Jinguo Liu (刘金国)

Postdoc fellow in Harvard university

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"朝正确的方向努力，而不是去摘下垂的果实。"

Education

Nanjing Institute of Technology — *Nanjing*

B.S. in Software Engineering — *2008–2012*

When I was a college student, I read a book "Quantum Computation and Quantum Information" by Michael A. Nielsen. I was deeply impressed by the beautiful computation framework in the book, and decided to learn more about quantum computing in Prof. Yang Yu's group in Nanjing University.

Nanjing University — *Nanjing*

Ph.D. Theoretical Physics — *2012–2017*

Adviced under Prof. Qianghua Wang, doing numeric simulation of condensed matters. I mastered tensor networks algorithms and renormalizationing group theories, and became a geek in simulating quantum many body systems. Most of my works are about designing numeric algorithms to solve important problems in physics, like multi-channel Kondo problem and fractional topological excitation. In the last year as a doctor candidate, I won the first prize in ZTE fantastic algorithm challenge, which is a good proof of my solid algorithmic background of matrix computation and combinatorial optimization.

Skills

Programming Julia, Python, Fortran

Language Chinese, English

Knowledge Tensor Networks, Differentiable Programming, Quantum computing, Condensed matter physics, Combinatorial optimization

Experience

Institute of Physics (IOP), Chinese Academy of Sciences — *Beijing*

Postdoc — *2017–2019*

Then I became a postdoc of a young and charming guy Lei-Wang. Besides providing valuable suggestions in my research, Lei also creates a lot of opportunities for me, like encouraging me to give lectures and talks in international conferences and summer schools. My postdoc career is in Institute of Physics (IOP), Chinese Academy of Sciences. That time my research interest is automatic differentiation and quantum algorithms, this is a field that can incubate several killer Apps. I also developed the quantum simulation framework Yao.jl with a built in automatic differention engine together with a genuine Julia lover Xiu-Zhe Luo. I mentored a student for Julia on the GSoC project of differentiable tensor networks. It is a valuable experimence for me to lead a project. The open source repository `OMEinsum` is listed bellow.

QuEra computing — *Waterloo*

Consultant — *2020.01-2020.07*

Working on projects stachastic optimizers and classical benchmarking quantum approximation optimization algorithm (QAOA). Waterloo is a nice place, I like the animals on the steet.

Harvard university — *Boston*

Postdoc fellow — *2020.08-*

Thanks to QuEra's sponsorship, I became a postdoc in Mikhail Lukin's group working on several projects I am proud of. One is understanding independent set solution space mainly motivated to understand quantum systems better, I am my collaborlators proposed the generic tensor network approach to solve solution space properties in a unified framework. Another is mapping a general maximum independent set (MIS) problem to one with restricted geometry of diagonal coupled grid graph. For a n vertex graph, our algorithm introduces an overhead of $O(n^2)$ which is probably optimal, which is a leap comparing to the previous algorithm having an $O(n^8)$ overhead. Since our algorithm makes solving MIS problem with physical devices practical, with the understadning of it value, it is now being patented. Other projects including speeding up SLM hologram computation for generating arbitrary geometry by 4 orders with an improved fourier transformation, a time evolution algorithm on random tensor networks et al.

Honors & Awards

2007 **First prize**, Physics Olympiad — *JiangSu, China*

2017 **First prize (out of 8000 teams, 100,000 RMB award)**, ZTE Fantastic Algorithm Challenge — *Xi An, China*

2016 **Academic Excellence Scholarship**, Nanjing University — *NanJing*

Selected Presentations

March Meeting *Boston*

Presenter *2019*

Gave a talk "Differentiale Quantum Circuits and Generative Modeling"

Juliacon *Baltimore*

Presenter *2019*

Gave a talk "Differential Programming Tensor Networks"

Deep Learning and Quantum Programming: A Spring School *Dongguan*

Lecturer *2019*

Gave lectures on quantum computing.

Selected Publications

Maximum independent sets: from unit disk graphs to arbitrary connectivity *Unpublished*

Jinguo Liu, Min-Thi Nguyen, Shengtao Wang and Hannes Pichler *2022*

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Computing solution space properties by generic programming tensor networks *Unpublished*

Jinguo Liu, Xun Gao, Shengtao Wang, Midelyn Cain and Mikhail Lukin *2022*

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Tropical tensor network for ground states of spin glasses *Phys. Rev. Lett. 126, 090506*

Jinguo Liu, Lei Wang and Pan Zhang *2021*

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Yao.jl: Extensible, Efficient Framework for Quantum Algorithm Design *Quantum*

Xiuzhe Luo, Jinguo Liu, Pan Zhang and Lei Wang *2020*

- One of the main authors of the most popular quantum circuit simulator in Julia language.