CS-482 Machine Learning
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Assignment 2 Report

From the datasets available, we chose to work with the Breast Cancer Dataset[1]. While loading the data we made the following determinations:

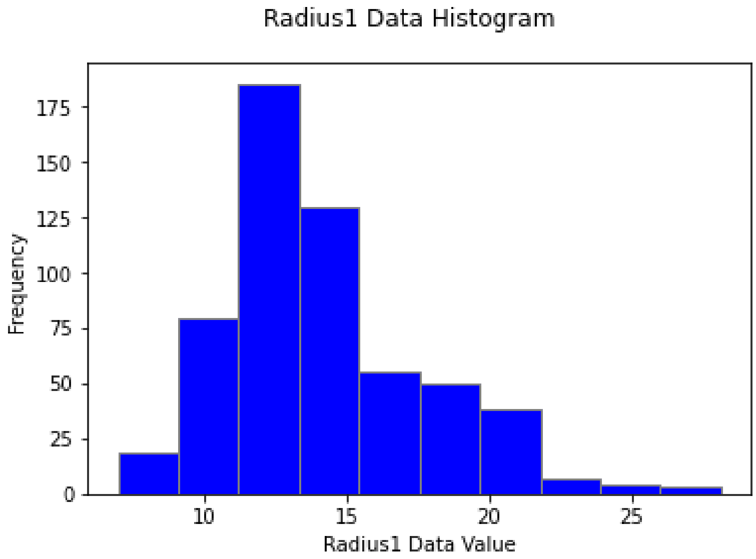
1. Number of Features
   a. data-numpy array of shape (569, 30 + 1) = **30 Features**
2. Names of the Features
   a. Feature Names: ['radius1', 'texture1', 'perimeter1', 'area1', 'smoothness1', 'compactness1', 'concavity', 'concave_points', 'symmetry1', 'fractal_dimension1', 'radius2', 'texture2', 'perimeter2', 'area2', 'smoothness2', 'concavity2', 'concave_points2', 'symmetry2', 'fractal_dimension2', 'radius3', 'texture3', 'perimeter3', 'area3', 'smoothness3', 'compactness3', 'concavity3', 'concave_points3', 'symmetry3', 'fractal_dimension3']
3. Name of Target
   a. Target Name: **Diagnosis**
4. Number of Samples
   a. data-numpy array of shape (569, 31) = **569 Samples**
5. First Five Rows of the Data
   a.
   ```
   Row  0 : [  17.99    10.38   122.8   1001.      0.118    0.278    0.3      0.147
   0.242    0.079    1.095    0.905    8.589  153.4      0.006    0.049
   0.054    0.016    0.03     0.006   25.38    17.33   184.6   2019.
   0.162    0.666    0.712    0.265    0.46     0.119]
   ```
   b.
   ```
   Row  1 : [  20.57    17.77   132.9   1326.      0.085    0.079    0.087    0.07
   0.181    0.057    0.543    0.734    3.398   74.08     0.005    0.013
   0.019    0.013    0.014    0.004   24.99    23.41   158.8   1956.
   0.124    0.187    0.242    0.186    0.275    0.089]
   ```
   c.
   ```
   Row  2 : [  19.69    21.25   130.    1203.      0.11     0.16     0.197    0.128
   0.207    0.06     0.746    0.787    4.585   94.03     0.006    0.04
   0.038    0.021    0.022    0.005   23.57    25.53   152.5   1709.
   0.144    0.424    0.45     0.243    0.361    0.088]
   ```

[1] https://archive.ics.uci.edu/dataset/17/breast+cancer+wisconsin+diagnostic

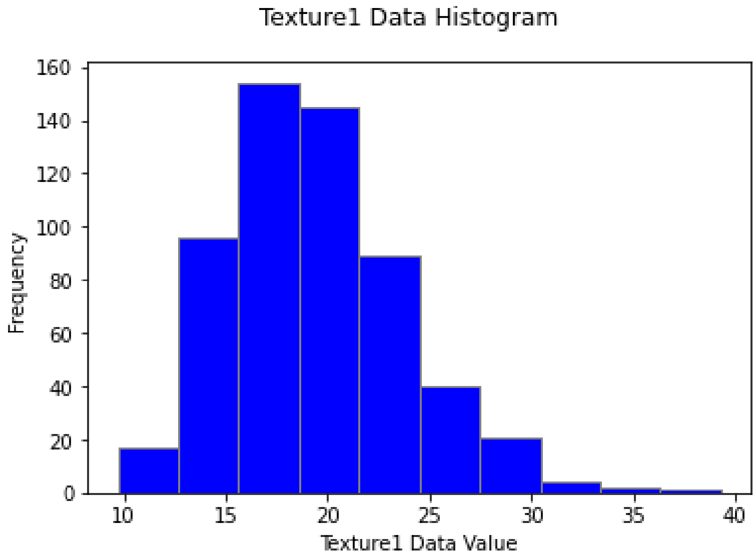
d. Row 3 : [11.42 20.38 77.58 386.1 0.142 0.284 0.241 0.105 0.26
0.097 0.496 1.156 3.445 27.23 0.009 0.075 0.057 0.019
0.06 0.009 14.91 26.5 98.87 567.7 0.21 0.866 0.687
0.258 0.664 0.173]

e. Row 4 : [20.29 14.34 135.1 1297. 0.1 0.133 0.198 0.104
0.181 0.059 0.757 0.781 5.438 94.44 0.011 0.025
0.057 0.019 0.018 0.005 22.54 16.67 152.2 1575.
0.137 0.205 0.4 0.163 0.236 0.077]

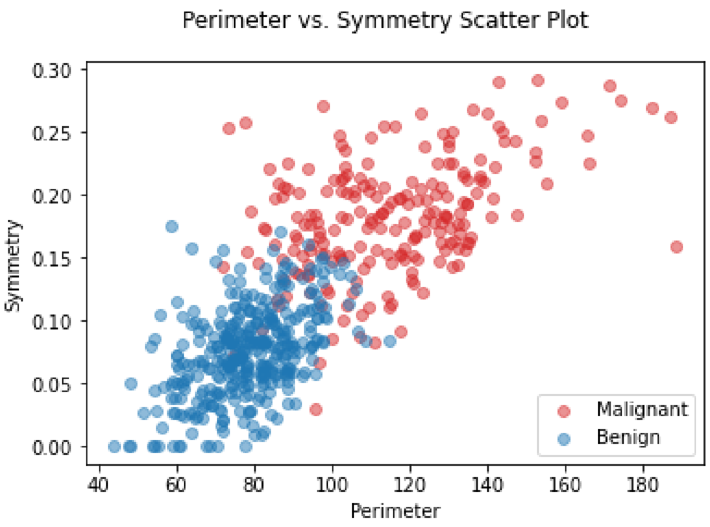
6. Histogram of Radius1



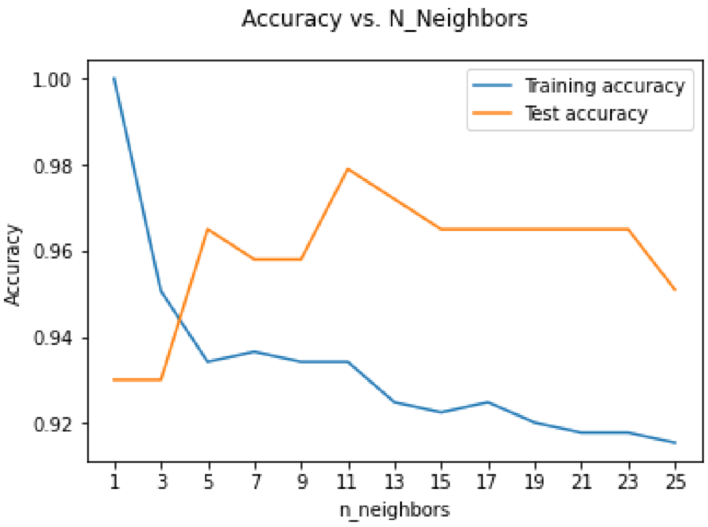
7. Histogram of Texture1



8. Scatter Plot of Perimeter vs. Symmetry Based on Target



Knowing that our problem is a binary classification between Malignant and Benign for Breast Cancer we followed the k-NN algorithm. Before we started training the model, we had to determine the correct number of neighbors to be used in the model. To determine this, we compared test accuracy verse training accuracy with differing numbers of neighbors with the lowest number of neighbors being 1 and the highest being $\sqrt{n} + 3$ where n is the number of samples in our dataset. From this we computed the created the following chart.



Using the previous chart, we decided to use 5 as our number of neighbors. To check how well our choice is we ran this number of neighbors, with the same training and test data as before, with Cross-validation and StratifiedKFold using 5 folds. The following chart shows the resulting scores.

	Fold-1	Fold-2	Fold-3	Fold-4	Fold-5	Mean
Training Accuracy	0.953	0.871	0.976	0.859	0.918	0.915
Test Accuracy	1.0	0.966	0.862	1.0	0.893	0.950

The lower training accuracy when compared to the test accuracy was expected as the Accuracy vs. N_Neighbors chart labeled the accuracy to be higher at this number of neighbors.