Foundations of Machine Learning End Term

Data Set: - Letter Challenge Unlabelled

Letter Challenge Dataset consists of many features like x-box, y-box, height, width, and many other which predicts the letter (Target Variable) either +/-. So, based on pixels, edges and some of the other features it will predict the outcome of letter. There are 20,000 Instances in the Data and 16 Features and 1 Target Variable. Except Letter all the other features are integers but there are some unnecessary ’?’ in the Data Set. So, around 10,000 ? are present in the data. – includes 7240 and + includes 2760.

Cleaning Data: -

So, ‘?’ are replaced with Blanks and then replaced with NaN’s. Then after, for the analysis we replace blanks with - . So, Now – values are 17240 and + values are 2760.

Normalization: -

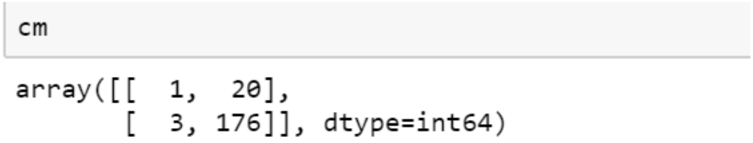
Rescaling the Numerical attributes into the range of 0 and 1. So, we have only Numerical Columns in the Data Set. By adding all these Numerical Columns into a Data Frame ‘Data’ we can Normalize these columns which results in between 0 and 1.

For our Analysis purpose we change the +/ - with 0 and 1. Then, by converting ‘letter’ from String/Object to Integer.

Logistic Regression: -

For Logistic Regression, we use Normalized Data and storing these ‘x’. To Predict we use our Target Variable. Next, we split the Data using train_test_split. Test Size I have chosen is 0.01. Then by using sklearn.preprocessing we import standardscaler. StandardScaler transforms data in such a way that the distribution will have 0 mean and standard deviation of 1.

Importing Logistic Regression from Scikit Learn. Accuracy obtained in the Logistic Regression is 88.5%.



```
cm
```

```
array([[  1,  20],
       [  3, 176]], dtype=int64)
```

Confusion Matrix of Logistic Regression

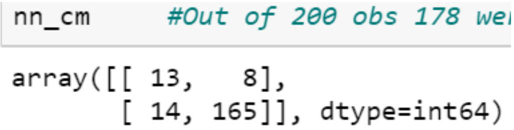
From the above matrix, we can say that 23 observations were predicted wrong and 177 observations were predicted right.

Neural Network: -

So, using the same train_test_split and test size of 0.01 we are performing Neural Network. Again, From Scikit Learn we import Multi-Layer Perceptron Classifier with Hidden Layers 100 and 40. So, the accuracy obtained in Neural Network is 89%. So, There's a increase in Accuracy from Logistic to Neural Network because of Hidden Layers.

***Confusion Matrix*: -**

From *SkLearn.metrics* we import Confusion Matrix to check True Positives, False Positives, True Negatives, True Positives. Below, is the Confusion Matrix of Neural Network.



```
nn_cm     #Out of 200 obs 178 wei

array([[ 13,   8],
       [ 14, 165]], dtype=int64)
```

Confusion Matrix

From Confusion Matrix, we got about 200 Observations in which 178 are predicted true and 22 were falsely predicted.

Random Forest: -

"Random Forrest is an Ensemble of Decision Trees. Ensemble is an Aggregation function."

We import RandomForestClassifier from sklearn.ensemble to perform Random Forest.

Accuracy of Random Forest is 99.5% which is of better accuracy than the other algorithms.

Accuracy Scores of Different Algorithms

Algorithms	**Accuracy Score**
Logistic Regression	88.5%
Neural Network	89%
Random Forest	99.5%

So, from the above algorithms we can say that Random Forest is the best model to predict the letters which has the best accuracy of all the other algorithms.