COMPONENT 1

Water quality analysis

1. **Specify the accuracy you achieved across 3 architectural modifications (e.g., different numbers of layers, different hyperparameters, etc.)**

Modification	Activation function	Accuracy (validation)	Loss (Validation)	Accuracy (train)	Loss (train)	Epoch	Drop out	Hidden layers	Time (sec)
Before Tunning	Relu	0.88	1.76	0.85	2.2	10	0.9 & 0.2	2	2.8
Model 1	Sigmoid	0.93	0.19	0.93	0.22	10	0.7 & 0.2	3	3.91
Model 2	Relu	0.95	0.26	0.93	0.29	15	0.2	2	4.87
Model 3	Tanh	0.88	0.21	0.88	0.23	20	0.5	2	5.8

2. Why do you think your accuracy is not higher / lower?

Accuracy couldn't go higher than the observed figures recorded because we are working with a dataset that has few entries as a result the model does not learn enough for it to achieve a higher accuracy. Another reason accuracy couldn't go higher is as a result of low dimensionality. To achieve an accuracy of 98% we will need to normalize the dataset, finetune other hyperparameters such as adding more hidden layers or specify the learning rate in the optimizer. Also, we can achieve a higher accuracy by applying dimensionality reduction methods such as PCA but that is not covered in the scope of this project. In spite of all these, higher accuracy might not be achieved due to dimensionality reduction.

3. **What effect does the optimisation function have on network performance?**

Optimization function	Accuracy (Validation)	Loss (Validation)	Time (sec)
RMSprop	0.96	0.12	2.7
Adam	0.96	0.14	2.8
SGD	0.88	nan	2.5
Adadelta	0.90	0.68	3.1

Optimizers are algorithms that change the weights and learning rate of a neural network thereby minimizing the loss and provide the most accurate results possible. “The goal is to hit the sweet spot of maximum value optimization, where foolish risk is balanced against excessive caution” (Steven, 2017 p. 69). Changing the learning rates of a neural network minimises the loss on the model thereby giving you a higher accuracy for the trained data. From the above table, RMSprop and Adam optimizers gave the highest accuracy with RMSprop giving the lowest possible loss which implies that it has the best learning rate.

4. **What happens if you include more than 4 (hidden) layers?**

Several neurons in the hidden layers can lead to overfitting. This occurs when the network has learned a lot about the training data and as such negatively impacts the accuracy of the test data set. This also increases the training time. When 5 hidden layers was used to train the model, the accuracy dropped and it took a longer time to run. Notice how the model overfits the validation loss in the diagram below.

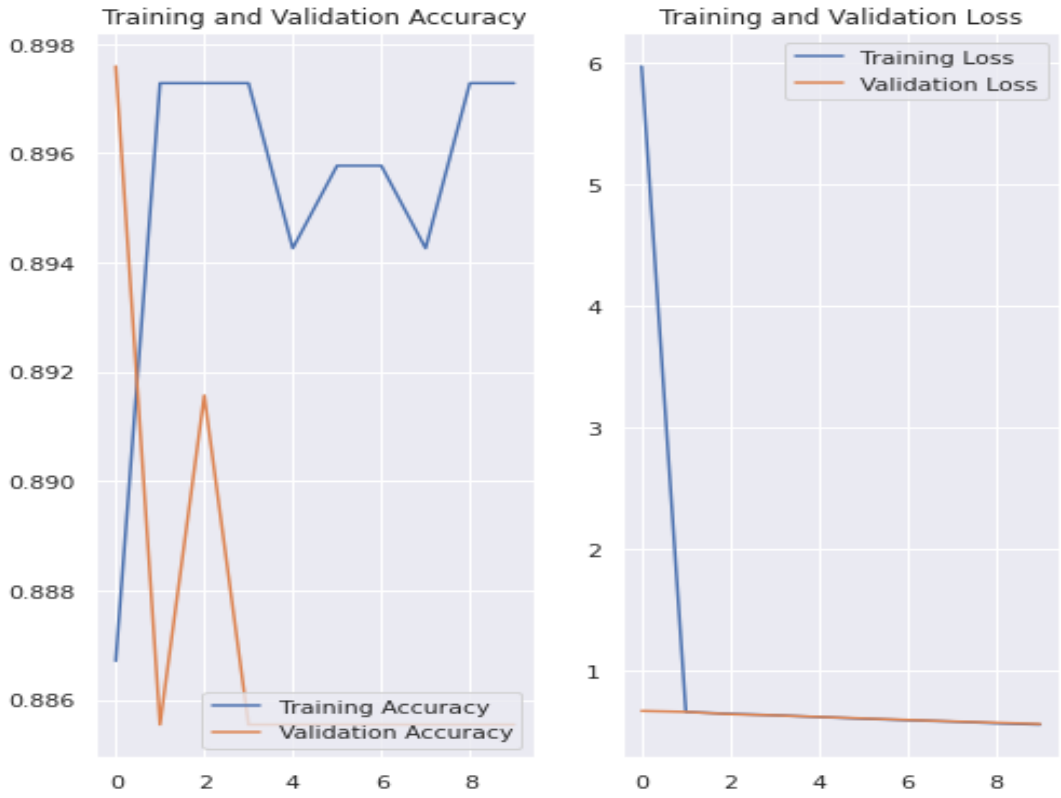

Figure 1: Plot of more than 4 hidden layers

5. What is the effect of the data size on your accuracy?

Small dataset or not enough different image set can result in our model memorising instead learning the dataset.

6. Suitable graphical plot of the data.

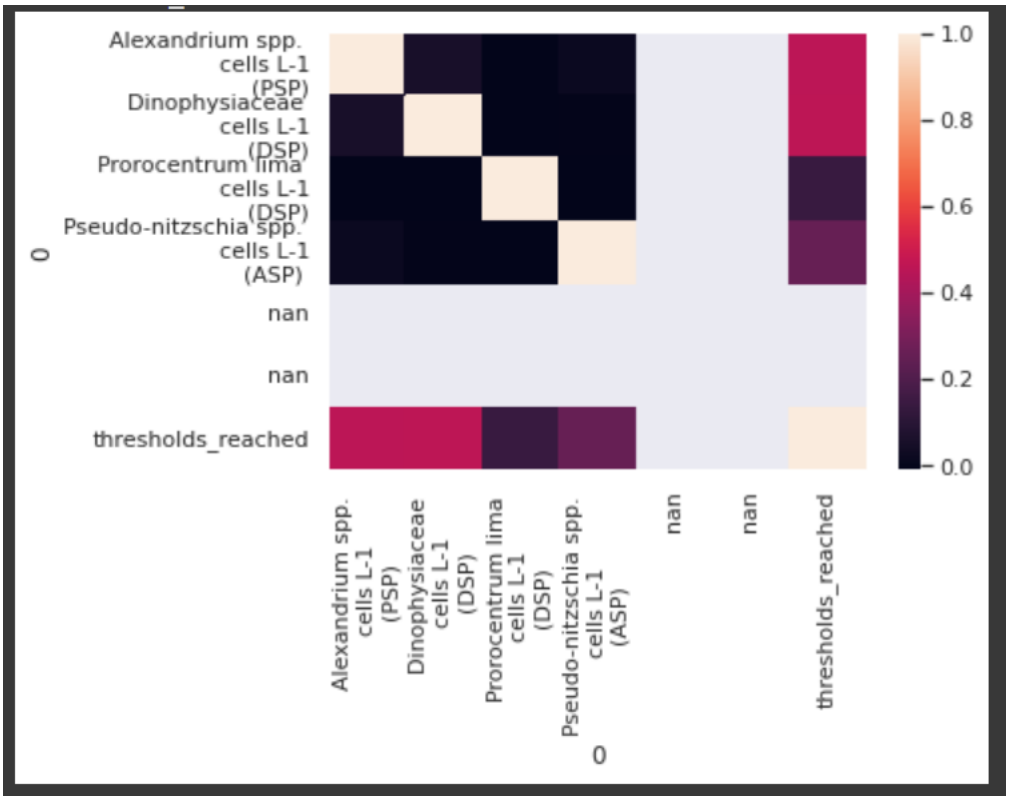

Figure 2: Heat map showing the correlation between the data