Jongha "Jon" Ryu

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Research Interests

I am interested in developing practical algorithms for more reliable and interpretable machine learning, using tools from information theory and statistics. More specifically, I am interested in **structured representation learning**, **sequential decision making/online learning**, and **learning with uncertainty**.

Employment

Massachusetts Institute of Technology (MIT) Aug. 2022 – present
Postdoctoral Associate at Research Laboratory of Electronics
· Host: Gregory W. Wornell

Education

University of California San Diego (UCSD) Sep. 2015 – Jun. 2022
Ph.D. in Electrical Engineering (GPA: 3.99/4.0)
· Advisors: Young-Han Kim and 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

Seoul Science High School Mar. 2006 – Feb. 2008
· 1 year early graduation

Research Experience

Graduate Student Researcher Sep. 2015 – Jun. 2022
Department of ECE, UCSD

Research Intern Jun. 2019 – Dec. 2019
AI Research Group, Qualcomm Technologies, Inc.
· Researched deep learning based sequential models for speech processing [C4].

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

Preprints

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

[P1] Jaeyoon Yoo, Heonseok Ha, Jihun Yi, **Jongha Ryu**, Chanju Kim, Jung-Woo Ha, Young-Han Kim, Sungroh Yoon, "Energy-based sequence GANs for recommendation and their connection to imitation learning", arXiv:1706.09220.

[P2] **J. Jon Ryu**, Yoojin Choi, Young-Han Kim, Mostafa El-Khamy, Jungwon Lee, "Learning with Succinct Common Representation with Wyner's Common Information", Under Review; 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 manuscript was presented at *the Bayesian Deep Learning workshop at NeurIPS 2021*.)

[P3] **J. Jon Ryu**, Young-Han Kim, "One-Nearest-Neighbor Search is All You Need for Minimax Optimal Regression and Classification", arXiv:2202.02464.

[P4] **J. Jon Ryu**, Young-Han Kim, "An Information-Theoretic Proof of Kac–Bernstein Theorem", arXiv:2202.06005.

[P5] **J. Jon Ryu**, Alankrita Bhatt, "On Confidence Sequences for Bounded Random Processes via Universal Gambling Strategies", arXiv:2207.12382, Under minor revision at *IEEE Transactions on Information Theory*.

[P6] 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?", arXiv:2402.06160, Under Review.

[P7] Tejas Jayashankar*, **J. Jon Ryu***, Xiangxiang Xu, and Gregory W. Wornell, "Lifted Residual Score Estimation", Under Review. (Note: A preliminary version of this manuscript is to be presented at *ICML 2024 Workshop on Structured Probabilistic Inference & Generative Modeling*.)

Journal Papers

[J1] **J. Jon Ryu***, Shouvik Ganguly*, Young-Han Kim, Yung-Kyun Noh, Daniel Lee, "Nearest neighbor density functional estimation from inverse Laplace transform", arXiv:1805.08342. *IEEE Transactions on Information Theory*, vol. 68, no. 6, pp. 3511-3551, June 2022.

Conference Papers

[C1] Alankrita Bhatt†, Jiun-Ting Huang†, Young-Han Kim†, **J. Jon Ryu**†, and Pinar Sen†, "Monte Carlo methods for randomized likelihood decoding", *56th Annual Allerton Conference on Communication, Control, and Computation (Allerton)*, September 2018.

[C2] **Jongha Ryu**, Young-Han Kim, "Conditional distribution learning using neural networks and its application to universal image denoising", *International Conference on Image Processing (ICIP)*, October 2018.

[C3] Alankrita Bhatt†, Jiun-Ting Huang†, Young-Han Kim†, **J. Jon Ryu**†, and Pinar Sen†, "Variations on a theme by Liu, Cuff, and Verdú: The power of posterior sampling", *Information Theory Workshop (ITW)*, November 2018.

[C4] Yang Yang, Guillaume Sautiere, **J. Jon Ryu**, Taco Cohen, "Feedback Recurrent Autoencoder", *45th International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, May 2020.

[C5] **J. Jon Ryu**, Jiun-Ting Huang, Young-Han Kim, "On the Role of Eigendecomposition in Kernel Embedding", *2021 IEEE International Symposium on Information Theory (ISIT)*, Jun 2021.

[C6] **J. Jon Ryu**, Alankrita Bhatt, Young-Han Kim, "Parameter-free Online Linear Optimization with Side Information via Universal Coin Betting", *Artificial Intelligence and Statistics (AISTATS)*, April 2022.

[C7] Alankrita Bhatt*, **J. Jon Ryu***, Young-Han Kim, "On Universal Portfolios with Continuous Side Information", *Artificial Intelligence and Statistics (AISTATS)*, April 2023.

[C8] Abhin Shah, Maohao Shen, **J. Jon Ryu**, Subhro Das, Prasanna Sattigeri, Yuheng Bu, Gregory W. Wornell, "Group Fairness with Uncertainty in Sensitive Attributes", arXiv:2302.08077, *2024 IEEE International Symposium on Information Theory (ISIT)*, July 2024. (Note: A preliminary version of this manuscript was presented at *ICML 2023 Workshop on Spurious Correlations, Invariance, and Stability*.)

[C9] **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", arXiv:2402.0365, *International Conference on Machine Learning (ICML)*, July 2024.

[C10] **J. Jon Ryu, Gregory W. Wornell**, "Gambling-Based Confidence Sequences for Bounded Random Vectors", arXiv:2402.03683, *International Conference on Machine Learning (ICML)*, July 2024. (*Spotlight*).

Invited Talks

- **From Information Theory to Machine Learning Algorithms: Two Vignettes**.
  - · Signals, Information and Algorithms Laboratory, MIT, Cambridge, MA, USA, Mar. 2022.
  - · Center for AI and Natural Sciences, KIAS, Seoul, South Korea, Mar. 2022.
- **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.
- **On Confidence Sequences from Universal Gambling**.
  - · Prof. Aaditya Ramdas' Group Meeting, CMU, Pittsburgh, PA, USA, Oct. 2022.

· 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.

Skills

Python (PyTorch, Tensorflow, Keras), MATLAB, R, Julia

Honors and Awards

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
· Gold prize (2010), Honorable mention (2009) (among non-math majors)
· Bronze Prize (2013) (among math majors)

Teaching Experience

Instructor (MIT)

- **6.7800 Inference and Information** Spring 2024
  · Designed and taught new research-related topics as special sessions.
  · **Topics**: minimax bit prediction, improved Sanov's bound, universal learning approach for RoShamBo 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

Other Experience

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