JONGHA (JON) RYU

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RESEARCH INTERESTS

My research builds spectral and information-theoretic foundations for machine learning. As an information theorist by training, I distill complex ideas, unify principles across domains, and translate them into scalable algorithms bridging theory and practice. Recent work includes neural network-based operator learning for scientific simulation [C1], [C7], [C8], score-based generative modeling [C4], and uncertainty quantification and anytime-valid inference [J2], [C2], [C3], [C6].

EMPLOYMENT

Massachusetts Institute of Technology (MIT) Aug. 2022 – present
Postdoctoral Associate at Electrical Engineering & Computer Science Department
· Advisor: Prof. Gregory W. Wornell

EDUCATION

University of California San Diego (UCSD) Sep. 2015 – Jun. 2022
Ph.D. in Electrical Engineering (GPA: 3.99/4.0)
· Thesis advisors: Prof. Young-Han Kim and Prof. Sanjoy Dasgupta
· Thesis title: "From Information Theory to Machine Learning Algorithms: A Few Vignettes"

M.S. in Electrical Engineering Dec. 2018

Seoul National University (SNU) Mar. 2008 – Aug. 2015
Bachelor of Science (*summa cum laude*, GPA: 4.11/4.3)
· Double major in **Electrical and Computer Engineering** & **Mathematical Sciences**; minor in **Physics**

JOURNAL PAPERS

(* indicates equal contribution. † indicates alphabetical orders.)

[J1] **J. Jon Ryu***, Shouvik Ganguly*, Young-Han Kim, Yung-Kyun Noh, Daniel Lee, "Nearest neighbor density functional estimation from inverse Laplace transform". *IEEE Trans. Info. Theory*, vol. 68, no. 6, pp. 3511-3551, Jun. 2022.

[J2] **J. Jon Ryu**, Alankrita Bhatt, "On Confidence Sequences for Bounded Random Processes via Universal Gambling Strategies", *IEEE Trans. Info. Theory*, vol. 70, no. 10, pp. 7143-7161, Oct. 2024.

SELECTED CONFERENCE PAPERS

[C1] **J. Jon Ryu**, Xiangxiang Xu, Hasan Sabri Melihcan Erol, Yuheng Bu, Lizhong Zheng, Gregory Wornell, "Operator SVD with Neural Networks via Nested Low-Rank Approximation", *International Conference on Machine Learning (ICML)*, Jul. 2024.

[C2] **J. Jon Ryu**, Gregory W. Wornell, "Gambling-Based Confidence Sequences for Bounded Random Vectors", *ICML*, Jul. 2024. **Spotlight** (top 3.5%).

[C3] Maohao Shen*, **J. Jon Ryu***, Soumya Ghosh, Yuheng Bu, Prasanna Sattigeri, Subhro Das, Gregory W. Wornell, "Are Uncertainty Quantification Capabilities of Evidential Deep Learning a Mirage?", *Annual Conference on Neural Information Processing Systems (NeurIPS)*, Dec. 2024.

[C4] Tejas Jayashankar*, **J. Jon Ryu***, Gregory W. Wornell, "Score-of-Mixture Training: Training One-Step Generative Models Made Simple via Score Estimation of Mixture Distributions", *ICML*, Jul. 2025. **Spotlight** (top 2.6%).

[C5] **J. Jon Ryu**, Abhin Shah, Gregory W. Wornell, "A Unified View on Learning Unnormalized Distributions via Noise-Contrastive Estimation", *ICML*, Jul. 2025.

[C6] **J. Jon Ryu**, Jeongyeol Kwon, Benjamin Koppe, Kwang-Sung Jun, "Improved Offline Contextual Bandits with Second-Order Bounds: Betting and Freezing", *Conference on Learning Theory (COLT)*, Jun. 2025.

[C7] Minchan Jeong*, **J. Jon Ryu***, Se-Young Yun, Gregory W. Wornell, "Efficient Parametric SVD of Koopman Operator for Stochastic Dynamical Systems", *NeurIPS*, Dec. 2025.

[C8] **J. Jon Ryu**, Samuel Zhou, Gregory W. Wornell, "Revisiting Orbital Minimization for Neural Operator Decomposition", *NeurIPS*, Dec. 2025.

Selected Preprints

[P1] **J. Jon Ryu**, Pavan Yeddanapudi, Xiangxiang Xu, Gregory W. Wornell, "Contrastive Predictive Coding Done Right for Mutual Information Estimation". arXiv:2510.25983.

[P2] **J. Jon Ryu**, Yoojin Choi, Young-Han Kim, Mostafa El-Khamy, Jungwon Lee, "Learning with Succinct Common Representation with Wyner's Common Information", arXiv:1905.10945v2. (Note: A preliminary version of this manuscript was presented at *the Bayesian Deep Learning Workshop at NeurIPS 2018*, and an abridged version of the current version was presented at *the Bayesian Deep Learning workshop at NeurIPS 2021*.)

Invited Talks

- **From Information Theory to Machine Learning Algorithms: Two Vignettes**.
  - Signals, Information and Algorithms Laboratory, MIT, Cambridge, MA, USA, Mar. 2022 (remote).
  - Center for AI and Natural Sciences, KIAS, Seoul, South Korea, Mar. 2022 (remote).
- **From Wyner's Common Information to Learning with Succinct Representation**.
  - Information Theory and Applications (ITA) Workshop, La Jolla, CA, USA, May 2022.
  - Machine Intelligence and Data Science Laboratory, Seoul National University, Seoul, South Korea, Jan. 2023.
  - Inference and Information for Data Science Lab, KAIST, Daejeon, South Korea, Jan. 2023.
- **Nearest Neighbor Density Functional Estimation From Inverse Laplace Transform**.
  - Center for AI and Natural Sciences, KIAS, Seoul, South Korea, Aug. 2022 (remote).
- **On Confidence Sequences from Universal Gambling**.
  - Prof. Aaditya Ramdas' Group Meeting, CMU, Pittsburgh, PA, USA, Oct. 2022 (remote).
  - Hanyang University, Seoul, South Korea, Jan. 2023.
- **Operator SVD with Neural Networks via Nested Low-Rank Approximation**.
  - MLTea talk, MIT, Cambridge, MA, USA, Nov. 2023.
  - Information Theory and Applications (ITA) Workshop, La Jolla, CA, USA, Feb. 2024.
  - Mitsubishi Electric Research Laboratories, Cambridge, MA, USA, Sep. 2024.
  - KAIST AI Graduate School of AI, Daejeon, South Korea, Sep. 2024 (remote).
  - Center for AI and Natural Sciences, KIAS, Seoul, South Korea, Oct. 2024 (remote).
  - Flatiron Institute, New York, NY, USA, Oct. 2024 (remote).
  - MIT JTL Urban Mobility Lab, Cambridge, MA, USA, Sep. 2025 (remote).
  - Prof. Devavrat Shah's Group Meeting, MIT, Cambridge, MA, USA, Nov. 2025.
- **Efficient Generative Modeling and Operator Learning from First Principles**.
  - Frontier Research, Prescient Design, Genentech, New York, NY, USA, May 2025 (remote).
  - Department of Electrical and Engineering, POSTECH, Pohang, South Korea, Jun. 2025 (remote).
  - Department of Computer Science and Engineering, POSTECH, Pohang, South Korea, Aug. 2025 (remote).
- **Tools for Scalable and Reliable Scientific Inference from First Principles**.
  - Prescient Design, Genentech, Sep. 2025.

Honors and Awards

Spotlight Recognitions (top ∼3% acceptance rate) — ICML 2024, ICML 2025

Top Reviewer Awards — NeurIPS 2023, NeurIPS 2025

Departmental Fellowship — Sep. 2015 – Jun. 2016
Department of ECE, UCSD

Kwanjeong Scholarship for Graduate Study — Sep. 2015 – Jun. 2020
Kwanjeong Scholarship Foundation, South Korea

Kwanjeong Scholarship for Undergraduate Study — Mar. 2010 – Dec. 2013
Kwanjeong Scholarship Foundation, South Korea

University Students Contest of Mathematics
Korean Mathematical Society
- Among non-math majors: Gold prize (2010), Honorable mention (2009)
- Among math majors: Bronze Prize (2013)

Internship Experience

Research Intern Jun. 2019 – Dec. 2019
AI Research Group, Qualcomm Technologies, Inc.
· Researched deep learning based sequential models for speech processing.

Research Intern Jun. 2018 – Sep. 2018
Deep Learning Team, SoC R&D, Samsung Semiconductor Inc.
· Developed a new information-theoretic representation learning principle [P2].

Teaching Experience

Instructor (MIT)

- **6.7800 Inference and Information** Spring 2024, Spring 2025
  · Designed and taught new research-related topics as special sessions as a co-instructor.
  · **Topics**: minimax bit prediction, universal inference and concentration, universal learning approach for Rock–Paper–Scissor machine, variational perspective on generative modeling.

Teaching Assistant (UCSD)

- **ECE 250 Random Processes** Winter 2017
- **ECE 154C Communication Systems** Spring 2017
  · Designed hands-on programming assignments for the class based on Julia.
  · **Topics**: Basic source coding and channel coding algrotihms.
- **ECE 225B Universal Probability and Applications in Data Science** Spring 2018
  · Designed hands-on programming assignments for the class based on Python.
  · **Topics**: Lempel–Ziv probability assignment, context-tree weighting, and universal portfolio.
- **ECE 269 Linear Algebra and Applications** Winter 2019

Mentoring Experience

Tejas Jayashankar, Ph.D. Student, MIT (now at Meta) Sep. 2022 – present
· Topic: Developing new generative modeling techniques.
· Outcome: Co-developed a new training technique for one-step high-quality image generators [C4].

Abhin Shah, Ph.D. Student, MIT (now at Five Rings) Sep. 2022 – Aug. 2024
· Topic: (1) Learning with fairness. (2) Learning principles for unnormalized probability models.
· Outcome: Co-authored a paper on learning under fairness constraint with uncertain attributes, presented at ISIT'24. Co-authored a paper on unifying learning principles for unnormalized probability models [C5].

Maohao Shen, Ph.D. Student, MIT Sep. 2022 – present
· Topic: (1) Efficient uncertainty quantification algorithms. (2) Efficient LLM alignment with feedback data.
· Outcome: Co-authored a paper on uncertainty quantification for black-box models, presented at NeurIPS'24 [C3]. Developing a unified RLHF framework for LLM alignment (work in progress).

Pavan Yeddanapudi, Undergraduate Student, MIT Sep. 2024 – present
· Topic: (1) Efficient estimation of information measures for high-dimensional data [P1]. (2) Score-based techniques for representation learning (work in progress).

Samuel Zhou, Undergraduate Student, MIT Mar. 2025 – present
· Topic: (1) New linear-algebraic optimization framework for representation learning [C8]. (2) New techniques for interpretable representation learning (work in progress).

Other Experience

Military Service (mandatory) Mar. 2011 – Dec. 2012
Republic of Korea Army

References

Gregory W. Wornell
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