Mandatory Assignment 2 - Brage Hamre Skjørestad, August Berge Andersen, Linus Krystad Raaen

**Data Exploration**

We started with loading the data and doing some exploration. It had 150 data points, with three classes with their values being in the range [0.1, 7.9]. Furthermore, the data was perfectly balanced. See image of class distribution below (Figure 1):Et bilde som inneholder tekst, skjermbilde, diagram, programvare

Automatisk generert beskrivelse

*Figure 1*

**Pre-processing / Encoding**

Not much pre-processing was needed because the data was so balanced, but we did normalize it from 0 to pi because we planned on using angle encoding. After that we split the data into train/validation/test sets at 70/15/15, respectively.

**Loss Function**

We started off with trying out Mean Square Error (MSE) and Root Mean Square Error (RMSE), but those didn’t really work because we were solving a classification problem and not a regression problem. Therefore, we ended up going for Log Loss.

**QNNs**

We first implemented IBM’s “real amplitudes” QNN from the lecture notes as this was a good way to just get the ball rolling and start understanding the structure of QNNs.

After we got that to work we implemented our own.

**Gradient Descent**

We first started by using SPSA as our optimizer just so we could quickly see if our real amplitudes implementation worked and actually gave us an answer. After that we implemented our own gradient descent using the methods described in the lecture notes.

It took some back and forth to find the perfect learning rate and other hyperparameters for the gradient descent, but we settled on learning\_rate=0.7, maxiter=100, shots=100 and that seemed to work well.

**Final Results**

We ended up getting 100% accuracy after 90 minutes of runtime when using Real Amplitudes with 5 layers.

Here is the confusion matrix:

ADD CONFUSION MATRIX HERE

*Figure 2*

Here is the learning curves:

ADD LEARNING CURVES HERE  
*Figure 3*

**Joke**

Why do elephants have trunks?

Because they would look funny with a suitcase.