*AMENDMENT
For favour of Posting

THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

MATHEMATICS COLLOQUIUM

Analyzing variational quantum algorithms by Lie algebras

By

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Tencent

Abstract

Variational quantum algorithms leverage classical computational power to train parameters in parameterized quantum circuits, with the hope of achieving quantum computational advantages before the realization of fault-tolerant quantum algorithms. However, variational quantum algorithms face many challenges, including gradient estimation, barren plateaus, hardware and sampling noise, and circuit structure design. This presentation introduces the exploration of variational quantum algorithms in recent years using Lie algebra, as well as our recent work in this area. To demonstrate the role of Lie algebra, we analyze the algebraic structures of the QAOA algorithm - a type of widely researched combinatorial optimization variational quantum algorithm - on some special graphs (such as cycle graphs and complete graphs). We compute the dimension and give an explicit basis of the dynamic Lie algebras, identify its center, and obtain its simple Lie algebra decompositions with explicit basis given for each subalgebra. Based on this, we prove that there is no common "barren plateau" training difficulty in variational quantum algorithms on cycle graphs. It is hoped that this work will inspire more systematic research in the future and lead to rigorous algebraic analysis and effective design of variational quantum algorithms.

Biography:

Shengyu Zhang is a Distinguished Scientist at Tencent, and the Director of Tencent Quantum Lab. He received his Ph.D. in computer science at Princeton University in 2006 and subsequently held positions as a postdoctoral researcher at the California Institute of Technology. Prior to joining Tencent in 2018, he served as an Assistant Professor and Associate Professor at The Chinese University of Hong Kong. His research interests encompass quantum computing theory and systems, algorithm design, computational complexity, foundation of machine learning, and AI for sciences.

***Date : 01 November 2024 (Friday)**
Time : 3:00pm – 4:00pm
Venue : Lecture Theater D (near Lift 22)

All Are Welcome!