

Yoonsoo Nam, Ph.D.

Postdoctoral researcher
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Research Interests

- Neural network dynamics analysis through simplified models (e.g., linear networks)
- Feature learning mechanisms and the inductive bias of deep neural networks (e.g., LLMs)
- Mathematical foundations and pedagogical frameworks for deep learning theory (i.e., physics of deep learning)

Education

University of Oxford

DPhil in Theoretical Physics (advisor: Ard A. Louis)
Inductive Bias from Layerwise Structure and Backpropagation in Neural Networks: Analysis through Simplified Models and Empirical Frameworks

October 2020 ~
July 2025

University of Cambridge

MASt in Theoretical Physics
Result: Pass

October 2013~
July 2014

University of Oxford

BA in Physics
Result: First Class Honours (4th place in Prelims)
Dissertation: Using three-wave quantum inference for molecule detection

October 2008~
July 2013

Gyeonggi Science High School

March 2006 ~
February 2008

Academic Experience

Korea Advanced Institute of Science and Technology (KAIST)

Postdoctoral researcher
OptiML lab, Kim Jaechul Graduate School of AI (advisor: Chulhee Yun)
Center for Large Language Model Innovation (InnoCORE-LLM)

November 2025~
Present

Industry Experience

Naver Corporation

ML Engineer at AutoML Team (Clova)

August 2019 ~
July 2020

- Developed Hyperparameter tuning tool with hyperband, GP, and PBT
- Development of Multiprocess proxyless differential Neural Architecture Search for CNN

ML Engineer at Local Search Team (Search)

September 2017
~ August 2019

- Development of Personalized restaurant recommendation for millions of users (SmartAround) using Graph-CNN similar to PinSage.
- Restaurant and keywords embedding

Tmax Data

January 2015 ~
September 2017

Software engineer / Researcher (alternative military service)

- Main developer of transaction layer in relational database engine, which is system-software written in C that ensures data atomicity and consistency in high-concurrency environments.
- Development of three times faster rollback for long transactions

Awards & Honors

InnoCore Program

2025 ~ Present

Postdoc fellowship program from Korea ministry of science and ICT

Super Rookie Award

2017

Best Junior Developer of the year (Tmax Data)

President Science Scholarship

2008 ~ 2012

Full scholarship from Korea Student Aid Foundation

International Olympiad on Astronomy and Astrophysics (IOAA)

2007

Bronze medal

International Young Physicist Tournament (IYPT)

2007

Silver medal (Second place)

Publications

Conferences/Journals

1. Automation of Rietveld Refinement through Machine Learning

Suk Jin Mun, Yoonsoo Nam, and Sungkyun Choi

Journal of Applied Crystallography

2. Decoupling Dynamical Richness from Representation Learning: Towards Practical Measurement

Yoonsoo Nam, Nayara Fonseca, Seok Hyeong Lee, Chris Mingard, Niclas A. Göring,

Ouns El Harzli, Abdurrahman Hadi Erturk, Soufiane Hayou, Ard A. Louis

International Conference on Learning Representations (ICLR) 2026

3. Position: Solve Layerwise Linear Models First to Understand Neural Dynamical Phenomena (Neural Collapse, Emergence, Lazy/Rich Regime, and Grokking)

Yoonsoo Nam^{*}, Seok Hyeong Lee^{*}, Clementine CJ Domine, Yeachan Park, Charles London, Wonyl Choi, Niclas A. Goring, Seungjai Lee

International Conference on Machine Learning (ICML) 2025

4. An Exactly Solvable Model for Emergence and Scaling Laws in the Multitask Sparse Parity Problem

Yoonsoo Nam^{*}, Nayara Fonseca^{*}, Seok Hyeong Lee, Chris Mingard, Ard A. Louis

Annual Conference on Neural Information Processing Systems (NeurIPS) 2024

5. HyperTendril: Visual Analytics for User-driven Hyperparameter Optimization of Deep Neural Networks

Heungseok Park, Yoonsoo Nam, Ji-Hoon Kim[†], and Jaegul Choo[†]

IEEE Transactions on Visualization and Computer Graphics 27 (Feb. 2021), pp. 1407-1416

Workshops

1. Disentangling Feature Learning from Generalization in Neural Networks

Niclas A. Göring, Charles London, Abdurrahman Hadi Erturk, Chris Mingard, Yoonsoo Nam, Ard A. Louis

ICML 2025 Workshop on High-dimensional Learning Dynamics (HiLD)

2. Algorithmic Stability of Minimum-Norm Interpolating Deep Neural Networks

Ouns El Harzli^{*}, Yoonsoo Nam^{*}, Ilja Kuzborskij, Bernardo Cuenca Grau, Ard A. Louis

Neurips 2024 Workshop on Mathematics of modern machine learning (M3L)

Preprints/Under Review

1. Saddle-to-Saddle Dynamics in Self-Supervised Shortcut Learning

Juhwan Kim, Yoonsoo Nam[†], Sungyoon Lee[†]

2. Supervised Sparse Auto-encoders as Unconstrained Feature Models for Semantic Composition

Ouns El Harzli^{*}, Hugo Wallner^{*}, Yoonsoo Nam, Haixuan Xavier Tao

arXiv:2602.00924

3. A Simple Mean Field Model of Feature Learning

Niclas A. Göring, Chris Mingard, Yoonsoo Nam, Ard A. Louis

arXiv:2510.15174

4. Exploiting the equivalence between quantum neural networks and perceptrons

Chris Mingard, Jessica Pointing, Charles London, Yoonsoo Nam, Ard A. Louis

arxiv 2407.04371

^{*} Equal Contributions

[†] Co-correspondence

Patents

1. Method And System For Searching Information Based On Location

Jihoon Choi, Jinho Kim, Yiseul Kim, Junhyun Yoo, Daek Go, Yoonsoo Nam, Yeonghwan Jeon
Assignee: Naver Corporation; Patent Application Number (Date): 1020180028891 (2018.03.12)

2. Method And System For Item Recommendation

Jihoon Choi, Jinho Kim, Yiseul Kim, Junhyun Yoo, Daek Go, Yoonsoo Nam, Yeonghwan Jeon
Assignee: Naver Corporation; Patent Application Number (Date): 1020180033298 (2018.03.22)

Invited Talks

NIMS Innovation Center for Industrial Mathematics, Seongnam, South Korea March 2025

Host: Minjung Gim

UNIST AIGS Graduate Seminar, Ulsan, South Korea March 2025

Title: Solve Layerwise Linear Models First to Understand Neural Dynamical Phenomena

2026 SAARC Closing Workshop, Busan, South Korea February 2026

Title: Solve Layerwise Linear Models First to Understand Neural Dynamical Phenomena

KIAS CAINS 2026 Winter Workshop, Goseong, South Korea January 2026

Title: Understanding Batch Normalization and Skip Connection through Lazy/Rich Dynamics Removes Grokking

SISSA, Trieste, Italy September 2025

Host: Sebastian Goldt

KAIST, Seoul, South Korea July 2025

OptiML (Host: Chulhee Yun)

Sejong University, Seoul, South Korea July 2025

Host: Yeachan Park

Hanyang University, Seoul, Korea July 2025

LRNING (Host: Sungyoon Lee)

Korea University, Seoul, South Korea July 2025

AI+Math Lab (Host: Donghun Lee)

KIAS AI Center Seminar, Seoul, South Korea June 2025

Title: Solve Layerwise Linear Models First to Understand Neural Dynamical Phenomena

Professional Services & Outreach

Academic service

Reviewer: ICML (2026), ICLR (2026), NeurIPS (2025), HiLD Workshop @ ICML (2025)

January 2025 ~
Present

Pedagogical Contribution

Textbook project: *An intuitive guide to theory of neural networks* (In progress)

February 2025 ~
December 2029
(Expected)

- Authoring a textbook to provide a principled yet accessible framework for deep learning theory for talented undergraduates and graduates. Rather than focusing on formal proofs or heuristic engineering rules, the book adopts a physics-inspired approach to uncover the underlying principles of neural dynamics and feature learning.

Advisory & Industry Engagement

External Technical Consultant, Intervest (Venture Capital)

November 2025 ~
Present

- Providing technical due diligence and strategic assessments for AI and LLM-based startups
- Bridge expert networks for technology validation/assessment.

The 15th Cohort Member, NextCEO Forum (Samsung Securities)

- Selected for a premier leadership network comprising next-generation CEOs

March 2026 ~
November 2026