1 Literature Review

1.1 Quantum Computing

[1] **Quantum computation and quantum information:** This is the classical textbook for learning quantum computing algorithms and quantum information technology (e.g. quantum Fourier transform, quantum phase estimation).

1.2 Quantum Machine Learning

[2] **Quantum machine learning:** A review paper on QML techniques and algorithm. List QML algorithms including Bayesian Inference, Online Perception, Least Square Fitting, Quantum BM, Quantum PCA, Quantum SVM and Quantum reinforcement learning, and whether they use HHL algorithm or not.

[3] **Machine learning & artificial intelligence in the quantum:** This is an extensive review paper with a strong focus on agent-based models.

[4] **Quantum machine learning: what quantum computing means to data mining:** A textbook introducing CML and QML algorithms. This is the first monograph on the subject that also covers more esoteric topics, for instance, what we call today quantum learning.

[5] **Supervised learning with quantum computers:** This is the most up-to-date book on QML.

[6] **Quantum machine learning for data scientists:** This is a review paper on the quantum computing, quantum algorithms that is usually used in QML, and QML algorithms.

1.3 Input data encoding

This subsection is about the techniques to transfer classical data to quantum data, which means to create superpositions with arbitrary weights.

[5] **Supervised learning with quantum computers:** This book includes the strategies of implementing the classical-quantum interface, which is to encode classical data into quantum data.

[7] **Creating superpositions that correspond to efficiently integrable probability distributions:** Create the input quantum states for Grover's search, and this technique can also be used in some other quantum algorithms, such as HHL algorithm.

[8] **Quantum Networks for Generating Arbitrary Quantum States:** The quantum circuits for generating superpositions with arbitrary weights.

1.4 Papers for Specific Algorithms

1.4.1 HHL algorithm

[9] **Quantum algorithm for linear systems of equations:** This is the first paper to propose the HHL algorithm. The purpose of this algorithm is to find $\vec{x}$ satisfying $\vec{x} = \vec{b}$ using a quantum computer (A is a s-sparse $N \times N$ matrix, and $\vec{b}$ is a unit vector. Both of them are known), if one is not interested in $\vec{x}$ itself, but certain statistical feature of the solution $\langle x|M|x\rangle$ is some quantum mechanical operater).

[10] **Quantum circuit design for solving linear systems of equations:** An experimental implementation for the HHL algorithm, which introduces a quantum circuit for solving a 4×4 linear system.

[11] **Quantum circuits for solving linear systems of equations:**An experimental implementation for the HHL algorithm, which introduces a quantum circuit for solving a 2×2 linear system.

[12] **Experimental realization of quantum algorithm for solving linear systems of equations:** An experimental Implementation of HHL algorithm.

[13] **Experimental quantum computing to solve systems of linear equations:** An experimental Implementation of HHL algorithm.

1.4.2 Quantum Support Vector Machine

[14] **Quantum optimization for training support vector machines:** This paper implement quantum Support Vector Machine (SVM) based on Grover's search algorithm, with quadratic speedup, compared with classical SVM. And it uses the classical datasets, Iris dataset and Breast cancer dataset.

[15] **Quantum support vector machine for big data classification:** This paper implement quantum SVM with exponential speedup. The computational complexity for classical SVM is $O(log(\epsilon^{-1})poly(N, M))$. The ϵ is the accuracy, and N is the number of features, which is the dimension of input data, and M is the number of training data. While by using quantum SVM, we can reduce the computational complexity to $O(log(NM))$.

[16] **Least squares support vector machine classifiers:** By reformulate SVM into least square SVM, we can use linear equations to denote the Lagrange function. Then we can transform the quantum SVM into a linear system, and use HHL quantum circuit to solve the problem. This process is mentioned in [15].

[17] **Experimental Realization of a Quantum Support Vector Machine:** The implementation of quantum SVM algorithm [15], on solving a simple pattern recognition problem of whether a hand-written number was a 6 or a 9.

1.5 Implementation and SDKs

[18] **Getting started with qiskit - qiskit terra 0.7.0 documentation:** The documentation webpage for Qiskit version 0.7.0, with the introduction of its packages, functions and examples for quantum gates.

[19] **Welcome to the Docs for the Forest SDK - pyQuil 2.0 documentation** The documentation webpage for pyQuil version 2.0, including the introduction to its QVM and the compiler.

[20] **Optimization of circuits for ibm's five-qubit quantum computers:** If we just use the local simulator to run the quantum circuit, we need not to take the structure of quantum chip into consideration. But if we want to run quantum circuit on quantum chip, there will be some additional limitations, for example, we cannot apply a Controlled-NOT gate betweenb two qubits without any connection. This paper introduces quantum circuits to break the constraints of hardware limitations, and methods to reduce the number of gates in circuits.

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