JinYeop Song

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Education

Massachusetts Institute of Technology *Cambridge, MA, USA*
Ph.D. Candidate in Physics and Statistics *Aug 2020 - Jun 2026 (Expected)*
Supervisor: Jeff Gore

Korea Advanced Institute of Science and Technology *Daejeon, Korea*
B.S. in Physics (Major) and Math (Minor) *(Summa Cum Laude)* *Mar 2014 - Jun 2020*

Korea Science Academy of KAIST *Busan, Korea*
High School for Gifted Students in Science *Mar 2011 - Feb 2014*

Interests

Physics of LLM, LLM Scaling Laws, Foundation Models for Science, LLM Agents

Work Experience

IBM-MIT Watson AI Lab *Boston, MA, USA*
`Summer Intern` *2025*

Machine Learning Alignment and Theory Scholars *Berkeley, CA, USA*
`Research Fellow` *2025*

Samsung Electronics Research *Korea*
`Summer Intern` *2020*

Harvard-MIT Health Sciences and Technology *Boston, MA, USA*
`Summer Intern` *2019*

Publications

AI Papers

[1] **Song, J.**, Gore, J. & Kleiman, M. "Quantifying the Power of Langague Model Agent through Empowerment" Submitted to Neurips 2025.

[2] 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." Submitted to Neurips 2025.

[3] **Song, J.***, Han, S.*, Gore, J., & Agarwal, P. "Emergence and Effectiveness of Task Vectors in In-Context Learning: An Encoder Decoder Perspective" ICML 2025, **Spotlight**.

[4] 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" AIDrugX, Neurips-W 2025.

[5] Ying, A.*, **Song, J.***, Cui. H.* et al. "MethylGPT - Foundational GPT-like model for human methylation data" 2024. Under review in Nature Methods[Link]

[6] Pearce, T., & **Song, J.** "Reconciling Kaplan and Chinchilla Scaling Laws" TMLR, 2024. [Link]

[7] **Song, J.***, Liu, Z.*, Tegmark, M., & Gore, J. "Resource model for neural scaling law," BGPT, ICLR-W 2024. [Link]

Physics Papers

[1] **Song, J.***, Hu, J. & Gore, J. "Emergent cohesiveness governs coalescence between microcosms," In Preparation, 2024.

[2] **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]

[3] 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]

[4] 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. [Link]

Research Projects

Laboratory of Complex Intelligence, MIT *Boston, MA*
PhD Candidate (PI: Prof. Jeff Gore) *Jun 2023 - Present*

- Investigating the latent contextual knowledge structures of LLMs.
- Exploring emergent phenomena, such as neural scaling laws.

Laboratory of Complex Ecosystems, MIT *Boston, MA*
PhD Candidate (PI: Prof. Jeff Gore) *Feb 2021 - Present*

- Employing complex physics approach to understand (1) generic pattern of microbial coalescence and community cohesiveness. (2) Emergent pattern of evolution of multispecies community.

Laboratory of Chromatin Imaging, KAIST *Daejeon, Korea*
Research Assistant (PI: Prof. Wonki Cho) *Feb 2020 - Present*

- Developed thermodynamic simulation code for multivariate Antibody binding.

Laboratory of Biomedical Optics, KAIST *Daejeon, Korea*
Undergraduate Researcher (PI: Prof. YongKeun Park) *Feb 2018 - Aug 2020*

- Developed deep-learning based computational algorithm for 3D time-lapse tracking of T-cell(CAR-T).
- Imaged and analyzed 3D refractive index map of sepsis bacterial pathogens for classification model.

Biomedical OCT Research Center, Massachusetts General Hospital *Boston, MA, USA*
Research Intern (PI: Prof. Brett Bouma) *Jun 2019 - Aug 2019*

- Developed computational analysis pipeline for mapping brain image to mural connectome.

Laboratory of Quantum and Nanophotonics, KAIST *Daejeon, Korea*
Undergraduate Researcher (PI: Prof. YongHoon Cho) *Jul 2014 - Feb 2015*

- Investigated exciton-polariton coupling effect of GaN nanoporous DBR cavity using FDTD simulation and optical experiments.

Awards and Honors

Machine Learning and Theory Scholarship (MATS) *2025*
Mokam Research Scholarship *2023*
Asan Graduate Research Scholarship *2021 - 2025*
Best Oral Presentation Award - KPS *2023*
Excellent Graduate of KAIST *2020*
Korea Presidential Science Scholarship *2014 - 2020*

Teaching & Extracurricular

Organizer: AI Weekly Journal Club *Jun 2024 - Present*
Teaching Assistant: "Complex Systems Biology" *2023*
Freshmen Tutoring Program Mentor *2015-2018*

Military Service

Korea National Police Agency *2018*

References

Prof. Max Kleiman *University of Washington*
Prof. Jeff Gore *Massachusetts Institute of Technology*
Prof. Oh, Byung-Ha *KAIST*