

# Quantum Machine Learning Research Topic and Corresponding Literatures

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## 1 Topic 1: Design Variational Quantum Circuit (VQC) Ansatz by AI, eg. Reinforcement Learning

1. A quantum information theoretical analysis of reinforcement learning-assisted quantum architecture search <https://arxiv.org/pdf/2404.06174.pdf>
2. Bayesian Parameterized Quantum Circuit Optimization <https://arxiv.org/pdf/2404.11253.pdf>
3. Quantum Architecture Search with Unsupervised Representing Learning <https://arxiv.org/pdf/2401.11576.pdf>
4. Optimizing ZX-Diagrams with Deep Reinforcement Learning <https://arxiv.org/pdf/2311.18588>
5. Light-cone feature selection for quantum machine learning <https://arxiv.org/pdf/2403.18733>
6. Light Cone Cancellation for VQE Ansatz <https://arxiv.org/pdf/2404.19497>

## 2 Topic 2: Design VQC with some features, eg. Symmetry, Topology

1. Here comes the  $SU(N)$ : multivariate quantum gates and gradients <https://quantum-journal.org/papers/q-2024-03-07-1275/>

2. Geodesic Algorithm for Unitary Gate Design with Time-independent Hamiltonians <https://arxiv.org/pdf/2401.05973.pdf>
3. Tensorized Pauli decomposition algorithm <https://arxiv.org/pdf/2310.13421>

### **3 Topic 3: Simulate VQC or in real device, eg. State vector, Tensor**

1. Hybrid tree tensor networks for quantum simulation <https://arxiv.org/pdf/2404.05784.pdf>

### **4 Topic 4: About Reading-out information from VQC**

### **5 Topic 5: The inductive bias for VQC as machine learning models**

1. Inductive Bias for Deep Learning of High-Level Cognition <https://arxiv.org/pdf/2011.15091.pdf>
2. Contextually and inductive bias in quantum machine learning <https://arxiv.org/pdf/2302.01365.pdf>
3. The inductive bias of quantum kernel <https://arxiv.org/pdf/2106.03747.pdf>

### **6 Topic 6: Optimize method, eg. Gradient descent, natural gradient, gradient-free or with some features**

1. Efficient Gradient Estimation of Variational Quantum Circuit with Lie Algebraic Symmetries <https://arxiv.org/pdf/2404.05108.pdf>
2. Optimizing Variational Quantum Algorithms with qBang: Efficient Interweaving metric and Momentum to Navigate Flat Energy Landscapes <https://quantum-journal.org/papers/q-2024-04-09-1313/>

3. Quantum conjugate gradient method using the positive-side quantum eigenvalue transformation <https://arxiv.org/pdf/2404.02713.pdf>
4. A Novel Noise-Aware Classical Optimizer for Variational Quantum Algorithms <https://arxiv.org/pdf/2401.10121.pdf>
5. Variational Quantum Simulation: A case study for understanding warm starts <https://arxiv.org/pdf/2404.10044.pdf>
6. Guided-SPSA: Simultaneous Perturbation Stochastic Approximation assisted by the Parameter shift rule <https://arxiv.org/pdf/2404.15751.pdf>
7. Improving Gradient Methods via Coordinate Transformations: Applications to Quantum Machine Learning <https://arxiv.org/pdf/2304.06768>
8. Better Optimization of VQE by Combining the Unitary Block Optimization Scheme with Classical Post-Processing <https://arxiv.org/pdf/2404.19027>
9. Quantum Global Minimum Finder Based on Quantum Variational Search <https://arxiv.org/pdf/2405.00450>
10. Hybrid Quantum-Classical Scheduling for Accelerating NN Training with Newton's Gradient Descent <https://arxiv.org/pdf/2405.00252>
11. Training robust and generalizable quantum models <https://arxiv.org/pdf/2311.11871>
12. Quantum-Informed Recursive Optimization Algorithms <https://journals.aps.org/prxquantum/pdf/10.1103/PRXQuantum.5.020327>

## 7 Topic 7: Mitigation Noise and Barren Plateau

1. Can Error Mitigation Improve Trainability of Noisy Variational Quantum Algorithms? <https://quantum-journal.org/papers/q-2024-03-14-1287/>
2. Exploiting many-body localization for scalable quantum simulation <https://arxiv.org/pdf/2404.17560>
3. A Review of Barren Plateaus in Variational Quantum Computing <https://arxiv.org/pdf/2405.00781>
4. Improving Trainability of VQC via Regularization Strategies <https://arxiv.org/pdf/2405.01606>

## **8 Topic 8: Scale Quantum Machine Learning, the most literature aimed at small applications or problems**

1. Towards provably efficient quantum algorithms for large-scale machine-learning models <https://www.nature.com/articles/s41467-023-43957-x#Sec7>
2. Quantum machine learning of large datasets using randomized measurements <https://arxiv.org/pdf/2108.01039.pdf>
3. QNLP <https://arxiv.org/pdf/2403.19758>
5. A quantum neural network framework for scalable quantum circuit approximation of unitary matrices <https://arxiv.org/pdf/2405.00012>

## **9 Topic 9: What's the theory guarantee behind if QML better than Classical models**

1. Better than classical? The subtle art of benchmarking quantum machine learning models <https://arxiv.org/pdf/2403.07059.pdf>

## **10 Topic 10: What's kind of problem set can be solved effectively by QML or VQC**

1. What makes data suitable for a locally connected neural networks ? A necessary and sufficient conditions based on quantum entanglement <https://arxiv.org/pdf/2303.11249.pdf>  
Analysing the classical model with quantum method by tensor networks.
2. Quantum Solvable Nonlinear Differential Equations <https://arxiv.org/pdf/2305.00653.pdf>

## 11 Topic 11: Some hot applications, eg. Quantum Generative model, Quantum Reinforcement Learning

1. VQC-based Reinforcement Learning with Data Reuploading: Performance and Trainability <https://arxiv.org/pdf/2401.11555.pdf>
2. On Quantum Natural Policy Gradients <https://arxiv.org/pdf/2401.08307.pdf>
3. Variational Quantum Algorithms for Semidefinite Programming <https://arxiv.org/pdf/2112.08859>
4. Tensor Networks Based quantum Optimize Algorithm <https://arxiv.org/pdf/2404.15048>
5. Guardians of the Quantum Gan<https://arxiv.org/pdf/2404.16156>
6. Quantum Speedup in Regret Analysis of Infinite Horizon Average-Reward Markov Decision Processes <https://arxiv.org/pdf/2310.11684>

## 12 Topic 12: How to explain QML

1. Understanding quantum machine learning also requires rethinking generalization <https://doi.org/10.1038/s41467-024-45882-z>
2. Quantum-inspired activation functions in the convolutional neural networks <https://arxiv.org/pdf/2404.05901.pdf>
3. Bounds and guarantees for learning and entanglement <https://arxiv.org/pdf/2404.07277.pdf>
4. On the interpretability on Quantum Machine Learning <https://arxiv.org/pdf/2308.11098.pdf>

Explainable Quantum Machine Learning and Explainable AI, the references of "on the interpretability on Quantum Machine Learning" are worth reviewing.

5. Learning Quantum Processes with Quantum Statistical Query <https://arxiv.org/pdf/2310.02075>

6. Revealing the working mechanism of quantum neural networks by mutual information <https://arxiv.org/pdf/2404.19312>
7. Analyzing variational quantum landscapes with information content <https://www.nature.com/articles/s41467-023-43957-x#Sec7>
8. Theoretical guarantees for permutation-equivariant quantum neural networks <https://www.nature.com/articles/s41534-024-00804-1>

## 13 Topic 13: How to encode the classical data into VQC effectively

1. Efficient quantum amplitude encoding of polynomial functions <https://quantum-journal.org/papers/q-2024-03-21-1297/>
2. Optimal Universal Quantum Encoding for statistical inference <https://arxiv.org/pdf/2404.08172.pdf>
3. Let Quantum Neural Networks Choose Their Own Frequencies <https://arxiv.org/pdf/2309.03279.pdf>
4. Approximating Korobov Functions via quantum Circuit <https://arxiv.org/pdf/2404.14570>
5. A quantum compiler design method by using linear combinations of permutations <https://arxiv.org/pdf/2404.18226>
6. Qubit encoding for a mixture of localized functions <https://arxiv.org/pdf/2404.18529>
7. Circuit Complexity of Quantum Access models for encoding classical data <https://arxiv.org/pdf/2311.11365>

## 14 Topic 14: Continuous Problem in Quantum World

1. Quantum Kernel Method with Continuous Variable <https://arxiv.org/pdf/2401.05647.pdf>

## Some New

1. Fermionic Machine Learning <https://arxiv.org/pdf/2404.19032>