Machine Learning: Breast Cancer Classification in python

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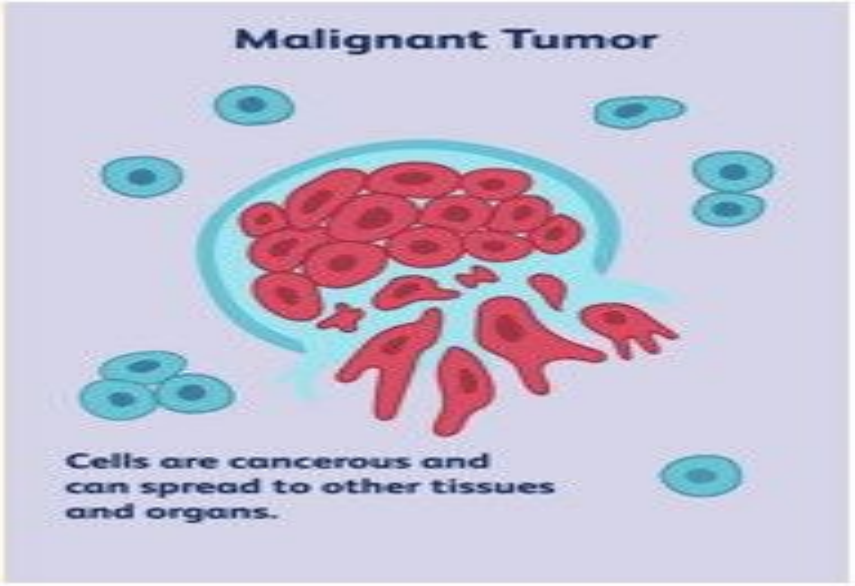
Project Overview

- The dataset I will be using to do this classification is collected from Kaggle under the UCI repository. It is real data collected in Wisconsin on the Diagnosis of Breast Cancer patients.
- The diagnosis shows whether the conditions were Benign or Malignant.
- I will be doing a visual inspection of the dataset and clean it up using python and its many libraries including pandas, numpy, keras etc.
- I will also do some transformation to the data that I am most interested in this analysis, for example, If a value needs to be converted into integers for the sake of our statistical computation.
- I will create three models for testing and determine the most efficient model by Accuracy and then create a confusion matrix to further test the Accuracies of the models and the best among the rest.

Breast Cancer

Benign Conditions are when the cells are not cancerous. It is most common.

Malignant are when the cells in the breast are cancerous. Here is some examples of lump sizes :



Visually inspecting and Cleaning data

I used the df.head function to examine the first five rows of the data and all the columns. It cannot be seen in this image, however, it has 33 columns and the last column has nan values

```
[ ] # Before I go forward I would exxamine my data and to do this i will look at the first 5 with the df.head function
    df.head()
```

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean	concave points_mean	symmetry_
0	842302	M	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001	0.14710	0.
1	842517	M	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869	0.07017	0.
2	84300903	M	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974	0.12790	0.
3	84348301	M	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414	0.10520	0.
4	84358402	M	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980	0.10430	0.

Continue Cleaning

I dropped the nan values using df.dropna and when i printed the new shape i have 569 rows with 32 columns so it worked.

```
[70] #Now i want to examine the shape of my data(how many rows, and columns)
     df.shape
     #when i ran it found that i have 569 rows and 33 columns. so theres 569 patients with 33 data p

     (569, 33)
```

```
     #from the visual inspection of my data i saw that column 33 has nan values so i will drop
     df = df.dropna(axis=1)
     df.shape

     (569, 32)
```

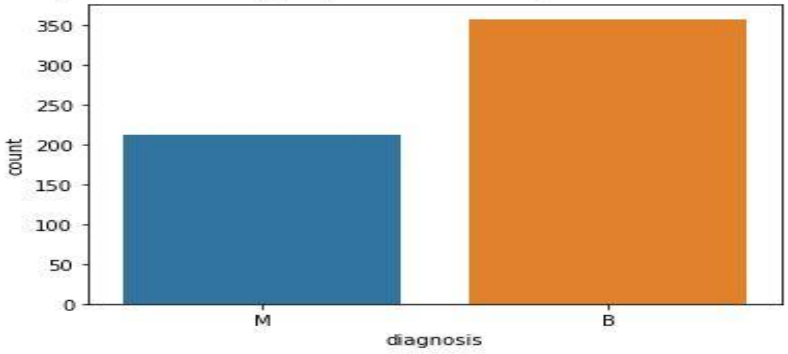
Examining Diagnosis Column

```
[72] #After visually inspecting my data and cleaning it out dropping nan values, now i c
     #by looking at the diagnosis column to determine number of Benign (B) or Malignant
     df['diagnosis'].value_counts()
```

```
B    357
M    212
Name: diagnosis, dtype: int64
```

```
#creating a visualization for the the cells to see a better picture
sns.countplot(df['diagnosis'], label='A count of the Diagnosis')
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pa
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f2e7ca44d68>
```



Looking at the dtypes

So in the diagnosis column we see that the data stored are objects we would need to encode this the Bs and Ms will be replaced by 1s and 0s

```
[74]  # I am going to look at the data types to see whic
      #some of the strings into a number value int or fl
      df.dtypes
```

```
id                         int64
diagnosis                 object
radius_mean              float64
texture_mean             float64
perimeter_mean           float64
area_mean                float64
smoothness_mean          float64
compactness_mean         float64
concavity_mean           float64
concave points_mean      float64
symmetry_mean            float64
fractal_dimension_mean   float64
radius_se                float64
texture_se               float64
perimeter_se             float64
area_se                  float64
smoothness_se            float64
compactness_se           float64
concavity_se             float64
concave points_se        float64
symmetry_se              float64
fractal_dimension_se     float64
radius_worst             float64
texture_worst            float64
perimeter_worst          float64
area_worst               float64
smoothness_worst         float64
compactness_worst        float64
concavity_worst          float64
concave points_worst     float64
symmetry_worst           float64
fractal_dimension_worst  float64
dtype: object
```

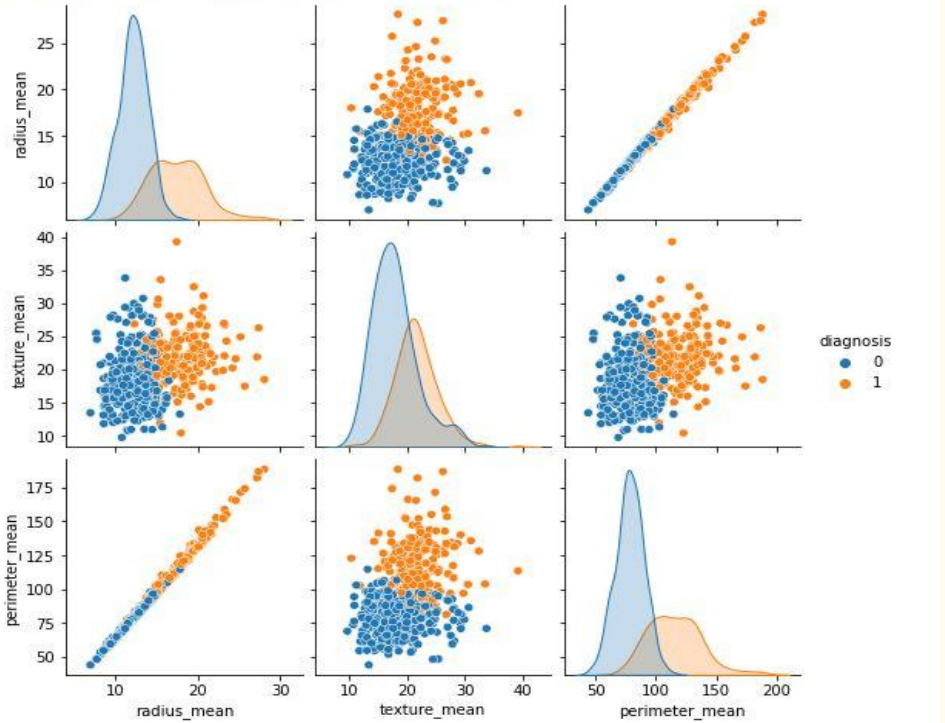
Encoding data to change objects to positive or negative, (1,0) respectively

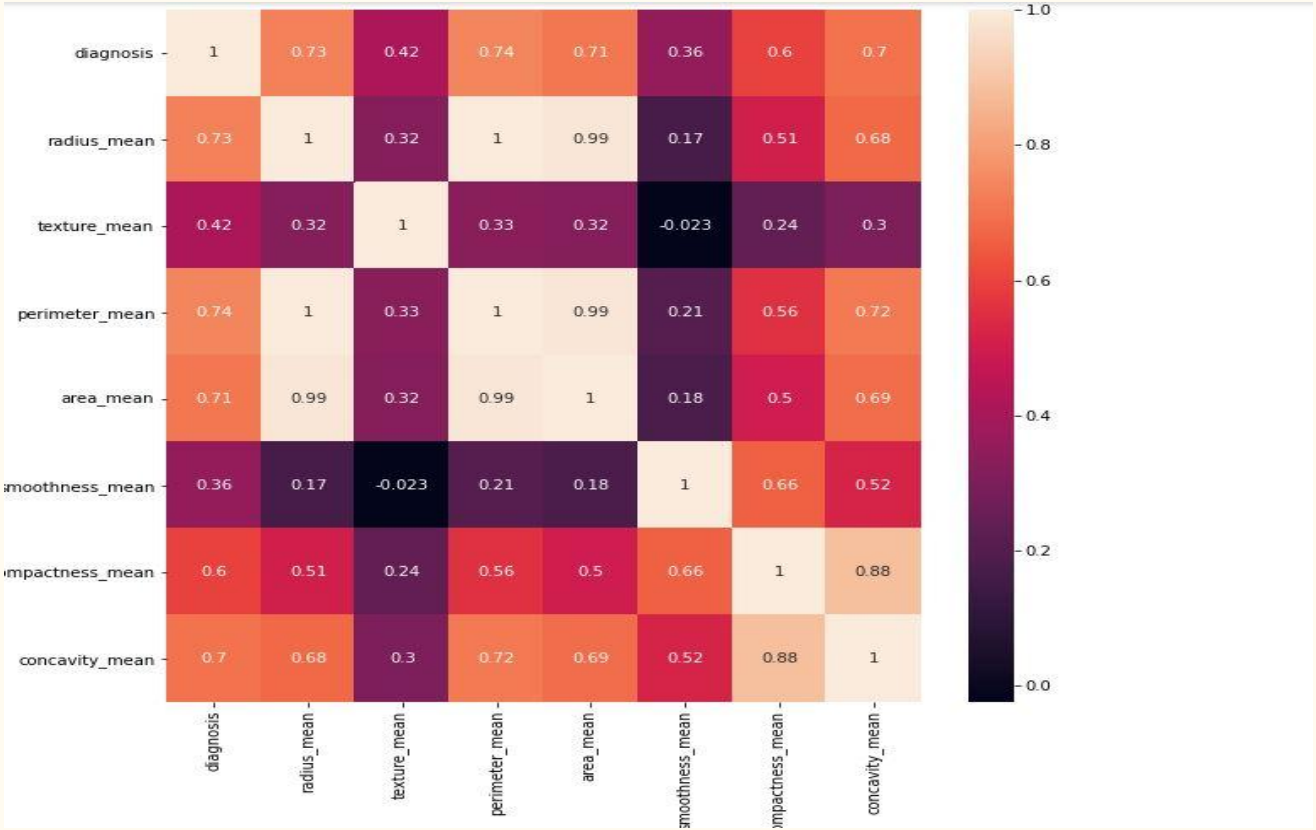
```
#encode categorical datavalues using sklearn and i will do this using iloc to i
from sklearn.preprocessing import LabelEncoder
labelencoder_Y = LabelEncoder()
labelencoder_Y.fit_transform(df.iloc[:,1].values)
```

```
array([1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 1,
       0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1,
       0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0,
       0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1,
       1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0,
       0, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1,
       1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0,
       0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1,
       1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1,
       1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0,
       0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0,
       0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1,
       0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0,
       0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0])
```

```
# create a pair plot from to comapre including all rows but stops at column 4
sns.pairplot(df.iloc[:,1:5], hue='diagnosis')
```

```
<seaborn.axisgrid.PairGrid at 0x7f2e75734b00>
```





Correlation is better shown on the heatmap with the values annotated

Testing & Training Models

Now i am going to split my dataset into dependent and independent (x,y) variables where y will be diagnosis and x is cancer features and use 75% for training and 25% testing.

```
#split the dataset into independent variables , y has the diagnosis and x has the cancer features

x = df.iloc[:,2:32].values
y = df.iloc[:,1].values
```

```
[89] #split the dataset 80% training and 20% testing
     x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.20, random_state = 0)

     #now I am going to scale my data
     sc = StandardScaler()
     x_train = sc.fit_transform(x_train)
     x_test = sc.fit_transform(x_test)
```

Accuracy

```
[95] # I am going to create a function for the the models I am going to use for my regress
     def models(x_train, y_train):
       #logistic regression
       log = LogisticRegression(random_state=0)
       log.fit(x_train, y_train)

       #Decision tree
       tree = DecisionTreeClassifier(random_state = 0)
       tree.fit(x_train, y_train)

       #Random forest classifier
       forest = RandomForestClassifier(n_estimators = 10,random_state = 0)
       forest.fit(x_train, y_train)

       # I also want to print the models accuracy on the trainig data
       print('[0] Logistics Regression Training Accuracy:', log.score(x_train, y_train))
       print('[1] Decision Tree Training Accuracy:', tree.score(x_train, y_train))
       print('[2] Random forest classifier Training Accuracy:', forest.score(x_train, y_tr

       return log, tree, forest
```

```
model=models(x_train, y_train)
```

```
[0] Logistics Regression Training Accuracy: 0.9906103286384976
[1] Decision Tree Training Accuracy: 1.0
[2] Random forest classifier Training Accuracy: 0.9953051643192489
```

Create a confusion matrix and determine Best Model

I am going to create a confusion matrix or error matrix to easily account for errors. It is usually in a table layout with true positive, false positive, true negative and false negative values.

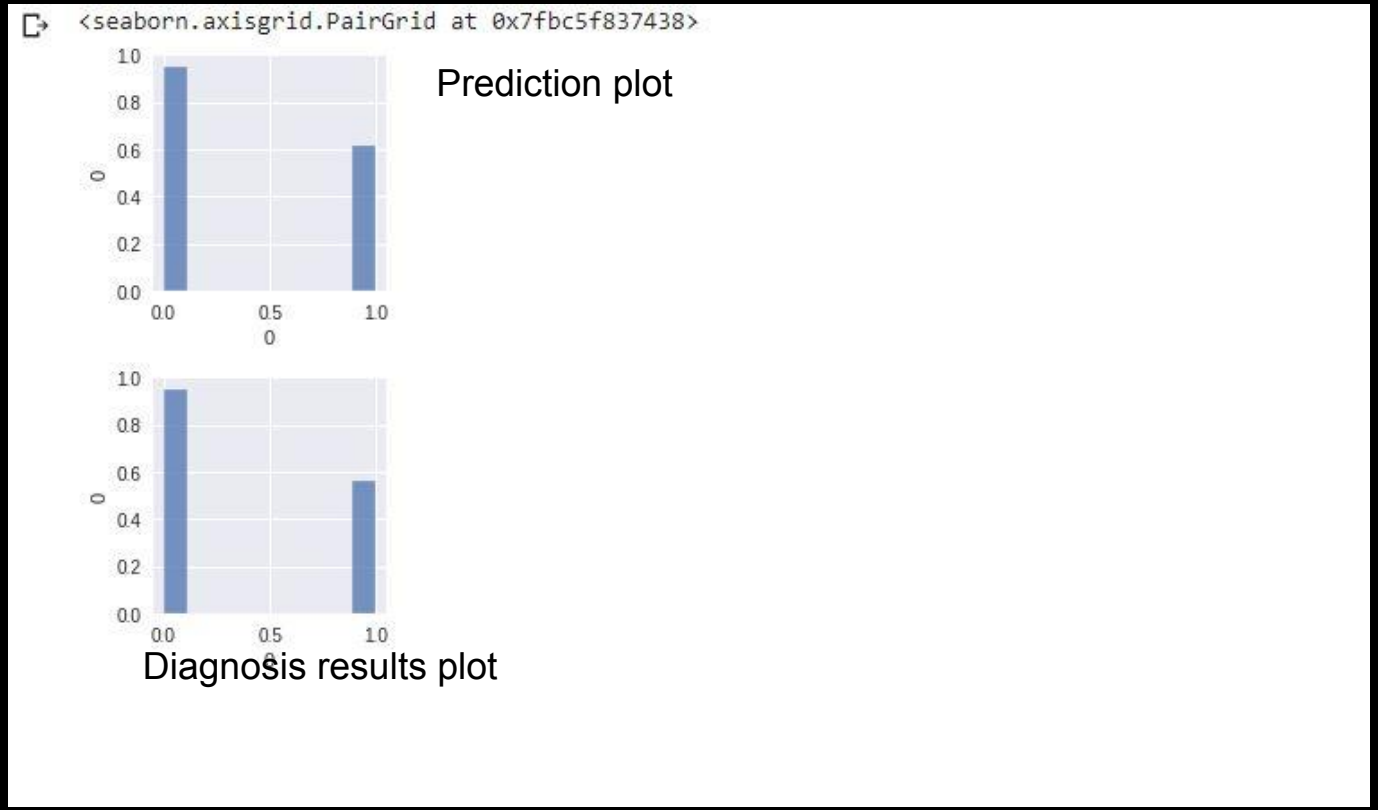
```
#So now we will test the accuracy of out model on our test da
#to print the confusion matrix for all models and their accur
for i in range(len(model)):
  print('model',i)
  cm = confusion_matrix(y_test, model[i].predict(x_test))
  TP = cm[0][0] #true positive
  TN = cm[0][1] #true negative
  FN = cm[1][0] #false negative
  FP = cm[0][1] #false positive
  print(cm)
  print('Testing Accuracy = ', (TP+TN)/(TP+TN+FN+FP))
  print()
```

```
model 0
[[86  4]
 [ 2 51]]
Testing Accuracy =  0.9375

model 1
[[79 11]
 [ 2 51]]
Testing Accuracy =  0.8737864077669902

model 2
[[86  4]
 [ 1 52]]
Testing Accuracy =  0.9473684210526315
```

```
#lets examine the prediction of the Random forest classifer
pred = model[2].predict(x_test)
print(pred)
print()
print(y_test)
```

```
[1 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 1 1 1 1 1 0 0 1 0 0 1 0 1 0 1 0 1 0 1 0
 1 0 1 1 0 1 0 0 1 0 0 0 1 1 1 1 1 0 0 0 0 0 0 1 1 1 0 0 1 0 1 1 1 0 0 1 0 0
 1 0 0 0 0 0 1 1 1 0 1 0 0 0 1 1 0 1 1 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 1 1 0
 1 1 0 0 0 0 0 0 0 0 0 1 0 1 0 1 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 1]

[1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0 0 1 0 0 1 0 1 0 1 0 1 0 1 0
 1 0 1 1 0 1 0 0 1 0 0 0 1 1 1 1 1 0 0 0 0 0 0 1 1 1 0 0 1 0 1 1 1 0 0 1 0 1
 1 0 0 0 0 0 1 1 1 0 1 0 0 0 1 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 1 1 0
 1 1 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 1]
```

an actual test



Loss

```
dict_keys(['loss', 'accuracy', 'val_loss', 'val_accuracy'])
```