Computation with tensor networks

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Abstract: In this talk, I will present methods and algorithms for solving statistical mechanics problems, combinatorial optimization problems, and quantum circuit simulations,  in an integrated framework based on tensor networks.

In statistical mechanics problems, the partition function (i.e. the normalization factor of the Boltzmann distribution) at a finite temperature can be obtained by contracting a tensor network that is converted from the stat. mech. problem. When equipped with the “Tropical” algebra, the tensor network contraction can be used to obtain ground state energy and entropy of the model directly at zero temperature. When the interactions in the stat. mech. model are complex, computing the partition function acts as estimating the amplitude of an end state of a quantum circuit, thus tensor network contractions can be used to simulate quantum computers. I will introduce approximate and exact algorithms for contracting tensor networks, and their wide applications, particularly in simulating Google’s Sycamore quantum circuits.

Pan Zhang is working as a professor at the Institute of theoretical physics, Chinese academy of sciences (ITP, CAS). He got his Ph.D. degree from Lanzhou University in 2009 and has been a post-doctoral research fellow at the Santa Fe Institute before joining ITP, CAS in 2015. Pan Zhang’s research is in the interdisciplinary field of statistical physics, machine learning, quantum many-body, and quantum computation.