Richard Licheng Zhu

richardzhu.info | rzhu.96@gmail.com | 224-388-8017

EDUCATION

BS IN PHYSICS, 2018 | California Institute of Technology, Pasadena, CA
GPA: 4.0, with honors.

EXPERIENCE / RESEARCH

CALTECH | Researcher in Perona/Yue Group
Sept 2017 - present | Berkeley, CA

- Collaboration with Joseph Marino on deep generative models.
- Investigating recent deep dynamical models, and extending results to reinforcement learning.

CALTECH | Researcher in Phillips/Thomson Group
Sept 2017 - present | Berkeley, CA

- Collaboration with Prof. Rob Phillips and Prof. Matt Thomson
- Examining dissipative potentials and genetic regulatory networks.

RIGETTI COMPUTING | Software Engineering Intern
June 2017 - September 2017 | Berkeley, CA

- Designed and wrote Python **reference-qvm**, an open-sourced implementation of a quantum virtual machine (QVM). Found on GitHub at *github.com/rigetticomputing/reference-qvm*
- Formulated and extended theory for novel fermionic-to-qubit transformation. First author on paper in process.
- Designed and implemented company's first automatic quantum chip constraint optimizer.
- Tested the viability of hybrid quantum-classical optimization algorithms, including VQE (variational quantum eigensolver) and QAOA (quantum approximate optimization algorithm).
- Researched acceleration of reinforcement learning sampling via quantum annealing.

VIRTUALITICS | Machine Learning & Data Science Engineer
March 2017 - present | Pasadena, CA

- Second machine learning hire for AI/VR startup.
- Engineered novel feature selection and efficient machine learning techniques (random forest, t-SNE) for data visualization in 3D (Python, C#).
- Consulted for clients ranging over Accenture, GM, Pimco, and the Financial Times.
- Participated in and won hackathon funded by the Department of Defense.

CALTECH | Condensed Matter Theory Fellowship
April 2016 - June 2017 | Pasadena, CA

- Investigated the possibility of long-lived particle density imbalances in quantum many-body localized systems, caused by periodic driving potentials and ratchet effects.
- Implemented and analyzed quantum simulation of Anderson-localized single particles in 1D tight-binding model.
- Confirmed predictions on compute cluster using highly-optimized Python and Julia scripts.
- Presented work at the Royal Society (London), first author on paper in process.
- Work has the potential to inspire experimental implementations of novel quantum batteries and capacitors.

CALTECH | Ph 11 Research Fellowship
June 2015 - October 2015 | Pasadena, CA

- Collaboration with Prof. Konstantin Batygin, examinining emergent phenomena within protoplanetary disks using n-body simulations of exoplanetary systems using the sympletic integrator **mercury** (Fortran77, Python).
- Implemented novel force routines in Fortran to account for Stokes drag, disk waves, and inward migration of larger planets.
- Derived and confirmed equations governing inward planet migration due to secular resonances.

HONORS AND AWARDS

2017	school	George W Housner Award
2017	school	Don Shepard Award
2017	national	OpenWERX Hackathon 1st Place
2017	school	Cambridge University study-abroad term
2016	school	San Pietro Travel Fellowship
2016	school	The Aerospace Corporation Fellowship
2015	school	Physics 11 Fellowship
2014	national	US Physics Team

PRESENTATIONS / CONFERENCES

2017	Long Beach, CA	Neural Information Processing Systems (NIPS)
2017	The Royal Society, London	Breakdown of ergodicity in quantum systems *(poster presented)*
2016	Pasadena, CA	Caltech SURF Seminar Day

PUBLICATIONS

1. **Zhu RL**, Rubin NC, Curtis MS, Sete E, Zeng W. Unifying fermionic-to-qubit transformations for practical quantum chemistry simulation. [Manuscript in preparation]
2. **Zhu RL**, Halpern NY, Refael G. Towards a Quantum Diode: Semi-supervised Models of Countertransport in an Anderson-localized System [Manuscript in preparation]

ACTIVITIES

2016-17	Avery House Vice-Chancellor
2015-16	Academics and Research Committee Representative
2015-17	Caltech Dhamaka Dance Team
2015-16	Avery House Social Director
2015-16	Caltech Hip Hop Dance Troupe
2014-15	Caltech Chamber Ensembles

TEACHING

1. Teaching Assistant for Complex Analysis (ACM 95a).
2. Teaching Assistant for Machine Learning (CS 155).
3. Teaching Assistant for Senior Physics Labs (Ph 77).
4. Teaching Assistant for Sophomore Physics Labs (Ph 6, Ph 7).

COURSEWORK

COMPUTER SCIENCE

Statistics and Inference
Research in Machine Learning
Machine Learning & Data Mining
Projects in Machine Learning
Advanced Topics in Machine Learning
Computing Systems
Algorithms
Decidability and Tractability

PHYSICS

Physics Labs ***(Teaching Assistant)***
Classical Mechanics
Quantum Mechanics
Statistical Physics
Solid-State Physics
Soft Condensed Matter Physics
Physical Biology of the Cell
Quantum Computation
Research in Theoretical Physics

PROJECTS

DEEP INFORMATION PROPAGATION | Self

- Goal: reproduce results in *arXiv:1611.01232* and extend to different activation functions (ReLU, etc.) and generalize to different neural network topologies.

ADVERSARIAL ATTACK ON CONVNETS | Self

- Goal: create demonstration that constructs an adversarial attack on a neural net, and illustrates which parts cause the neural net the most trouble in classification.
- Frameworks used: Flask, Python, Tensorflow, JavaScript.

AI FOR QUANTUM CHESS | CS 101 - Projects in Machine Learning

- Developed AI to play 'Quantum Chess', a variant of chess that allows moving pieces in superposition with a much higher branching factor than regular chess.
- Conceived and implemented modified Monte Carlo tree search methods utilizing inherent quantum interference/entanglement effects to develop first quantum AI

DEEP REINFORCEMENT LEARNING | CS 159 - Advanced Topics in Machine Learning

- Extended extant attempts at solving the *long-term planning* problem in deep reinforcement learning.
- Implemented several extensions (speedy Q-learning, temporal difference speedy Q-learning) of the standard deep Q-network algorithm and tested on the DeepMind Atari framework (Torch, Lua).
- Robust extensions demonstrated a 200% improvement using TDSQL over vanilla DQN algorithm at convergence.

KAGGLE MINIPROJECT | CS 155 - Machine Learning

- Placed top 8 out of over 80 students. Used openly-available resources to analyze the sentiment on a bag-of-words represented data set
- Utilized SVMs, random forest classifiers, and gradient-boosted classifiers in Scikit-learn and implemented search algorithm to find optimal parameters.

SHAKESPEARE BOT 5000 | CS 155 - Machine Learning

- Processed Shakespeare's sonnets into machine-readable format and implemented Hidden Markov Model (HMM) from scratch.
- Generated sonnets a la Shakespeare, obeying the typical meter/rhyme scheme. Experimented with sentiment analysis as well as part-of-speech tagging using the NLTK package.

WRITING

FLAIR.AI | Guest Writer

- Co-wrote a series of articles on metric learning and applications.

SKILLS

PROGRAMMING

Experienced:
Python • C++
Familiar:
JavaScript • Julia • Matlab • Fortran
Technologies:
Tensorflow • Torch • Unix • AWS EC2 • Google Cloud

LANGUAGES

Fluent:
English

Working proficiency:
Chinese