

Jinyeop Song

AI Researcher at Xaira Therapeutics

📞 (+1)617-949-1042 | ✉ yeopjin@mit.edu | 🏠 <https://jinyeop3110.github.io> | ❤ Boston, MA, USA

Education

Massachusetts Institute of Technology (MIT)

Ph.D. in Physics and Statistics - GPA: 4.8/5.0

Supervisor : Jeff Gore

Cambridge, MA, USA

Aug 2020 - Aug 2026

Korea Advanced Institute of Science and Technology

B.S. in Physics (Major) and Math (Minor) - GPA: 4.16/4.3 (Summa Cum Laude)

Daejeon, Korea

Mar 2014 - Jun 2020

Professional Experience

Xaira Therapeutics

AI Researcher

South San Francisco, CA, USA

Aug 2026 - Present

IBM Research – Watson AI Lab

Research Intern

Cambridge, MA, USA

2025

- Developed a knowledge-graph-augmented RAG framework for LLMs using multi-turn reinforcement learning (RL), achieving state-of-the-art accuracy with 47% lower generation cost and 6% higher transferability compared with prior methods.

Machine Learning Alignment and Theory Scholars

Research Fellow

Berkeley, CA, USA

2025

- Proposed a novel, goal-agnostic evaluation framework for LLM agents using the information-theoretic measure (i.e., empowerment: mutual information between actions and future states).

MIT

Graduate Research Assistant (PI: Prof. Jeff Gore)

Cambridge, MA, USA

Feb 2021 – Aug 2026

- Explored emergent phenomena (e.g., neural scaling behaviors, in-context learning) in LLMs, linking theories with empirical results.
- Developed a foundation model for human methylation data that predicts patient aging and chronic disease.
- Explored how interspecies interaction strength shapes the merging of two microbial communities using experiments and simulations.

Samsung Electronics Research

Research Intern

Suwon, Korea

2020

- Investigated post-quantum cryptography (lattice-based encryption methods) for use in DRAM products.

Harvard–MIT Health Sciences and Technology

Research Intern

Boston, MA, USA

2019

- Developed a neural connectome reconstruction algorithm that maps brain images into 3D space.

KAIST

Undergraduate Research Assistant

Daejeon, Korea

Jul 2014 – Aug 2020

- Biomedical Optics (PI: Prof. YongKeun Park): developed deep-learning algorithms for 3D time-lapse tracking of CAR-T cells; built classification models using 3D refractive-index maps for rapid pathogen identification.
- Chromatin/Protein Engineering (PI: Prof. Wonki Cho): implemented thermodynamic simulation code for multivalent antibody binding.
- Quantum & Nanophotonics (PI: Prof. YongHoon Cho): investigated exciton–polariton coupling in GaN nanoporous DBR cavities.

Full Publications

† denotes co-first authors.

AI related

[1] Liang, Q., **Song, J.**, Liu, Y., Gore, J., Fiete, I.R., Miikkulainen, R., & Qiu, X. “The Blessing of Dimensionality in LLM Fine-tuning: A Variance-Curvature Perspective.” *arXiv preprint* (2026). [PDF]

[2] **Song, J.**, Wang, S., Shun, J., & Zhu, Y. “Efficient and Transferable Agentic Knowledge Graph RAG via Reinforcement Learning.” *Under Review* (2026). [PDF]

[3] **Song, J.**, Gore, J., & Kleiman-Weiner, M. “Estimating the Empowerment of Language Model Agents.” *ICML 2026*. [PDF]

[4] Akke, M., Yang, S., Ruža, J., **Song, J.**, Pan, E., & Gómez-Bombarelli, R. “When Do LLMs Improve Bayesian Optimization? A Systematic Comparison Across Molecular and Protein Design.” *NeurIPS 2025, AI4Science Workshops*. [PDF]

[5] Son, G., Hong, J., Fan, H., Nam, H., Ko, H., Lim, S., **Song, J.**, Choi, J., Paulo, G., Yu, Y., & Biderman, S. “When AI Co-Scientists Fail: SPOT - Benchmark for Automated Verification of Scientific Research.” *arXiv preprint* (2025). [PDF]

[6] **Song, J.**[†], Han, S.[†], Agrawal, P., & Gore, J. “Emergence and Effectiveness of Task Vectors in In-Context Learning: An Encoder Decoder Perspective.” *ICML 2025, Spotlight*. [Link]

[7] Yang, S., Nam, J., Perez, T., **Song, J.**, Du, X., & Gomez-Bombarelli, R. “Probing the Embedding Space of Protein Foundation Models through Intrinsic Dimension Analysis.” *NeurIPS 2025, AIDrugX Workshop*. [Link]

[8] Ying, A.[†], **Song, J.**[†], Cui, H.[†] ... et al. “MethylGPT: a foundation model for the DNA methylome.” *Under Review at Nature Methods* (2024). [bioRxiv]

[9] Pearce, T., & **Song, J.** “Reconciling Kaplan and Chinchilla Scaling Laws.” *TMLR*, 2024. [Link]

[10] **Song, J.**[†], Liu, Z.[†], Tegmark, M., & Gore, J. “Resource model for neural scaling law.” *ICLR 2024, BGPT Workshop*. [Link]

Biophysics related

[1] **Song, J.**, Hu, J., & Gore, J. “Interspecies Interactions Drive Community-level Selection in Microbial Coalescence.” *Nature Ecology and Evolution*, 2026. [bioRxiv]

[2] Gore, J., Hu, J., He, Y., Barbier, M., **Song, J.**, & Bunin, G. “Transition from Global Stability to Multiple Attractors in Microcosms.” *Under Review at Nature Portfolio* (2025). [Preprint]

[3] **Song, J.**[†], Jeong, B.S.[†], ..., & Oh, B.H. “Noncovalent antibody catenation on a target surface greatly increases the antigen-binding avidity.” *eLife*, 9: e81646, 2023. [Link]

[4] Lee, M.[†], Lee, Y. H.[†], **Song, J.**[†], ..., & Park, Y. “Deep-learning-based three-dimensional label-free tracking and analysis of immunological synapses of CAR-T cells.” *eLife*, 9, 2020. [Link]

[5] Kim, G., Ahn, D., Kang, M., Jo, Y., Ryu, D., Kim, H., **Song, J.**, ..., & Kim, K. “Rapid species identification of pathogenic bacteria from a minute quantity exploiting three-dimensional quantitative phase imaging and artificial neural network.” *Light: Science & Applications*, 2022. [Link]

Awards and Honors

MATS Scholarship (2025), Mokam Research Scholarship (2023), Korean Physical Society Best Oral Presentation Award (2020), Asan Foundation Biomedical Science Scholarship (2021–2025), Excellent Graduate of KAIST (2020), KAIST Presidential Fellowship (KPF, 2016), Korea Presidential Science Scholarship (2014–2020)

Teaching & Extracurricular Experiences

2024 - 2025	Organizer: AI Journal Club	MIT
2023	Teaching Assistant: “Complex Systems Biology”	MIT
2015 - 2018	Freshmen Tutoring Program	KAIST

Skills

Programming: Python, PyTorch, CUDA, Git, MATLAB, R | **Languages:** English (Fluent), Korean (Native), Chinese (Elementary)

References

- Prof. Max Kleiman @ UW
- Prof. Jeff Gore @ MIT
- Prof. Oh, Byung-Ha @ KAIST