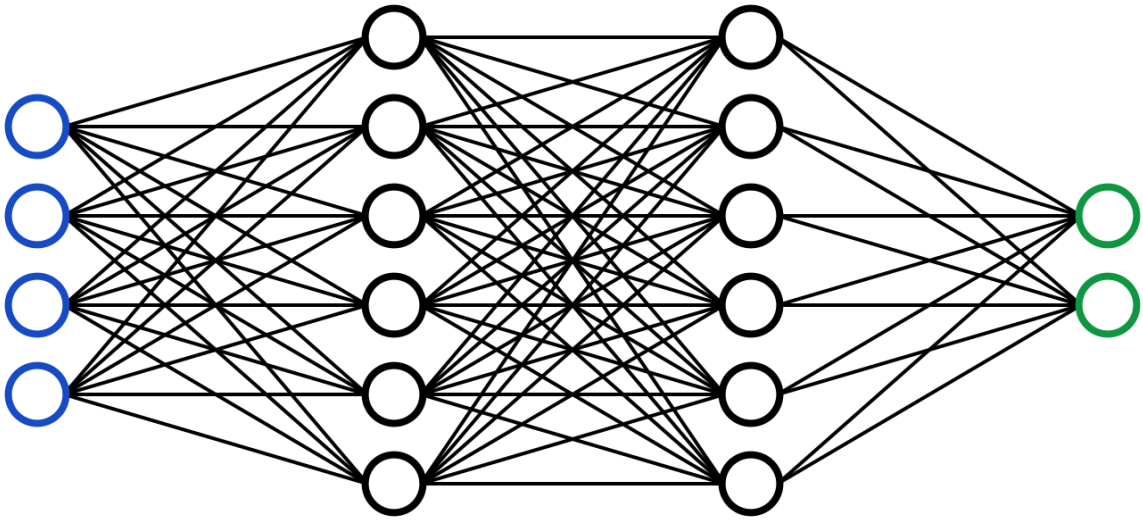
Pattern Recognition and Machine Learning

Lab 7 Report Kartik Choudhary [B20CS025]

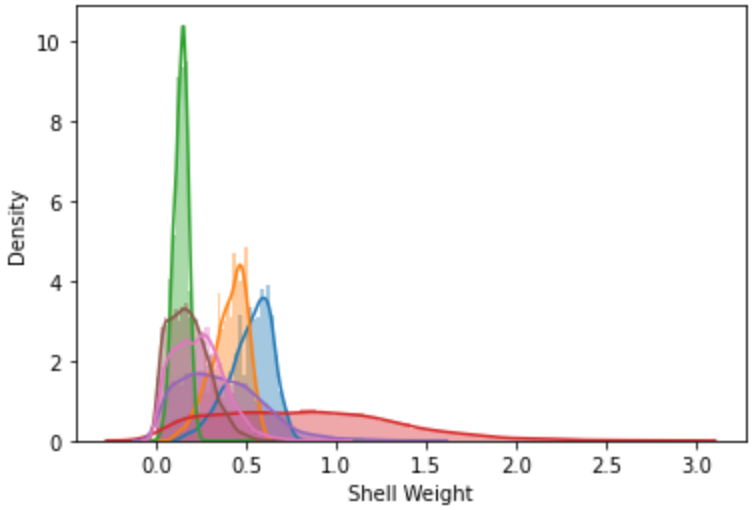
Neural Networks



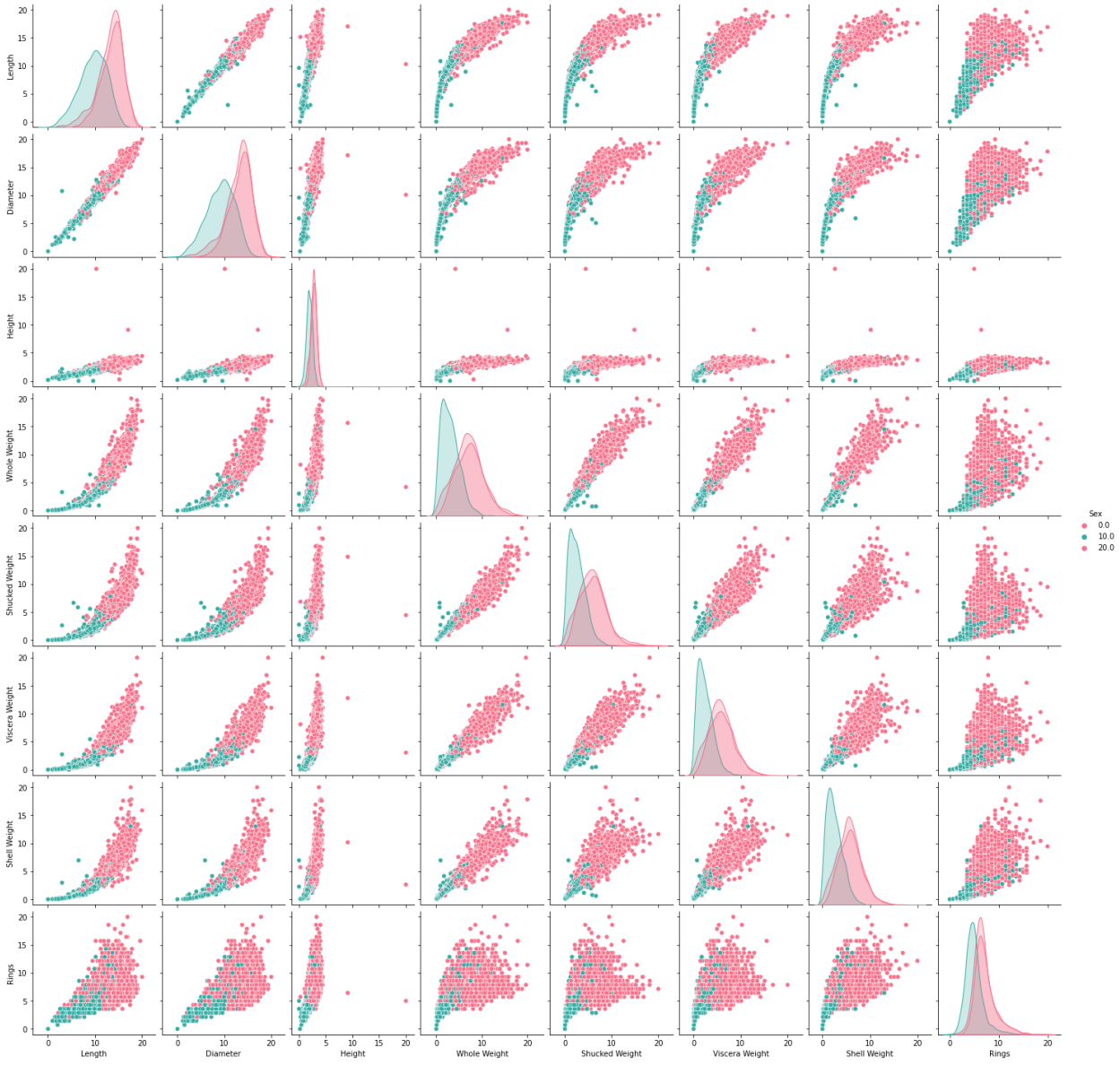
Question1: Creating a neural network using Pytorch Library

The Abalone Dataset was provided for this question. The dataset had 4177 rows and 9 columns. This is the classification problem and the deciding class ‘Sex’ is encoded using the label encoder importing from Sklearn. The distribution plot for all the characteristic

featutues of the given dataset can be visualized as:



The given data was then normalised and the pairplot was plotted using the seaborn library.



The dataset is split into test and train with 80% to the training data and remaining 20% to the testing data.

Hyperparameters fo the neural network are as follows:

```
batch_size = 32
num_epochs = 500
learning_rate = 0.01
size_hidden1 = 8
size_hidden2 = 8
num_classes = 30
batch_no = len(X_train) // batch_size
cols = X_train.shape[1]
```

Neural Network's summary was obtained as follows :

```
----------------------------------------------------------------
        Layer (type)               Output Shape         Param #
================================================================
            Linear-1                [-1, 1, 8]              72
              Tanh-2                [-1, 1, 8]               0
            Linear-3                [-1, 1, 8]              72
              Tanh-4                [-1, 1, 8]               0
            Linear-5               [-1, 1, 30]             270
           Softmax-6               [-1, 1, 30]               0
================================================================
Total params: 414
Trainable params: 414
Non-trainable params: 0
----------------------------------------------------------------
Input size (MB): 0.00
Forward/backward pass size (MB): 0.00
Params size (MB): 0.00
Estimated Total Size (MB): 0.00
----------------------------------------------------------------
```

Epoch: 500 ||| Loss: 2.92425 ||| Train Accuracy: 53.22% ||| Test Accuracy : 54.69%

Question 2:

Dataset Name : **Dry Bean Dataset**

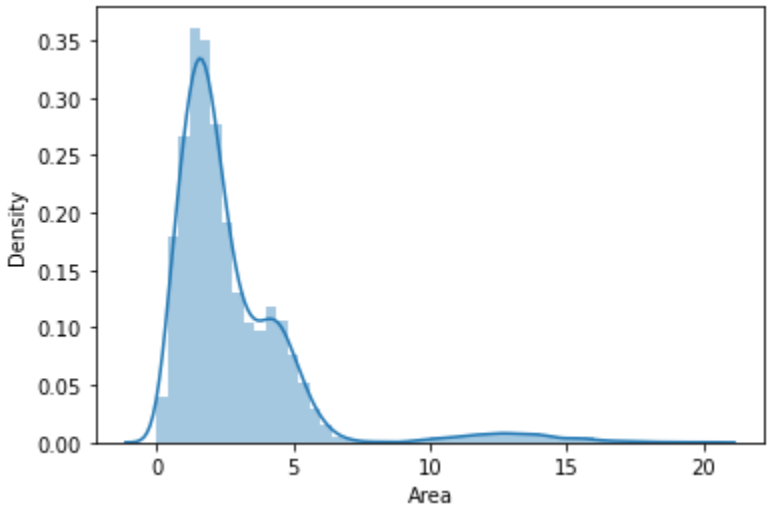
Provided Dataset's Dimension : 13611 rows × 17 columns

For Encoding I have only encoded feature "Class"

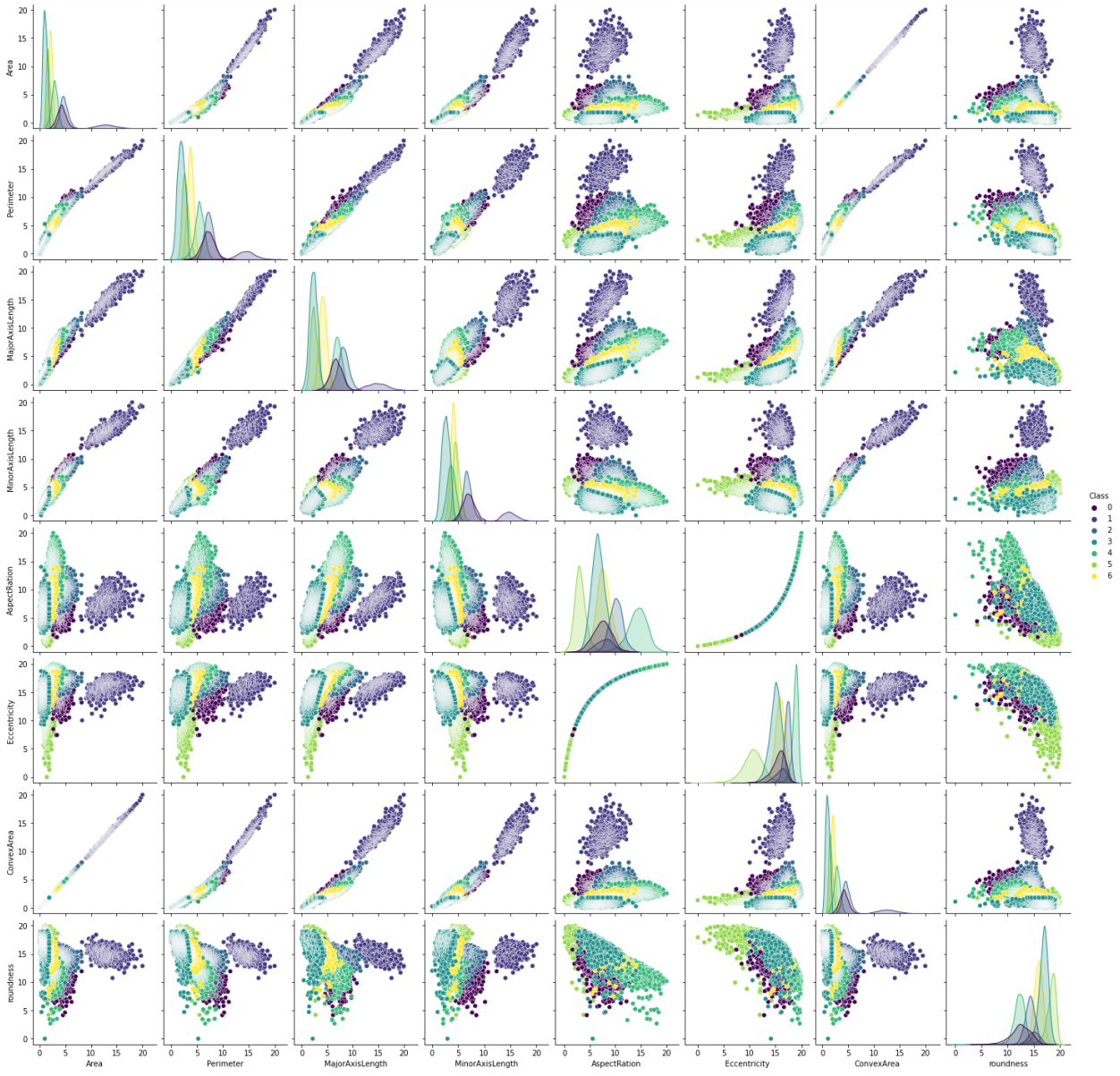
Then the Required features were kept, for “Axes Length” as mentioned in Question there was no feature that’s why I have used both major and minor axis length.

Then Except Class all the features were normalized.

Different from Question 1 in Question 2 DistPlot for individual features was obtained and visualized, one of them is shown here, which is of Area :



Pairplot with hue as “Class” is as follows :



Then data was splitted into Test and Train with 0.7 Train and 0.3 Test at random state 0

HyperParameters of the Neural Network are as follows :

Batch Size = 1

Number of Epochs = 500

Learning Rate = 0.1

Value of Lambda = 1e-3

Size of hidden layer1 = 12

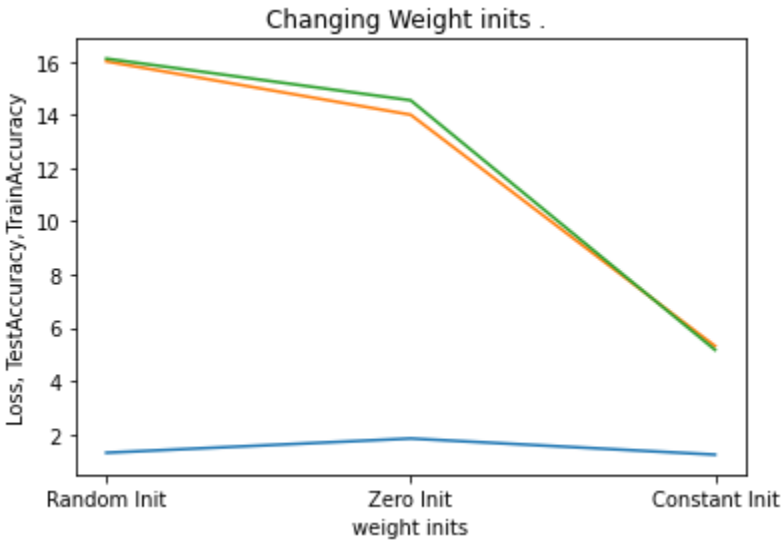
Size of hidden layer2 = 3

Size of hidden layer3 = 7

Experimenting With Weight Initialisation, Activation Function and Hidden layer size :

Weight Initialisation

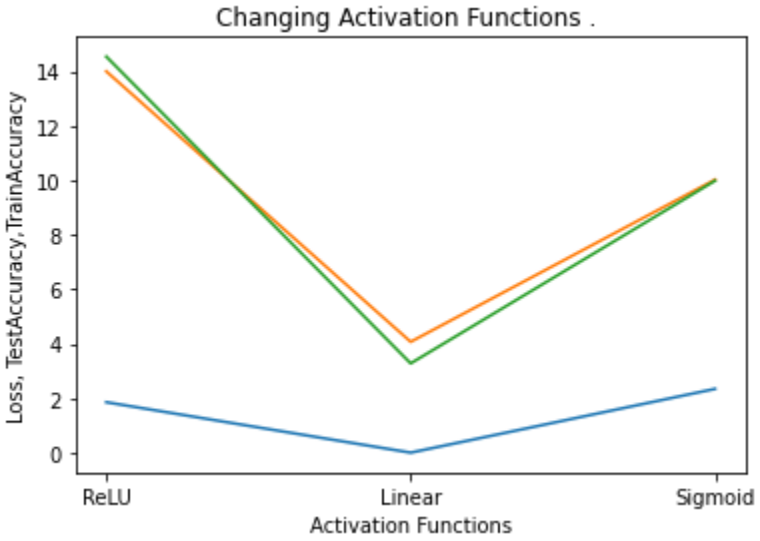
	Loss	**Training Accuracy**	**Testing Accuracy**
Random Init	1.30320724972	16.0071376089010%	16.1116552399608%
Zero Init	1.83831764475	14.0023092264091%	14.544564152791%
Constant Init	1.23182182656	5.31122074105174%	5.16650342801175%



Best Weight Initialisation among the three is : Random Initialisation

Activation Layer

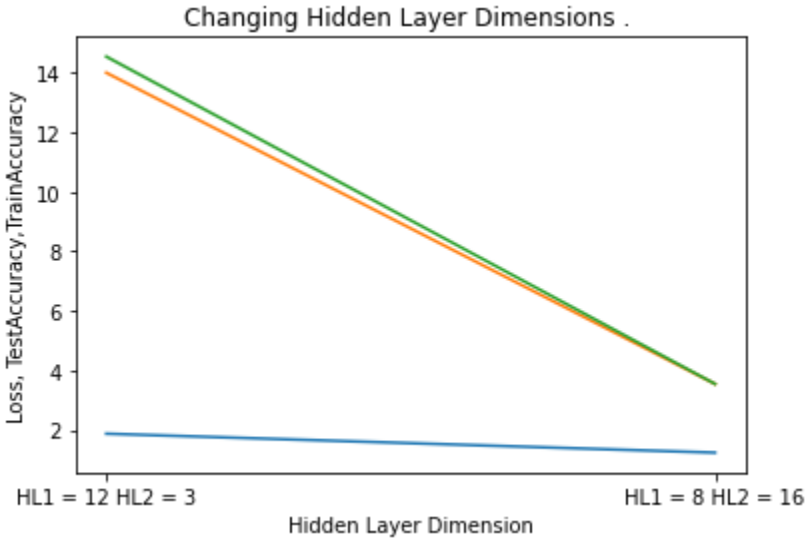
	Loss	Testing Accuracy	Training Accuracy
RELU	1.855753944425162	14.0023092264091%	14.5445641527913%
Linear	0.004177462531243	4.07263566705153%	3.28109696376101%
Sigmoid	2.345234567352536	10.0282345612345%	9.98780654467654%



Best Activation Function thus obtained for my model is : ReLU(Rectified Linear)

Hidden Layer Size

	Loss	Testing Accuracy	Training Accuracy
HL1 = 12 HL2 = 3	1.878602351294035	14.0023092264091%	14.5445641527918%
HL1 = 8 HL2 = 16	1.242180123220587	3.54781148315314%	3.55044074436826%



Saving and Loading of weights:

For saving and loading of weight I have used the .pkl format in the file named weights.pkl.

Weights are saved to the file in the form of a dictionary.