Jacob Miller, Ph.D.

jmjacobmiller@gmail.com | jemisjoky.com
(802) 734-2539 | Starksboro, Vermont

Personal Statement

I've had a passion for math, science, and computers since childhood, extending into my graduate career developing interdisciplinary frameworks for quantum computation. These interests have more recently led me to machine learning, where I'm trying to use my extensive theoretical background to develop better tools for understanding deep learning. I work well on teams, love sharing my interests with others, and produce surprising insights often.

Highlights

- ✓Top student in physics PhD cohort
- ✓Powerful analytical tool kit drawing from diverse range of disciplines
- ✓Strong research career with good publication record
- ✓Genuinely nice person, good with individual and team projects
- ✓Clear and effective communicator
- ✓Decently fluent in Mandarin, too!

Research & Work Experience

Graduate research in quantum computation, Univ. of N.M., 2013 - 2017
- Used tensor toolbox and diverse software simulations to characterize computational behavior of quantum systems in terms of distinct phases of matter
- Developed non-traditional blend of analytical and numerical techniques to prove unexpected applications of different (quantum) computer architectures

Quantum foundations research, Perimeter Institute, Summer 2010
- Studied statistical estimators for characterizing quantum behavior

Quantum matter simulation, Wellesley College, Summer 2009
- Built MATLAB simulator for interacting Bose-Einstein condensates

Renewable energy internship, All Earth Renewables, Summer 2007 & 2008
- Wrote software for solar tracking and for fitting circuit parameters from data

(Formal) Education

MS & PhD in Physics, University of New Mexico, 2011 - 2017
- Graduate dissertation, "*Measurement-based quantum computation and symmetry-protected topological order*", was top physics thesis of 2014-2017 (see Distinctions)

BS in Engineering w/ Physics, Olin College of Engineering, 2007 - 2011
- Received four year full tuition F.W. Olin Scholarship

Distinctions

- Physics dept's sole nomination to Popejoy Award for university-wide best STEM dissertation at UNM during the 3 year period 2014-2017, 2017
- Chair's Dissertation Award for best graduate physics dissertation, 2017
- Two lead author publications in top-tier physics journal *Physical Review Letters,* 2018 & 2015
- William G. Larsen award for best graduate physics/math TA, 2012

Teaching & Service

Teaching assistant for student labs, Univ. of N.M., 2011 - 2013
- Supervised undergraduate physics labs, was chosen as best physics/math TA for 2012

Course design and instruction, Univ. of N.M., 2013 - 2014
- Co-designed and co-taught new intro-level math class from scratch

Head of TACLA coffee club, Univ. of N.M., 2014 - 2017
- Handled purchasing, billing, and maintenance of popular coffee room in physics dept.

Proficiencies

Languages: Python and MATLAB, along with some Haskell, C++, and Javascript

Software tools: Numpy, Scipy, TensorFlow, Keras, LaTeX, Jekyll, Git, Linux CLI

Analytical tools: Linear and multilinear/tensor algebra, statistics, complexity theory, percolation theory, programming language semantics, convex optimization, graph theory, game theory, abstract algebra, category theory, topology, ...

Publications & Projects

J. Miller and A. Miyake, "*Latent computational complexity of symmetry-protected topological order with fractional symmetry*", Physical Review Letters **120**, 170503 (2018)

- Using simplified model of 2D quantum states, gave evidence for the existence of a phase of computationally universal quantum matter
- Proof utilized self-taught techniques from homological algebra, along with optimized numerical search in space of rank-3 tensors encoding states

J. Miller, S. Sanders, and A. Miyake, "*Quantum supremacy in constant-time MQC: A unified architecture for sampling and verification*", Physical Review A **96**, 062320 (2017)

- Laid out new architecture for sampling from provably quantum probability distribution
- Discovered several unexpected improvements arising from surprising insights into computational complexity theory and statistical analysis

This project was especially cool!

J. Miller and A. Miyake, "*Hierarchy of universal entanglement in 2D measurement-based quantum computation*", npj Quantum Information **2**, 16036 (2016)

- Discovered surprising variant of classic quantum computing protocol which has interesting connection with novel phases of quantum matter
- Crucial part of protocol involved numerical simulation of novel percolation problem

J. Miller and A. Miyake, "*Resource quality of a symmetry-protected topologically ordered phase for quantum computation*", Physical Review Letters **114**, 120506 (2015)

- Used analytic characterization of tensors to prove an entire phase of matter can be uniformly utilized for certain quantum computing tasks

J. Miller, "*The Adumbrant Notational System*", Humanities Capstone Project (2011)

- Studied lexicographically-derived "allowances" in existing mathematical notation, and how a hypothetical notational system using Chinese ideograms as variables might work

Other Information

- Born and raised on a dirt road in rural Vermont
- Learned Mandarin via 5 month immersive college study away program in Beijing
- Took a "gap year" after grad school to travel and relax, first going for a 14,000 mile motorcycle trip across the US and Canada in late 2017
- Backpacked across East Asia for 4 months in 2018, hiking, meeting friends, and drinking tea in Taiwan, Hong Kong, Mainland China, South Korea, and Japan