyst: Structured Pruning with Robust Bifurcation Dynamics, KIAS Center for AI and Natural Sciences 2026 Winter Workshop, Gangwon, Korea, 2026

Conference oral presentations

- IPPRO: Importance-based Pruning with PRojective Offset for Magnitude-indifferent Structural Pruning, ICCV2025 workshop U&ME, 2025
- OPC: One-Point-Contraction Unlearning Toward Deep Feature Forgetting, ICCV2025 workshop U&ME, 2025
- Bypassing stationary points in training deep learning models, Korean Mathematical Society 2024 Fall Meeting, 2024
- On completely decomposable defining equations of points in general position in Pn, Korean Mathematical Society 2020 Fall Meeting, 2020

Research Projects

AI-related (Group projects)

Since 2025 *Project Unlearning* (Project Lead, full-cycle)

- Collaborators: Bosung Jung and Suhyun Bae from AIMLK
- Revealed: MU methods forgets shallowly; performance on forget set is easily recovered
- Proposed: OPC for MU, designed for the deep feature forgetting and robustness on recovery and inversion attack
- Role: Project leader, proposed attack scheme, evaluation criteria and new MU method, and full management of overall project.
- Status: 1 full Manuscript accepted to ICCV workshop and uploaded to arxiv. 2 patents are pending.

Since 2025 *Project Pruning* (Project Lead, full-cycle)

- Collaborators: Jaehyuk Lee and Yeajin Lee from AIMLK
- Structured pruning with projective geometry
- Proposed: Importance criteria for structured pruning with magnitude-independent property.
- Role: Project leader, proposed importance criteria and related theory, full management of overall project including experiment design, finetuning strategies, etc.
- Status: Manuscript accepted to ICCV workshop, patent pending and further experiments on transformers are in progress.

2023-2025 *Project Autokinematics* (Project Lead, full-cycle)

- Joint work with Woonryong Kim from Mechanical Design & CAD Lab in Korea University, and Jeong-un Ha (AIMLK)
- Automated machine design problem on kinematics, starting with 4-bar joint problem with arbitrary number of precision points.
    - curve fitting problem on torus T^2, where curve parameter lies on projective space P^3
- Role: Project leader. Spearheaded the end-to-end research lifecycle, from conceptualizing the synthesis problem as L2O object,and led the collaboration between Math and Mechanical Engineering departments
    - Implemented: data synthesis module with efficient algorithm, and automated train/evaluation pipelines.
    - Proposed: Domain specified metrics, neural network design and overall training processes.
- Status: Manuscript uploaded to arxiv and 2 patents are pending.

2023-2025 *Project Earthquake* (Project Lead)

- Collaborators: Jaehyuk Lee, Chang-Hae Jung, Hanyoung Kim and Bosung Jung from AIMLK
- Imputation subproject: generating synthetic waveform at synthetic station using nearby station's observations and metadata.
    - Proposed diffusion-model based approach with domain-specific characteristics on seismic dataset.
- Role: Project leader. Managed: strategies for the generations, and model architectures, all evaluations and theoretical foundations.
- Status: 1 paper accepted to ICML 2025, 2 papers accepted to ICML 2025 workshops, 1 patent pending.

2023-2023 *6th AI Grand Challenge: Policy Supporting AI Round 2* (Team lead)

- Collaborators: Taehun Cha (Project leader), Yanggee Kim, Hanyoung Kim, Changhae Jung, Yejin Jeong and Nayoung Lee from AIMLK
- RAG (Retrieval augmented generation) task for automatic research report generation
- result: 7th place, award from the President of the Korea Electronics Research Institute
- Role: Group leader, managed assembly of hwp parser, retriever and generation module with proper prompt engineering, docker containers.

2023-2023 *6th AI Grand Challenge: Policy Supporting AI open track* (Project Lead)

- Collaborators: Taehun Cha, Jeong-un Ha, Yanggee Kim, Hanyoung Kim, Jaehyuk Lee, Keunsuk Cho, Changhae Jung, Yejin Jeong and Sanga Yoon from AIMLK
- Continued from 2022: multi-hop multimodal open-domain QA task
- result: 2nd winner
- Role: Project leader. Full management on overall tasks including GPT/rule-based data augmentation, multimodal retrieval model development and multi-hop QA solver development.

2022-2022 *6th AI Grand Challenge: Policy Supporting AI Round 1* (Project co-Lead)

- Collaborators: Taehun Cha, Jeong-un Ha, Hansol Jeon, Yanggee Kim, Hanyoung Kim, Jaehyuk Lee and Keunsuk Cho from AIMLK
- NLP task on document processing for structured & muti-hop QA with retrieval on open-domain conditions
- Achieved 7th place out of 54 teams (2nd of academic teams)
- Role: Project co-leader. Designed global solving pipeline, managed development processes and dataset, and implemented retrieval models, QG model for augmentation, evaluation server with Flask, docker containers, pdf and hwp parsers and preprocessor.

2022-2022 *Korean AI Competition*

- Collaborators: Taehun Cha, Yanggee Kim and Hansol Jeon from AIMLK
- ASR (automatic speech recognition) task on korean language.
- Held by Korean National Information Society Agency, supported by Naver Corp and Hyundai Motor Company
- Achieved 4th place out of 103 teams
- Role: Implementation of baseline models and korean decoder module for phonemes.

2021-2022 *Project Fashion* (Project Lead)

- Collaborators: Yanggee Kim, Jaehyuk Lee and Wooyoung Jung from AIMLK
- Generating 3D model with VTON (virtual try-on) from given cloth and 2D model images.
- Role: Project leader. Designed pipeline of the solution, data processing and model architecture and implemented via transfer learning.

2021-2021 *5th AI Grand Challenge 2021* (Project co-Lead)

- Collaborators: Taehun Cha, Hason Jeon and Dongwon Kim from AIMLK

- NLP task on Korean elementary school level math word problems, with various nonarithmetic operations required
- Awarded (ranking not published) and selected for the follow-up research
- Role: Project co-leader. Proposed global pipeline of solving problem with target sequence design, implemented pre and post-processing parts and managed model training.
- Paper published in COLING 2022, title: Noun-MWP: Math Word Problems Meet Noun Answers.

AI-related (Personal project)

Since 2023 *Project Mildpruning*

- personal research project on structured pruning
- pointed out the drawback of existing (group) lasso regularizer and proposed new regularizer.
  - which ensures lossless pruning and bifurcation
  - related to bypass algorithm for the implementation.
- status: 1 Manuscript presented to ICML workshop (full paper under review) and 1 Patent pending
- Extended to group project with multiple future directions.

2020-2023 *Project Bypass*

- personal research project on neural network training
- proposed and evaluated local-minima escaping algorithm for first order optimization on neural networks
- status: Done, paper published in IEEE TNNLS

Other projects (non-ML)

2019-2020 Graduate research project on Defining equations of finite points
2018-2019 Personal startup project on Reinforced blind clutches
2016-2017 Undergraduate research project on Commuting varieties
2011-2017 Personal project on safety blind clutches
2011-2012 R&E project for Study on the functional regulation of adipocytes
2009-2011 Personal project on Flat Light collecting devices

Honors & Awards

- 2nd Winner, 6th AI Grand Challenge: Policy Supporting AI Open Track by Korean Ministry of Science and ICT , 2023
- 7th Winner (Award from President of Korea Electronics Technology Institute, KETI), 6th AI Grand Challenge: Policy Supporting AI Round 2 by Korean Ministry of Science and ICT, 2023
- 4th Winner, Korean AI Competition (Award from President of National Information Society Agency, NIA), 2022
- 6th place, 5th AI Grand Challenge (AI for Math Problem Task) by Korean Ministry of Science and ICT, 2021

Teaching Assistant & Grading at Korea University

2025 MATH292 Mathematics for Artificial Intelligence
2019 MATH222 Linear Algebra II
2019 MATH221 Linear Algebra I
2019 GEQR011 Methodology of Mathematical Science

Technical Skills

- Programming: Python (Expert), LaTeX
- Deep Learning: PyTorch (Expert), TensorFlow, HuggingFace
- Engineering & Dev: Docker, Git/GitHub, Linux, Flask (API development), Cloud computing
- Mathematical Domains: Algebraic Geometry, Commutative Algebra, Optimization, Information theory, Geometric Deep Learning, Landscape geometry

Professional Services

Reviewer

2026:

- Transactions on Machine Learning Research (TMLR)
- Neural Information Processing Systems(NeurIPS 2026)
- International Conference on Machine Learning (ICML 2026)
    - Gold Reviewer Award (top 25% reivewer)

2025:

- International Conference on Learning Representations (ICLR 2026)
- British Machine Vision Conference (BMVC 2025)
- IEEE Transactions on Circuits and Systems for Video Technology

Member

- Korean Mathematical Society (KMS)