

RAN LIU

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RESEARCH INTERESTS

Machine Learning, Computational Neuroscience, and Computer Perception

- Low-dimensional latent representations of data
- Biological and medical information processing and analysis
- Deep learning interpretability and generalizability

EDUCATION

Georgia Institute of Technology

Ph.D. student in Machine Learning - ECE

Aug 2019 - Present

Fudan University

Bachelor of Science in Physics

Sep 2015 - Jun 2019

University of California, Berkeley

Exchange Student

Jan 2017 - May 2017

PUBLICATIONS

R. Liu, M. Azabou, M. Dabagia, C-H. Lin, M. Gheshlaghi Azar, K. B. Hengen, M. Valko, E. L. Dyer, "Drop, Swap, and Generate: A Self-Supervised Approach for Generating Neural Activity", the Conference on Neural Information Processing Systems (**NeurIPS**), **oral (top 1%)**, 2021.

M. Azabou, M. Gheshlaghi Azar, **R. Liu**, C-H. Lin, E.C. Johnson, K. Bhaskharan-Nair, M. Dabagia, K.B. Hengen, W. Gray-Roncal, M. Valko, E. Dyer, "Mine Your Own view: Self-supervised learning through across-sample prediction", arXiv, 2021.

A. Balwani, J. Miano, **R. Liu**, L. Kitchell, J. Prasad, E. Johnson, W. Gray-Roncal, E. Dyer. "Multi-scale modeling of neural structure in X-ray imagery", to appear at the IEEE International Conference on Image Processing (**ICIP**), 2021.

R. Liu, C. Subakan, A. H. Balwani, J. Whitesell, J. Harris, S. Koyejo, E. Dyer. "A generative modeling approach for interpreting population-level variability in brain structure", to appear in International Conference on Medical Image Computing and Computer Assisted Intervention (**MICCAI**) 2020.

C. Huang, B. Zhou, H. Zhang, B. Yang, **R. Liu**, et al. "Proximity-induced surface superconductivity in Dirac semimetal Cd_3As_2 ", **Nature Communications**, May 2019.

C. Zhang, Y. Zhang, X. Yuan, S. Lu, J. Zhang, A. Narayan, Y. Liu, H. Zhang, Z. Ni, **R. Liu**, et al. "Quantum Hall effect based on Weyl orbits in Cd_3As_2 ", **Nature**, Jan. 2019.

C. Huang, A. Narayan, E. Zhang, Y. Liu, X. Yan, J. Wang, C. Zhang, W. Wang, T. Zhou, C. Yi, S. Liu, J. Ling, H. Zhang, **R. Liu**, et al. "Inducing Strong Superconductivity in WTe_2 by Proximity Effect", **ACS nano**, June 2018.

INDUSTRY EXPERIENCE

Research intern at Facebook, Inc.

May 2021 - August 2021

Physical modeling team, advised by Dr. Andrew Grier

SELECTED RESEARCH PROJECTS

Using self-supervision and generative modeling to study brain

Jan 2020 - Present

Advisor: Prof. Eva Dyer, Georgia Institute of Technology

- Developed a self-supervised learning algorithm based on latent space augmentation to perform generative modeling and latent space disentanglement of neural activities (SwapVAE, accepted by NeurIPS 2021 as oral presentation).
- Developed a self-supervised representation learning method based on nearest-neighbor search inside the latent space, and applied the method on both vision and neural datasets (MYOW, arXiv).
- Proposed a multitask U-Net to perform both the fine-scale segmentation of brain's microstructure and the classification of brain areas (Double UNet, accepted by ICIP 2021).
- Developed a bidirectional approach to interpret low-dimensional latent representation of deep generative models from both receptive and projective field of nets (accepted by MICCAI 2020).

Temporal modeling and prediction of controversial posts

Aug 2019 - Dec 2019

Advisor: Prof. Diyi Yang, Georgia Institute of Technology

- Applied and adjusted state-of-the-art machine learning models (including BERT, BiLSTM, CRF, etc.) on a classification task of discourse acts and achieved record-high F1 score.
- Designed and extracted domain knowledge features about controversy-causing posts and employed those features on the early prediction of controversial posts on Reddit.
- Conducted temporal modeling of controversial posts' discussion structures with linguistic analysis of discourse acts and conversational interaction feature engineering results.

Link recommendation based on hierarchical graph analysis

Jan 2019 - Jun 2019

Advisor: Prof. Deqing Yang, Fudan University

- Constructed a hierarchical information graph based on user connections and geo-locations obtained from a self-crawled Twitter dataset.
- Conducted community detection based on modified fast unfolding algorithm.
- Designed a heterogeneous recommendation system via link prediction algorithms including Neural Collaborative Filtering and Factorization Machine.

Characteristic analysis of complex networks

Jul 2018 - Jan 2019

Advisor: Prof. Zhongzhi Zhang, Fudan University

- Analytically derived the Laplacian spectrums of several special scale-free complex networks with identical degree sequence.
- Calculated characteristic invariants including the enumeration of spanning trees of the studied complex networks, and related their properties to the consensus problem.
- Obtained the relationship between power-law degree distribution and consensus behavior on scale-free networks via the differences between fractal and non-fractal complex networks.

Investigation on physical properties of innovative nanodevices

Feb 2017 - Oct 2018

Advisor: Prof. Faxian Xiu, Fudan University

- Discovered a new type of quantum Hall effect in wedge-like Cd_3As_2 thin films (see Publications).
- Explored proximity-induced Fermi-arc superconductivity in $\text{Nb}/\text{Cd}_3\text{As}_2/\text{Nb}$ heterostructures and supercurrent in $\text{Nb}/\text{Cd}_3\text{As}_2/\text{Nb}$ Josephson junctions (see Publications).
- Fabricated $\text{NbSe}_2/\text{WTe}_2$ hybrid structures and investigated the proximity-induced superconductivity in topological Weyl materials (see Publications).

PROFESSIONAL EXPERIENCES

Conference reviewing

- sub-reviewer of ICML 2021, ICLR 2021, NeurIPS 2020, ACL 2019

Graduate Teaching Assistant at Georgia Institute of Technology

- Introduction to Signal Processing at Electrical and Computer Engineering (2019 Fall)

AWARDS AND RECOGNITIONS

ICML Diversity and Inclusion Fellowship	2020
Cox Fellowship from Georgia Tech	2019 - 2020
China National Scholarship — highest undergraduate scholarship nationally	2018
Chun-Tsung Scholar — honored by Chinese Undergraduate Research Endowment (CURE) awarded to less than 400 undergraduates nationally since its foundation	2018
First Prize of Outstanding Students Scholarship from Fudan — awarded to top 5%	2016
Outstanding Leadership Awards — honored to 10 student activity organizers per year	2018

SKILLS

Programming Languages	Python, MATLAB, SQL, Java, C/C++
Open Source Libraries	PyTorch, TensorFlow, Keras, scikit-learn, OpenCV, Gensim, etc.