Yilong Ju

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EDUCATION

Doctor of Philosophy, Department of Computer Science, Rice University **08/2019 – 12/2024**
Master of Science, Major in Data Science, University of Pennsylvania **08/2017 – 05/2019**
Bachelor of Engineering, Major in Industrial Engineering, Minor in Finance, Tsinghua University **08/2013 – 05/2017**

PROFESSIONAL EXPERIENCE

Building and Improving New Tools to Understand and Audit AI Decisions | Audit AI Inc. | Chief AI Officer and Cofounder **04/2023 – Present**

Funded and supported by Allen Institute for AI Incubator

- Conducted a customer pilot with one of the Big Three consulting firms on improving large language model (LLM) application performance and auditability. The customer agreed to move forward with us in future engagements
- Designed and implemented the codebase for the LLM application to allow for fast development and evaluation
- Designed and implemented the codebase of a prototype product which allows users who train ML/AI models to easily switch on an audit mode and UI/UX that allows them to perform in-depth analysis and reasoning on ML/AI decision making
- Added parallelization support to the full framework and validated the scalability of our product

RESEARCH PROJECTS

Computational Chromatography with Machine Learning | Rice University | Graduate Research Assistant **11/2021 – 09/2024**

Supervisor: Ankit Patel, Assistant Professor and Naomi J. Halas, Stanley C. Moore Professor, Department of Electrical and Computer Engineering, Rice University

- Developed a novel machine learning algorithm called Characteristic Peak Extraction (CaPE) for dimensionality reduction and feature extraction of surface-enhanced Raman spectroscopy (SERS) data, reducing signal dimensions from 1,738 to a range from 18 to 106
- Compared CaPE performance with existing methods for separating chemical components in SERS mixture spectra. CaPE achieves an absolute improvement of approximately 60% in accuracy for identifying chemicals
- Created a similarity metric called Characteristic Peak Similarity that achieves an absolute improvement of 14.9-25% in top-1 matching accuracy compared to existing metrics for matching SERS spectra to Raman library spectra, and an absolute improvement of 0.12 in test AUROC in detecting the presence of contaminants in soils samples

Arrhythmia Detection with Deep Learning | Rice University | Graduate Research Assistant **08/2021 – 02/2023**

Supervisor: Ankit Patel, Assistant Professor, Department of Electrical and Computer Engineering, Rice University and Parag Jain, Assistant Professor, Department of Critical Care, Texas Children's Hospital

- Analyzed electrocardiography (ECG) signals that have a total of 64.5 expert-labeled hours consisting of 509,833 cardiac cycles (R-R intervals) from 40 patients with congenital heart disease
- Developed a deep learning model able to distinguish junction ectopic tachycardia from normal sinus rhythm with an AUROC of 0.963, improving the logistic regression model with features designed by doctors by a large margin (an absolute 0.018 gain)
- Improved the true positive rate at 5% false positive rate from 71.8% to 85.2%

Analysis of Architectural Bias in Neural Networks | Rice University | Graduate Research Assistant **03/2020 – 06/2020**

Supervisor: Ankit Patel, Assistant Professor, Department of Electrical and Computer Engineering, Rice University

- Performed data analysis comparing frequency spectra of adversarial perturbations across multiple model architectures ResNets, Vision Transformers) and datasets (SVHN, CIFAR100)
- Generated and analyzed key visualizations demonstrating the relationship between convolution kernel sizes and high-frequency bias in neural networks, and the distribution of radial energy of adversarial perturbations
- Contributed to manuscript preparation and revision, resulting in publication at NeurIPS 2022 Shared Visual Representations in Human and Machine Intelligence (SVRHM)

Explaining and Improving Neural Network Performance in Quantum Systems | Rice University | Graduate Research Assistant **01/2020 – 04/2022**

Supervisor: Ankit Patel, Assistant Professor, Department of Electrical and Computer Engineering, Rice University and Han Pu, Professor, Department of Physics and Astronomy, Rice University

- Developed theoretical framework connecting convolutional neural networks (CNNs) to maximum entropy models and correlator product states, explaining how CNNs efficiently approximate quantum wavefunctions using linear parameters
- Created novel symmetry-enforcing training algorithms that reduce convergence time by 30-50% or reduce number of parameters by orders of magnitude while maintaining accuracy for quantum many-body systems
- Performed regression analysis to identify salient physical features captured by CNN solutions, achieving $R^2 = 0.786$ for predicting characteristic peak counts using physics-informed features
- Demonstrated how CNNs leverage quantum system symmetries and entanglement properties to solve the "curse of dimensionality" in exponentially large Hilbert spaces, providing insights into when CNNs may succeed or fail in solving physics problems

AWARDS

- Allen Institute for AI Incubator, $95,000

- NSF I-Corps Award, $50,000

PATENTS

- Analysis of Mixture Using Combination of Spectroscopy and Machine Learning, WO/2024/097224
- (Provisional) Neural Network Audit Engine, No. 63/609,240

PUBLICATIONS

- Oara Neumann, **Yilong Ju**, Andres B. Sanchez-Alvarado, Guodong Zhou, Weiwu Jiang, Bhagavatula Moorthy, Melissa Suter, Ankit Patel, Peter Nordlander, Naomi J. Halas. Machine Learning-enhanced Surface-Enhanced Spectroscopic Detection of Polycyclic Aromatic Hydrocarbons in Human Placenta. *PNAS (2025).*
- **Yilong Ju*,** Shah Saad Alam*, Jonathan Minoff, Fabio Anselmi, Han Pu, Ankit Patel. Interpreting Convolutional Neural Networks' Low Dimensional Approximation to Quantum Spin Systems. *Physical Review Research (2024), Editors' Suggestion*. *Equal contribution.
- Oara Neumann, Jingyi Zhou, **Yilong Ju**, Mary M. Bajomo, Andrés B. Sánchez-Alvarado, Julia Dolive, Beniam Kumela, Mattie Kumela, Ankit Patel, Peter Nordlander, and Naomi J. Halas. Surface-Enhanced Raman Spectroscopy: from the Few-Analyte Limit to Hot-Spot Saturation. *The Journal of Physical Chemistry C (2024)*.
- **Yilong Ju**, Jamie L.S. Waugh, Satpreet Singh, Craig G. Rusin, Ankit B. Patel, Parag N. Jain. A Multimodal Deep Learning Tool for Detection of Junctional Ectopic Tachycardia in Children with Congenital Heart Disease. *Heart Rhythm O2 (2024)*.
- **Yilong Ju***, Oara Neumann*, Mary Bajomo, Yiping Zhao, Peter Nordlander, Naomi Halas, Ankit B. Patel. Identifying Surface-Enhanced Raman Spectra with a Raman Library Using Machine Learning. *ACS Nano (2023)*. *Equal contribution.
- Mary Bajomo*, **Yilong Ju***, Jingyi Zhou, Simina Elefterescu, Corbin Farr, Yiping Zhao, Oara Neumann, Peter Nordlander, Ankit Patel, Naomi Halas. Detection and Identification of Polycyclic Aromatic Hydrocarbons Using Surface Enhanced Raman Spectroscopy and Effective Characteristic Peak Extraction. *PNAS (2022)*. *Equal contribution.
- Josue Ortega Caro, **Yilong Ju**, Ryan Pyle, Sourav Dey, Wieland Brendel, Fabio Anselmi, Ankit Patel. Local Convolutions Cause an Implicit Bias towards High Frequency Adversarial Examples. *NeurIPS 2022 Workshop SVRHM.*
- Jamie L.S. Waugh, Raajen Patel, **Yilong Ju**, Ankit Patel, Craig Rusin, Parag Jain. A Novel Automated Junctional Ectopic Tachycardia Detection Tool for Children with Congenital Heart Disease. *Heart Rhythm O2 (2022).*

PROFESSIONAL SERVICE

- Reviewer, Journal of the American Medical Informatics Association (2024, 2025), PLOS One (2024, 2025)

PRESENTATIONS

- Machine learning strategies for demixing individual chemical components in complex mixtures and matching between different types of spectroscopy, The 10th International Conference on Surface Plasmon Photonics