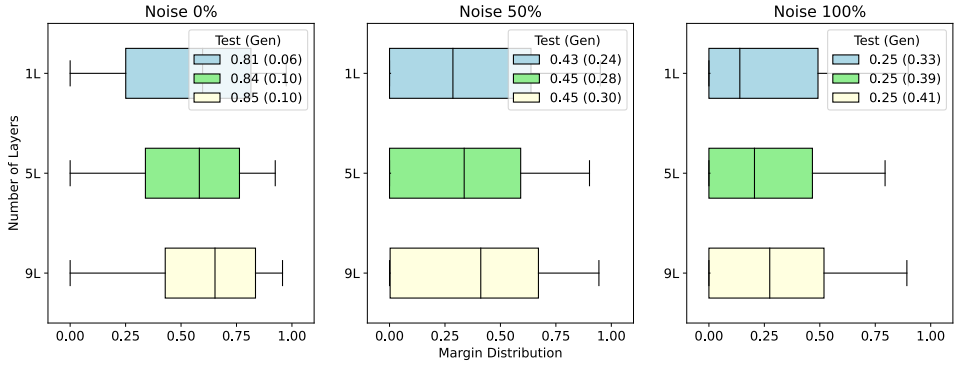

Figure 1: A Tukey box-and-whisker plot depicting the margin distributions of optimized 8-qubit Quantum Convolutional Neural Networks (QCNNs). The results for QCNNs with one, five, and nine layers are displayed, along with their corresponding test accuracies and generalization gap indicated in the legend. QCNNs were trained for 4-class classification task aimed at quantum phase recognition (QPR). The experiment was performed with varying degrees of label noise: QPR dataset with pure labels (left), half randomly labelled dataset (middle), and full randomly labelled datasets (right). As the noise (randomization) level increases, the margin distributions tend to exhibit a more pronounced skew towards the left, indicating that a greater proportion of samples are classified with smaller margins. Notably, the margin distribution exhibits a strong positive correlation with test accuracy and generalization gap across all scenarios.

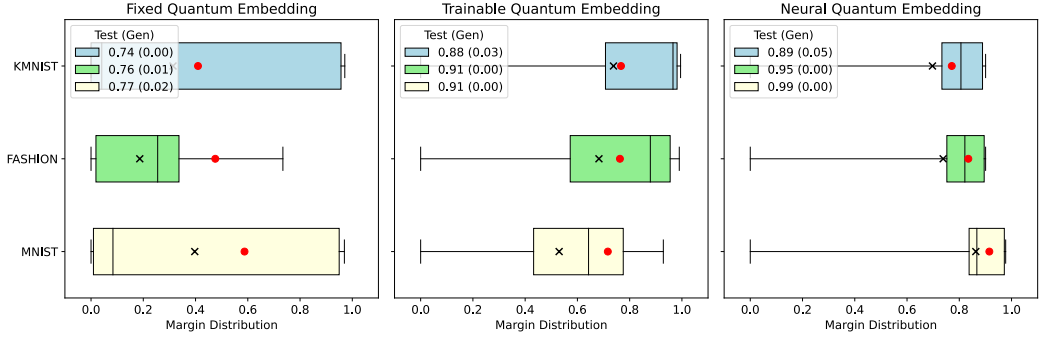

Figure 4: A Tukey box-and-whisker plot illustrating the margin distributions of optimized 8-qubit Quantum Convolutional Neural Networks (QCNNs). The plot shows results for QCNNs using fixed quantum embedding (left), trainable quantum embedding (middle), and neural quantum embedding (right). The QCNNs were trained on a binary classification task using the MNIST (bottom), Fashion-MNIST (middle), and Kuzushiji-MNIST (top) datasets. In addition to the margin distributions, the mean of the margins is indicated by a black cross, and the trace distance between ensemble quantum states is marked by a red circle.