Claims

1. A method for determining a target Quantum Neural Network (QNN) configuration for binary classification, the method comprising:

    receiving a binary classification dataset, the dataset comprising a plurality of feature data and target classification data;

    generating at least one guiding feature randomly selected from the plurality of feature data;

    generating a population of candidate QNN configurations based on the plurality of features, each candidate QNN configuration defining a QNN comprising a random mapping of each of the plurality of features to at least one qubit of the QNN and entanglement relationships between the qubits, and wherein each candidate QNN configuration comprises a mapping of each guiding feature to at least one qubit as defined in the QNN configuration;

    performing a genetic search in the population of QNN configurations for a target QNN configuration by:

        simulated execution of candidate QNNs initialized using the each QNN configuration in the population of QNN configurations;

        computing a fitness metric for each of the candidate QNNs based on outputs of simulated execution of the candidate QNNs and the target classification data; and

        iteratively evolving the population of QNN configurations based on the fitness metrics to identify a target QNN configuration with the highest fitness metric.

2. The method of claim 1, wherein iterative evolution of the population of QNN configurations comprises:

    selection of a subset of the QNN configurations based on the computed fitness metrics;

    generation of a subsequent population of QNN configurations by random mutation operations on the subset of the QNN configurations.

3. The method of any one of the preceding claims, wherein each QNN configuration comprises at least one configuration value defining operations performed on qubits in each layer of the QNN.
4. The method of claim 1, wherein the entanglement relationships between the qubits of the QNNs defined by the QNN configurations comprise multi-layered hierarchical entanglement relationships.
5. The method of claim 4, wherein the multi-layered hierarchical entanglement relationships comprise two qubit groups at each layer, wherein number of qubits in the two qubit groups at each layer are determined based on a tree split ratio.
6. The method of any one of the preceding claims, wherein the method further comprises random sampling of records in the domain dataset; and
simulated execution of candidate QNNs using the randomly sampled records.
7. The method of any one of the preceding claims, wherein the method further comprises defining a QNN based on the identified target QNN configuration; and
deploying the QNN based on the identified target QNN configuration to process live data and generate binary classification inferences.
8. The method of any one of the preceding claims, wherein the number of qubits in each candidate QNN configuration is less than the total number of features in the dataset; and at least a subset of qubits in each QNN configuration encode more than one feature data.
9. The method of claim 2, wherein mutation comprises introducing a random rotation to a subset of qubits of the QNNs defined by the subset of the QNN configurations.
10. A method for determining a target Quantum Neural Network (QNN) configuration for a problem domain, the method comprising:
    receiving a problem domain dataset, the dataset comprising a plurality of feature data and target variable data;
    generating at least one guiding feature randomly selected from the plurality of feature data;
    generating a population of candidate QNN configurations based on the plurality of features, each candidate QNN configuration defining a QNN comprising a random mapping of each of the plurality of features to at least one qubit of the QNN and

entanglement relationships between the qubits, and wherein each candidate QNN configuration comprises a mapping of each guiding feature to at least one qubit as defined in the QNN configuration;

performing a genetic search in the population of QNN configurations for a target QNN configuration by:

simulated execution of candidate QNNs initialized using the each QNN configuration in the population of QNN configurations;

computing a fitness metric for each of the candidate QNNs based on outputs of simulated execution of the candidate QNNs and the target variable data; and

iteratively evolving the population of QNN configurations based on the fitness metrics to identify a target QNN configuration with the highest fitness metric.

11. The method of claim 10, wherein iterative evolution of the population of QNN configurations comprises:

selection of a subset of the QNN configurations based on the computed fitness metrics;

generation of a subsequent population of QNN configurations by random mutation operations on the subset of the QNN configurations.

12. The method of claim 10 or claim 11, wherein each QNN configuration comprises at least one configuration value defining operations performed on qubits in each layer of the QNN.

13. The method of claim 10, wherein the entanglement relationships between the qubits of the QNNs defined by the QNN configurations comprise multi-layered hierarchical entanglement relationships.

14. The method of claim 13, wherein the multi-layered hierarchical entanglement relationships comprise two qubit groups at each layer, wherein the number of qubits in the two qubit groups at each layer are determined based on a tree split ratio.

15. The method of any one of claims 10 to 14, wherein the method further comprises random sampling of records in the domain dataset; and

simulated execution of candidate QNNs used the randomly sampled records.

16. The method of any one of claims 10 to 15, wherein the method further comprises defining a QNN based on the identified target QNN configuration; and
deploying the QNN based on the identified target QNN configuration to process live data and generate inferences.
17. The method of any one of claims 10 to 16, wherein the number of qubits in each candidate QNN configuration is less than the total number of features in the dataset; and at least a subset of qubits in each QNN configuration encode more than one feature data.
18. The method of claim 11, wherein mutation comprises introducing a random rotation to a subset of qubits of the QNNs defined by the subset of the QNN configurations.
19. A quantum computing system, the system comprising:
    a quantum circuit generated according to a target QNN configuration, wherein the target QNN configuration is determined by execution of the method of any one of claims 1 to 18.