



## Tutorial

### Title

Quantum Machine Learning

### Abstract

With the development of quantum technology, quantum computation has shown powerful computation capability. An emerging area of quantum machine learning has attracted wide interest. In quantum machine learning, the unique characteristics of quantum mechanics is utilized to provide potential advantages for machine learning tasks. In this tutorial, we first present a brief introduction to the basic principles of quantum computation. Then we introduce several quantum machine learning algorithms including quantum neural networks, quantum reinforcement learning and quantum-inspired learning algorithms.

### Duration

TWO-hours on Sunday, October 1, 2023

### Motivation -

Quantum machine learning is an emerging area with wide potential applications.

### Expected audience

Anyone who may be interested in the emerging area of quantum machine learning or quantum artificial intelligence.

### Outline of contents

- Introduction to quantum computation principles
- Quantum neural networks
- Quantum reinforcement learning
- Quantum-inspired learning algorithms

## Key references

[1] J. Biamonte, P. Wittek, N. Pancotti, P. Rebentrost, N. Wiebe, and S. Lloyd, “Quantum machine learning,” *Nature*, vol. 549, no. 7671, p. 195, 2017.

[2] D. Dong and I. R. Petersen I R. Quantum estimation, control and learning: opportunities and challenges. *Annual Reviews in Control*, 2022, vol. 54, pp. 243-251.

## List of speakers

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**Daoyi Dong** is currently an Associate Professor at the University of New South Wales, Canberra, Australia, and a Fellow of the IEEE. He received a B.E. degree in automatic control and a Ph.D. degree in engineering from the University of Science and Technology of China, Hefei, China, in 2001 and 2006, respectively. He was with the Institute of Systems Science, Chinese Academy of Sciences and with Zhejiang University. He had visiting positions at Princeton University, NJ, USA, RIKEN, Wako-Shi, Japan, University of Duisburg Essen, Germany and The University of Hong Kong, Hong Kong. His research interests include quantum control, machine learning and renewable energy. Dr. Dong was awarded an ACA Temasek Young Educator Award by The Asian Control Association and is a recipient of a Future Fellowship, an International Collaboration Award and an Australian Post-Doctoral Fellowship from the Australian Research Council, and a Humboldt Research Fellowship from the Alexander von Humboldt Foundation of Germany. He has published more than 110 journal papers in leading journals including *Nature Human Behaviour*, *Physical Review Letters*, *IEEE Transactions*, and *Automatica*, and more than 50 conference paper. He is a Member-at-Large, Board of Governors, and was the Associate Vice President for Conferences and Meetings, IEEE Systems, Man and Cybernetics Society. He served as an Associate Editor of *IEEE Transactions on Neural Networks and Learning Systems* (2015-2021). He is currently an Associate Editor of *IEEE Transactions on Cybernetics*, and a Technical Editor of *IEEE/ASME Transactions on Mechatronics*. He is a Fellow of the IEEE and Engineers Australia.