RYAN LIU

liuryan30@berkeley.edu
ryanliu30.github.io

EDUCATION

University of California, Berkeley *August, 2021 - May, 2025*
B.A., Computer Science and Physics GPA: 4.00/4.00

National Taiwan University *September, 2020 - June, 2021*
Precollege Student GPA: 4.17/4.3

RESEARCH EXPERIENCE

Berkeley Artificial Intelligence Research, AI+Science group *May 2024 - Ongoing*
Supervisor: Prof. Aditi Krishnapriyan

Fermi National Accelerator Laboratory, AI for HEP *Aug 2023 - May 2024*
Supervisor: Dr. Jennifer Ngadiuba

California Institute of Technology, Caltech SURF *Jun 2023 - Aug 2023*
Supervisor: Prof. Maria Spiropulu, Co-supervisor: Dr. Jennifer Ngadiuba, Dr. Jean-Roch Vlimant

Lawrence Berkeley National Laboratory, GNN4ITk *Nov 2021 - May 2024*
Supervisor: Dr. Paolo Calafiura

PUBLICATION

Ryan Liu, Abhijith Gandrakota, Jennifer Ngadiuba, Maria Spiropulu, Jean-Roch Vlimant. (2023). "Fast Particle-based Anomaly Detection Algorithm with Variational Autoencoder" *Accepted to Neurips Machine Learning and the Physical Sciences Workshop 2023.*

Ryan Liu, Abhijith Gandrakota, Jennifer Ngadiuba, Maria Spiropulu, Jean-Roch Vlimant. (2023). "Efficient and Robust Jet Tagging at the LHC with Knowledge Distillation" *Accepted to Neurips Machine Learning and the Physical Sciences Workshop 2023.*

Ryan Liu, Paolo Calafiura, Steven Farrell, Xiangyang Ju, Daniel Thomas Murnane, Tuan Minh Pham (2023). "Hierarchical Graph Neural Networks for Particle Track Reconstruction" *Accepted to 21st International Workshop on Advanced Computing and Analysis Techniques in Physics Research.*

RESEARCH PROJECT

Pure Transformer for Molecular Dynamics and Material Simulation
BAIR *May 2024 - Ongoing*
Implemented a machine learning force field based on non-equivariant sparse transformer.
Demonstrated three-fold faster training compared with MACE to achieve same accuracy.
Achieved competitive performance on MD22, SPICE, and MPTrj.

Fast Anomaly Detection with Variational Autoencoder for CMS L1T
Caltech SURF, Fermilab *June 2023 - August 2023*
Designed a decoding framework for particle-based autoencoders based on cVAE.
Proposed a training technique to facilitate encoder-only inference of anoamly detection with VAE.
Demonstrated a 2x improvement in signal efficiency compared with n-subjettiness.

Transfer Inductive Biases with Knowledge Distillation
Caltech SURF, Fermilab *June 2023 - August 2023*

Showed knowledge distillation can improve accuracy of a light-weight jet tagger.
Demonstrated knowledge distillation can improve robustness through inducing bias.

Hierarchical Graph Neural Networks for Particle Track Reconstruction
LBNL *April 2022 - October 2022*
Designed and implemented a Hierarchical GNN for charged particle tracking.
Outperformed the graph segmentation algorithm in Exa.TrkX pipeline on the TrackML dataset.
Demonstrated superior robustness against graph construction inefficiency.

High Performance Graph Segmentation for ATLAS GNN Track Reconstruction
LBNL *May 2024 - October 2024*
Analyzed failure modes of connected components as the graph segmentation algorithm.
Designed CC+JR algorithm that achieved three-fold faster inference and 0.9% efficiency improvement.

Novel Training Frameworks for Tracker Data
LBNL *March 2024 - Ongoing*
We explore various training objectives including event-level anomaly detection and Point cloud Joint Embedding Predictive Architecture (P-JEPA) and training techniques such as curriculum learning.

Foundation Model for High Energy Physics
Fermilab *February 2024 - Ongoing*
Generated a large event-level dataset with fast simulation tools for machine learning research.

Diffusion-Based State Sampler for Synthetic Experience Replay
UC Berkeley *September 2023 - December 2023*
Developed an efficient online-reinforcement learning algorithm with synthetic experience replay based on diffusion model and world model.

CLASS PROJECT

Pintos Educational Operating System
UC Berkeley *January 2024 - May 2023*
Implemented an operating system with multi-threading, scheduling, and hierarchical file system.
Led the design and implementation process of the four-person team.

Zero Tidal Love Number of Schwarzschild Black Holes
National Taiwan University *January 2021 – June 2021*
Computed perturbative expansion of Einstein equation near Schwarzschild background.
Rederived the zero tidal Love number for Schwarzschild balck holes with detailed computation.

SELECTED COURSEWORK

UC Berkeley
Deep Reinforcement Learning, Decision Making, and Control[1]: A
Operating Systems and System Programming: A+
Quantum Theory of Measurement[1]: A+
National Taiwan University
Quantum Information and Computation[1]: A+
Computational Physics[1]: A
Machine Learning[1]: A+
General Relativity[1]: A+

AWARDS

Gold Medal, European Physics Olympiad 2020 *July 2020*
Ranked 15th place and 1st place in Taiwan National Team.

[1]Graduate Class