2) Neural networks in Keras

1-

```
X = load_wine().data
y = load_wine().target
```

2-

```
def preprocess_data(X, y):
### TO DO ###
    X_out = scale(X)
    y_out = to_categorical(y)
    return X_out, y_out
```

Ratios of sizes
Data_train_val/(Data_train_val+Data_test) = .7
Data_train/(Data_train+Data_val) = .8

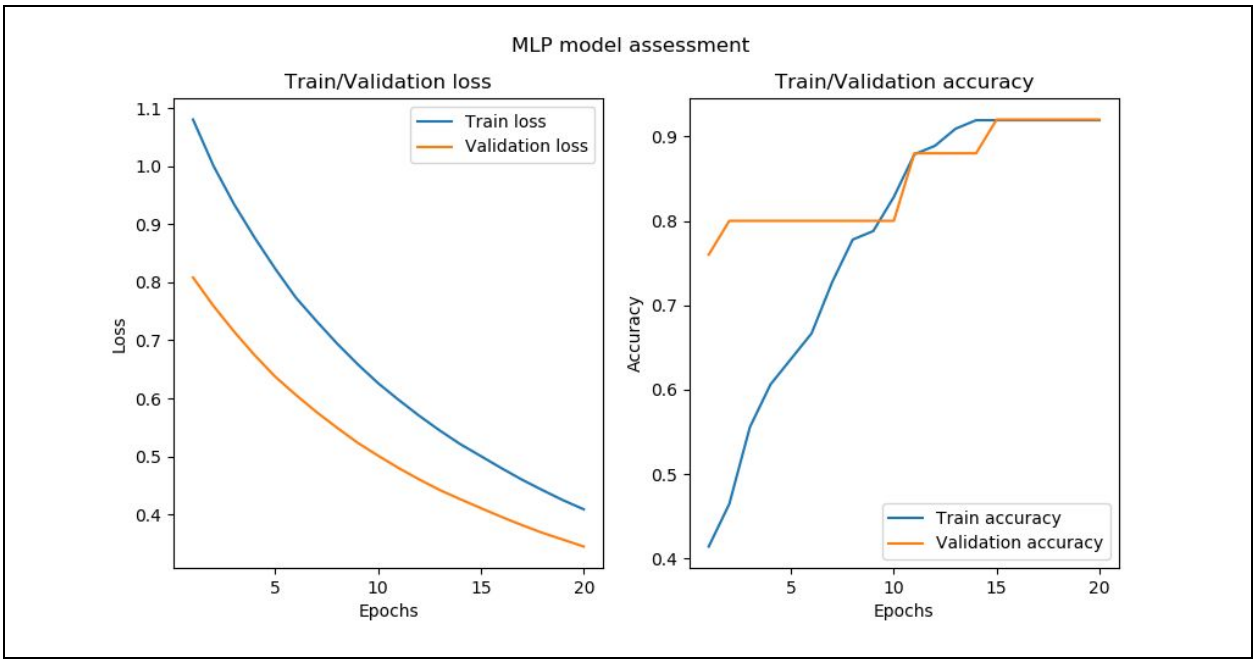
3- Please see the notebook at the end of this document

4-

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 10)                140
_________________________________________________________________
dense_2 (Dense)              (None, 3)                 33
=================================================================
Total params: 173
Trainable params: 173
Non-trainable params: 0
_________________________________________________________________
54/54 [==============================] - 0s 55us/step
```

5-

```
Test loss: 0.38749685883522034
Test accuracy: 0.9814814925193787
```



The model fits on the training data properly; the test accuracy is high (98%) which shows that the model does not underfit, and by comparing the train and validation loss and accuracy graphs, we observe that the model does not overfit.

6-

The defined hyperparameters:

```
hyper_parameters_instances = [{"Flag": True, "HiddenLayerActivationRelu": True},
                              {"Flag": True, "HiddenLayerActivationRelu": False},
                              {"Flag": False, "HiddenLayerActivationRelu": True},
                              {"Flag": False, "HiddenLayerActivationRelu": False}]
```

If the Flag is true then build_MLP adds one additional hidden layer and HiddenLayerActivationRelu determines the type of activation function in the hidden layers.

Finally, KFold_model_selection selects the best setting and trains a model based on that, and calculates the accuracy and loss values for the test set.

Please see the notebook at the end of this document.