Joint CQSE & NCTS Special Seminar

2022
Sep. 30, Friday

TIME   Sep. 30, 2022, 2:30~3:30pm

TITLE   Provably efficient machine learning for quantum many-body problems

SPEAKER Research Assistant, Hsin-Yuan Huang (Institute for Quantum Information and Matter, Caltech)

PLACE   Rm104, Chin-Pao Yang Lecture Hall, CCMS & New Physics Building, NTU

ONLINE   https://nationaltaiwanuniversity-zbn.my.webex.com/

Abstract:

Classical machine learning (ML) provides a potentially powerful approach to solving challenging quantum many-body problems in physics and chemistry. However, the advantages of ML over more traditional methods have not been firmly established. In this work, we prove that classical ML algorithms can efficiently predict ground state properties of gapped Hamiltonians in finite spatial dimensions, after learning from data obtained by measuring other Hamiltonians in the same quantum phase of matter. In contrast, under widely accepted complexity theory assumptions, classical algorithms that do not learn from data cannot achieve the same guarantee. We also prove that classical ML algorithms can efficiently classify a wide range of quantum phases of matter. Our arguments are based on the concept of a classical shadow, a succinct classical description of a many-body quantum state that can be constructed in feasible quantum experiments and be used to predict many properties of the state. Extensive numerical experiments corroborate our theoretical results in a variety of scenarios, including Rydberg atom systems, 2D random Heisenberg models, symmetry-protected topological phases, and topologically ordered phases.

Biography Brief:

Education:

Ph.D., California Institute of Technology   Oct. 2018 - Now

Advised by John Preskill (Physics) and Thomas Vidick (CS).

B.S., National Taiwan University   Sep. 2014 - Jun. 2018

Studied in Computer Science (major) and Physics (minor). GPA: 4.30/4.30, Rank:

1/120. Member of the Machine Learning and Data Mining Group; Advisor: Chih-Jen Lin

Research Experience:

Research Assistant, Institute for Quantum Information and Matter, Caltech
Oct. 2018 - Now

Research Intern, AWS Center for Quantum Computing, Mentor: Steven T. Flammia
Jun. 2021 - Sep. 2021

Research Intern, Google AI Quantum, Mentor: Jarrod R. McClean
Jun. 2020 - Oct. 2020

Visitor, Centre for Quantum Technologies, Host: Patrick Rebentrost
Jul. 2019 - Aug. 2019

Research Intern, Allen Institute for Artificial Intelligence, Mentor: Wen-tau Yih Jun. 2018 - Sep. 2018

Research Intern, Microsoft Research, Redmond, USA, Mentor: Chenguang Zhu
Jun. 2017 - Sep. 2017

Research Assistant, Dept. of Computer Science, NTU, PI: Chih-Jen Lin
Sep. 2014 - Jun. 2018

Research Assistant, Dept. of Life Science, NTU, PI: Hsueh-Fen Juan
May 2013 - Aug. 2014

Research Assistant, Institute of Earth Sciences, Academia Sinica, PI: Fong Chao
Mar. 2012 - Mar. 2013