1 Conclusion

This project explored the most basic of quantum machine learning algorithms by attempting to classify a subset of the Iris dataset. We have shown how we could encode such a dataset on qubits, scaling the feature values accordingly, and how a variational ansatz could be introduced to the quantum circuit to make predictions. These predictions, with the variational parameters as the only adjustable parameters, were then optimized using a classical optimizer. We were successful in the implementation of the quantum circuit, reaching a convergence of the cost function, and the classification accuracy was found to be around 80% for the training set. The circuit was also verified on a test set, where the model failed, and reached an accuracy of 50%. This shows room for improvement in the model, and the need for more complex circuits, and stronger optimization techniques. It could also be a sign of overfitting, however, as we have seen, reducing the complexity of the ansatz did not yield better results - meaning we can conclude with the necessity for more complex circuits, but with maybe fewer parameters. There are many ways to improve the complexity, by adding different rotation gates. Where we've used only R_y gates, we could've introduced both R_x and R_z gates (like we did in the encoding).

We did find however, that the quantum circuit was able to classify the known-data with a reasonable accuracy, and we saw the importance on choice of both encoding and ansatz. The lack on entanglement in the encoding of the data caused the model to fail even on the training set, highlighting the importance for entangling in such quantum circuit models when learning complex patterns in datasets.

Further work on this project would include more complex quantum circuits, both in encoding the data, and the variational ansatz. There is also a big improvement to made in the optimization schemes, looking at momentum-gradient based optimizers - such as ADAM - and adding more qubits, which would allow for more complex datasets to be classified.