Title: Session 1 - Feng Pan

Speakers:

Collection: POSTDOC WELCOME 2022

Date: October 24, 2022 - 9:50 AM

URL: https://pirsa.org/22100127

Abstract: Virtual

About me

Feng Pan, a numerical guy who keeps staying in the theoretical physics institutes (from ITP, CAS to PITP)

Research background: Statistical Mechanics, with special focus on physical models defined on complex graphs, mostly used tools are tensor network algorithms and neural network models (mostly generative models)

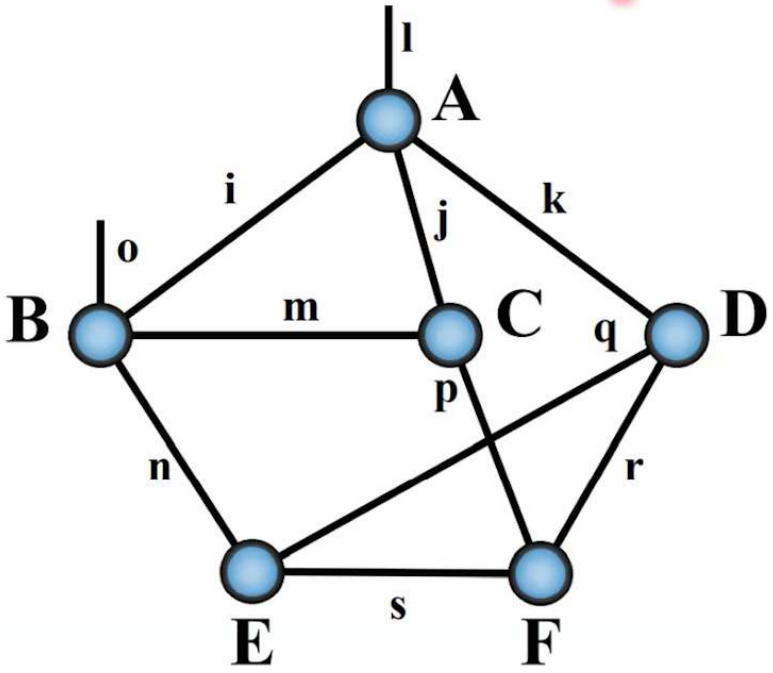
Background – Tensor Network Notations

Scalar

Vector

Matrix

Tensor

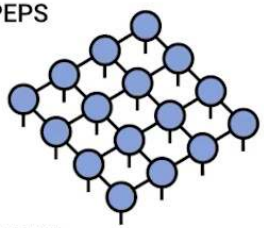


$$\sum_{ijkmnpqrs} A_{ijkl} B_{imno} C_{jmp} D_{kqr} E_{nqs} F_{prs} = R_{ol}$$

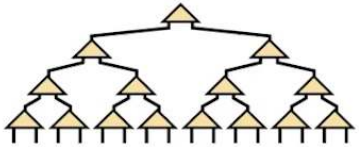
Motivation

Matrix Product State / Tensor Train

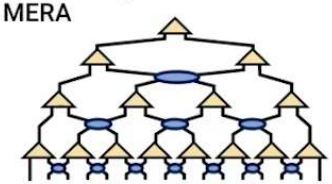
PEPS

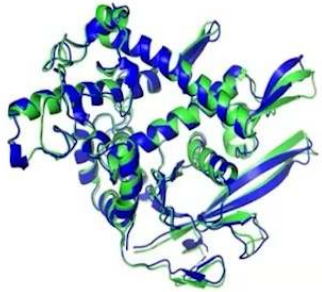


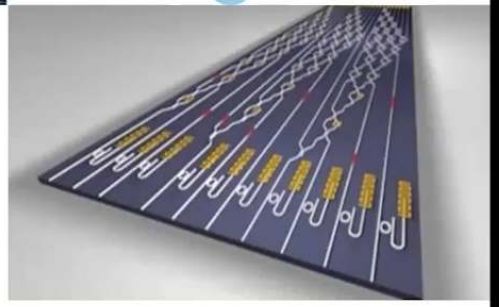
Tree Tensor Network / Hierarchical Tucker



MERA

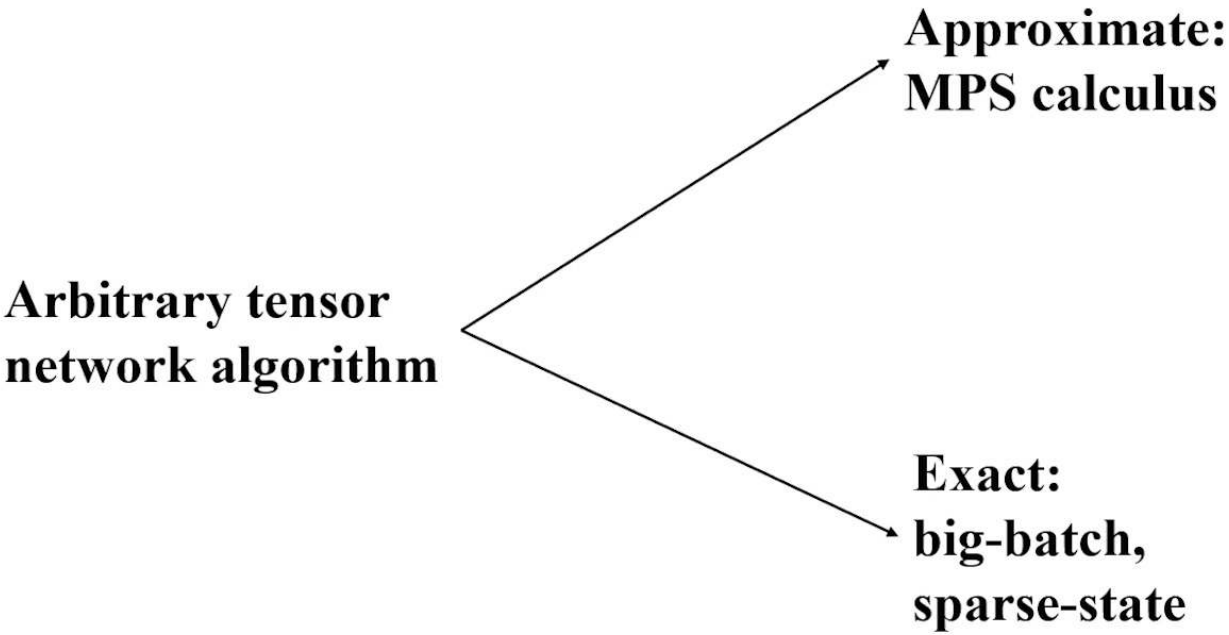




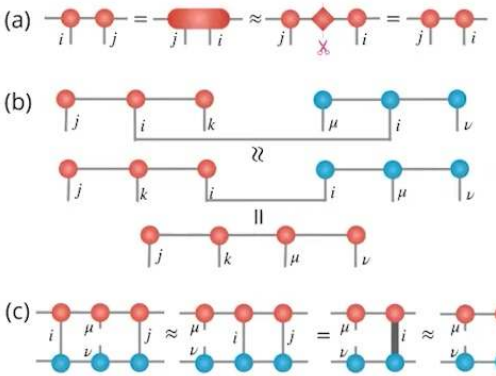


Goal: design arbitrary tensor network algorithm

Summary of my current work



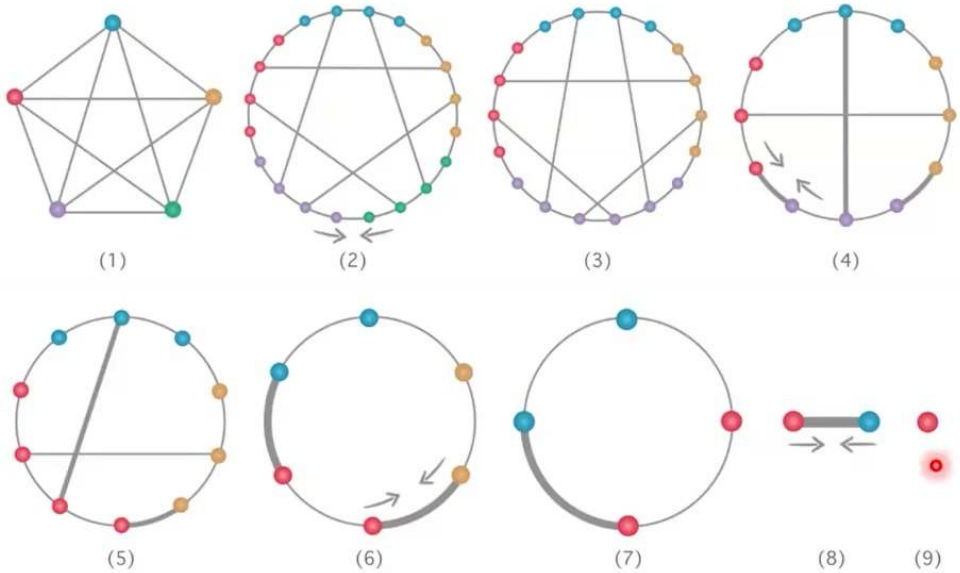
MPS calculus



Swap

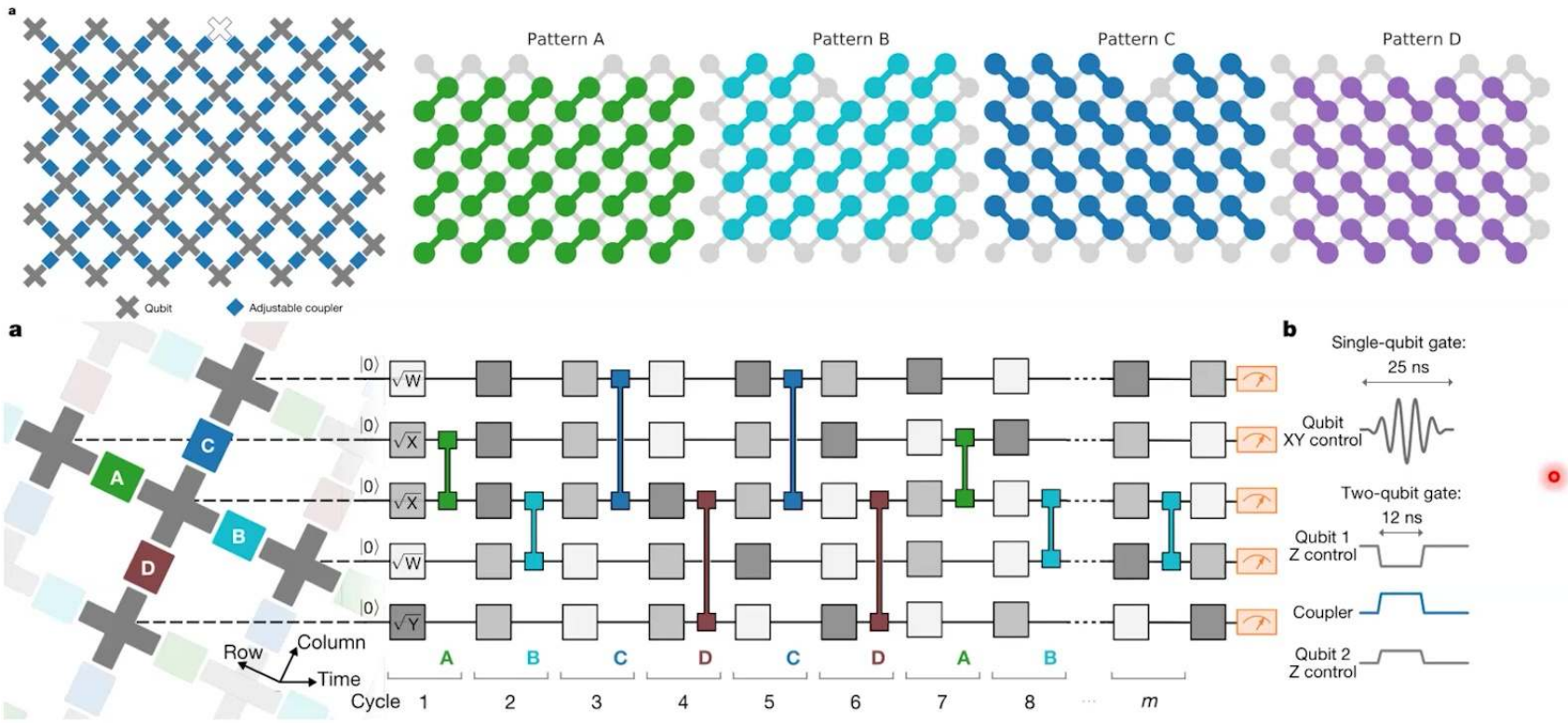
Contract

Merge



Pan, et al. *Phys. Rev. Lett.* 125.060503 (2020)

Sycamore quantum circuits and RQC sampling



200 seconds 1,000,000 bistrings 0.2% XEB fidelity

Arute, et al. *Nature* 574.7779 (2019): 505-510.

Classical simulation of RQC sampling experiments

	# bitstrings	Time complexity	Space complexity	Computational time	Hardware
Google' estimate	10^6	~4^33	2^26	10,000 years	Summit supercomputer
cotengra[1]	1	3.1*10^22	2^27	3088 years	One Quadro P2000
Alibaba[2]	64	6.66*10^18	2^29	267 days	One V100 GPU
Bigbatch[3]	10^6(correlated)	4.51*10^18	2^30	149 days	One A100 GPU
sparse-state[4]	10^6	3.49*10^18	2^30	320 days (~30 seconds for a supercomputer)	One V100 GPU

[1] Gray, and Kourtis. Quantum 5 (2021): 410.
[2] Huang, et al. Nature Computational Science 1.9 (2021): 578-587.
[3] Pan, and Zhang. *Phys. Rev. Lett.* 128.030501 (2022).
[4] Pan, Chen and Zhang. *Phys. Rev. Lett.* 129, 090502 (2022).

Thanks for your attention!