جامعة أم القرى
UMM AL-QURA UNIVERSITY

Data Analysis 2 Project

Duration: 1st Semester

Task 1 (Naive Bayes Classifier)

Submitted By:

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Introduction:

Naive Bayes classifiers are a collection of classification algorithms based on Bayes' Theorem. It is not a single algorithm but a family of algorithms where all of them share a common principle, i.e. every pair of features being classified is independent of each other. To start with, let us consider a dataset.

One of the most simple and effective classification algorithms, the Naïve Bayes classifier aids in the rapid development of machine learning models with rapid
prediction capabilities.

Naïve Bayes algorithm is used for classification problems. It is highly used in text classification. In text classification tasks, data contains high dimension (as each word represent one feature in the data). It is used in spam filtering, sentiment detection, rating classification etc. The advantage of using naïve Bayes is its speed. It is fast and making prediction is easy with high dimension of data.

This model predicts the probability of an instance belongs to a class with a given set of feature value. It is a probabilistic classifier. It is because it assumes that one feature in the model is independent of existence of another feature. In other words, each feature contributes to the predictions with no relation between each other. In real world, this condition satisfies rarely. It uses Bayes theorem in the algorithm for training and prediction

Data Features:

Variable Name	Role	Type
ID	ID	Categorical
Diagnosis	Target	Categorical
radius1	Feature	Continuous
texture1	Feature	Continuous
perimeter1	Feature	Continuous
area1	Feature	Continuous
smoothness1	Feature	Continuous
compactness1	Feature	Continuous
concavity1	Feature	Continuous
concave_points1	Feature	Continuous

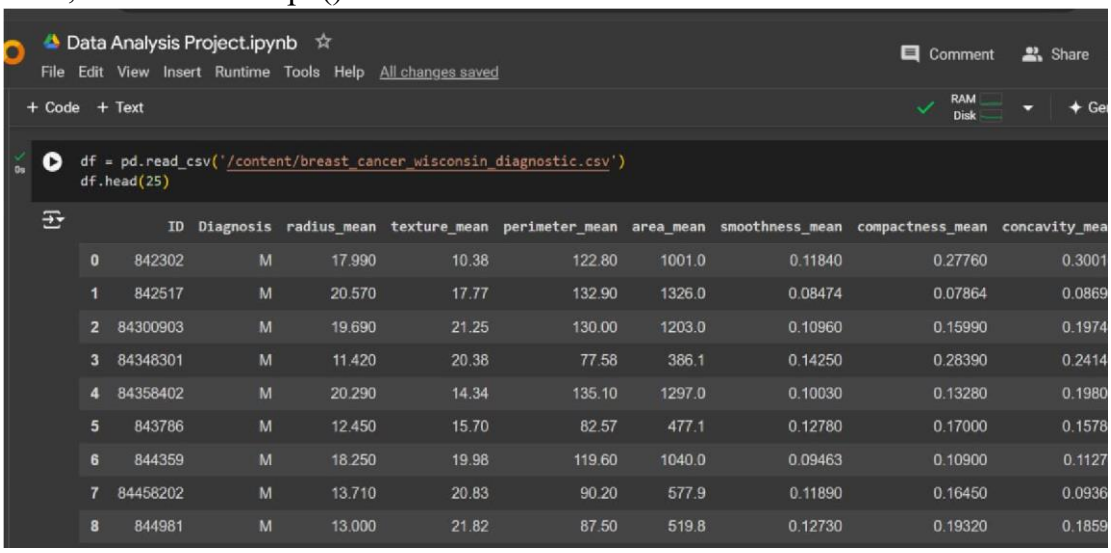
Variable Name	Role	Type
symmetry1	Feature	Continuous
fractal_dimension1	Feature	Continuous
radius2	Feature	Continuous
texture2	Feature	Continuous
perimeter2	Feature	Continuous
area2	Feature	Continuous
smoothness2	Feature	Continuous
compactness2	Feature	Continuous
concavity2	Feature	Continuous
concave_points2	Feature	Continuous

ANALYSIS:

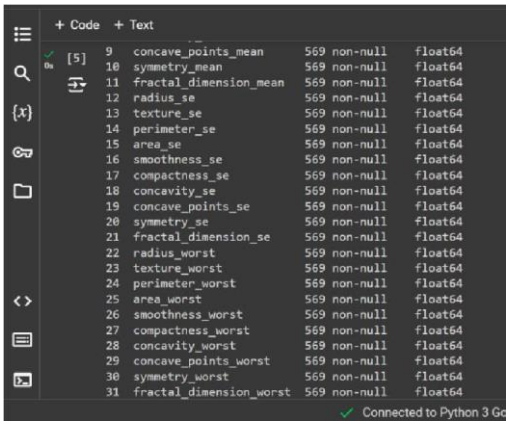
Explore the Dataset:

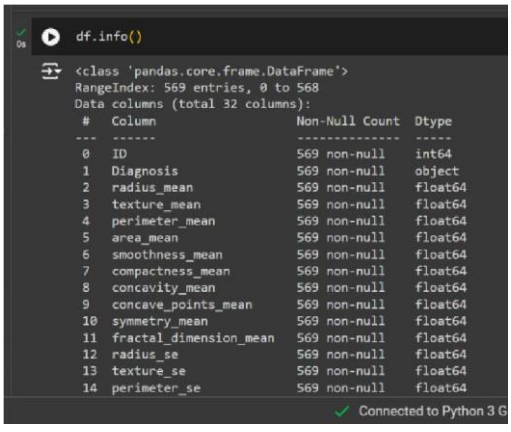
Loading the Dataset, View 25 Rows”df.head(25)” + "df.info()" for understanding the structure (Column Count, Column Name, Data types, And the number of non-null entries in each column) there is no Missing value!

Also, we use “df.shape()” for check the size.



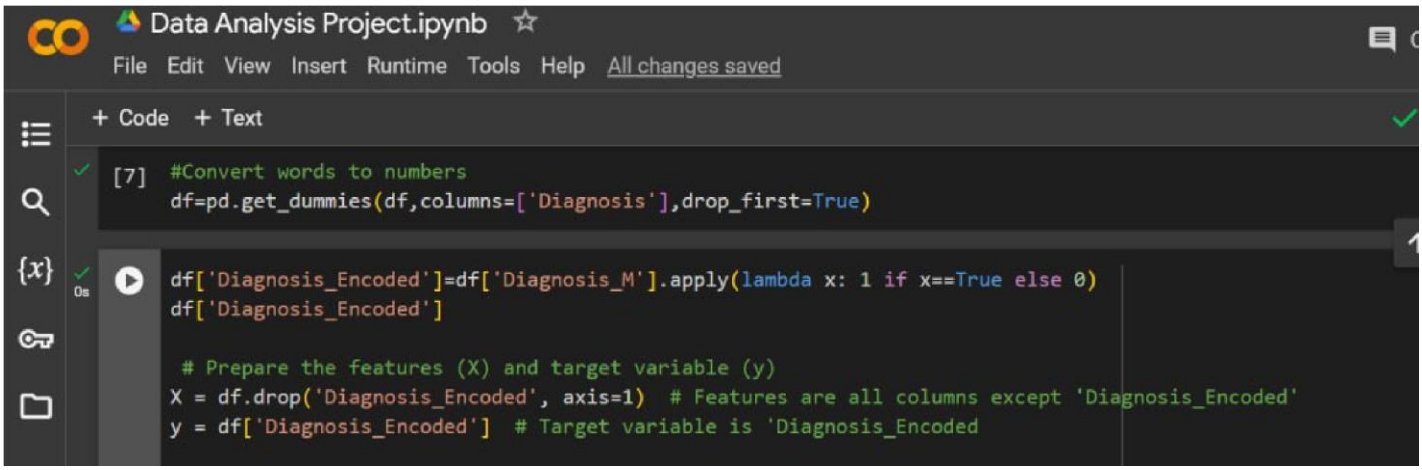
	ID	Diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mea
0	842302	M	17.990	10.38	122.80	1001.0	0.11840	0.27760	0.3001
1	842517	M	20.570	17.77	132.90	1326.0	0.08474	0.07864	0.0869
2	84300903	M	19.690	21.25	130.00	1203.0	0.10960	0.15990	0.1974
3	84348301	M	11.420	20.38	77.58	386.1	0.14250	0.28390	0.2414
4	84358402	M	20.290	14.34	135.10	1297.0	0.10030	0.13280	0.1980
5	843786	M	12.450	15.70	82.57	477.1	0.12780	0.17000	0.1578
6	844359	M	18.250	19.98	119.60	1040.0	0.09463	0.10900	0.1127
7	84458202	M	13.710	20.83	90.20	577.9	0.11890	0.16450	0.0936
8	844981	M	13.000	21.82	87.50	519.8	0.12730	0.19320	0.1859



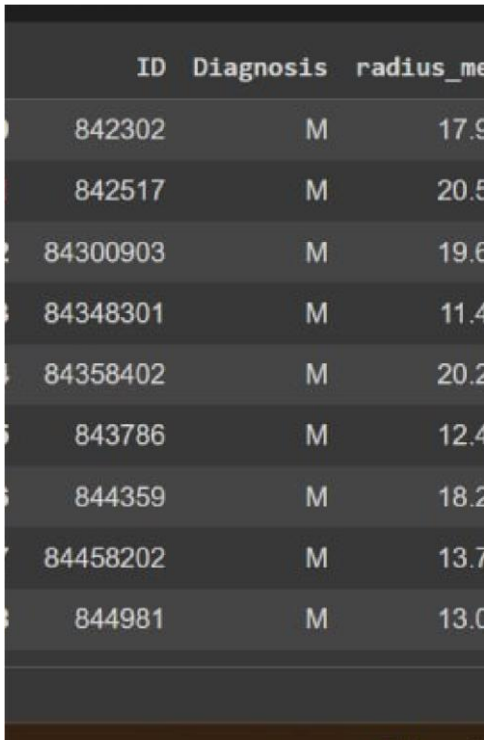


Modification:

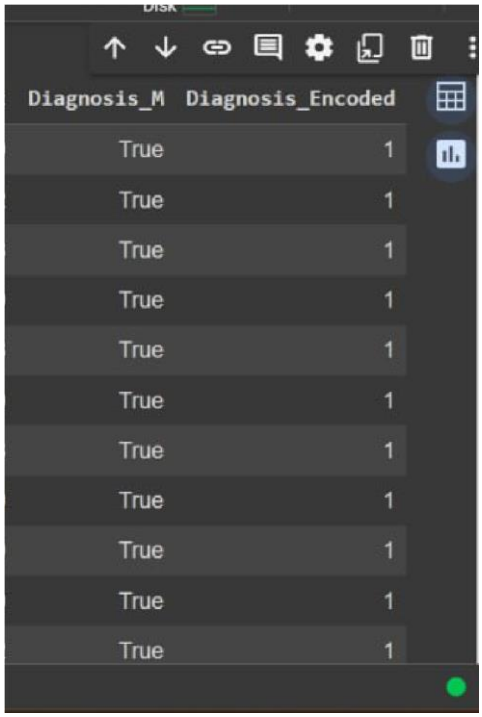
We used pd.get_dummies() function to convert categorical variables on Diagnosis column into a Binary column, True for B “Benign tumor” and False for M “malignant”.
Also, we used the function “apply() with lambda” to create a new column called “Diagnosis_Encoded” the lambda check if x = true it returns 1 And if x = false it returns 0.



Before And After Converting from Categorical to Continuous Variable:



	ID	Diagnosis	radius_me
	842302	M	17.9
	842517	M	20.5
2	84300903	M	19.6
3	84348301	M	11.4
4	84358402	M	20.2
5	843786	M	12.4
6	844359	M	18.2
7	84458202	M	13.7
8	844981	M	13.0



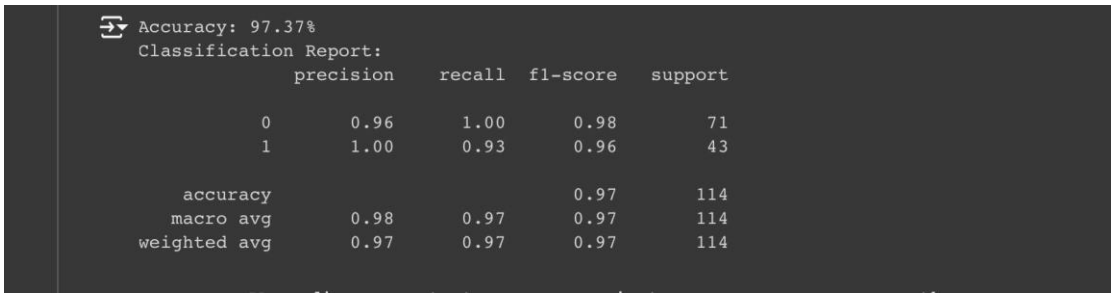
Diagnosis_M	Diagnosis_Encoded
True	1
True	1
True	1
True	1
True	1
True	1
True	1
True	1
True	1
True	1
True	1

Analysis:

splitting the dataset into training set and test set

We evaluate the performance of a trained classification model (Naive bayes) using “accuracy_score” and “classification_report” for precision, recall and f-score.

The results show that the accuracy 97.37% Which is a good performance!

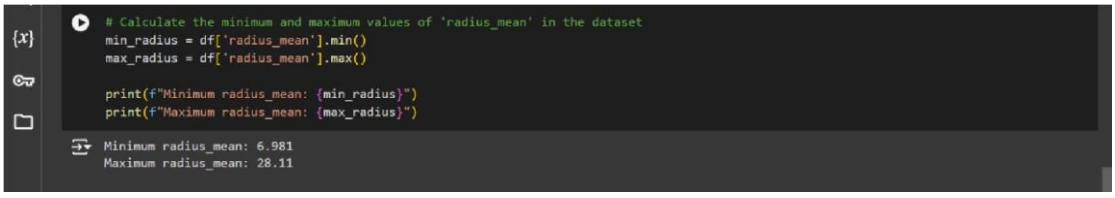


```
Accuracy: 97.37%
Classification Report:
              precision    recall  f1-score   support

           0       0.96      1.00      0.98        71
           1       1.00      0.93      0.96        43

    accuracy                           0.97       114
   macro avg       0.98      0.97      0.97       114
weighted avg       0.97      0.97      0.97       114
```

Analysis:

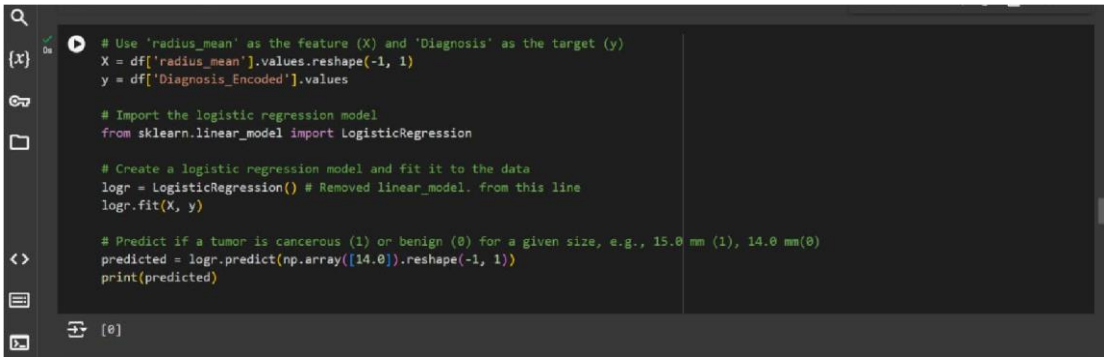
here we Calculate the minimum and maximum values of 'radius_mean' in the dataset that we use it on the next steps.

based on the "radius_mean" using logistic regression to predict whether a tumor is cancerous or benign based on the "radius_mean" and "Diagnosis_Encoded" features.



```
# Calculate the minimum and maximum values of 'radius_mean' in the dataset
min_radius = df['radius_mean'].min()
max_radius = df['radius_mean'].max()

print(f"Minimum radius_mean: {min_radius}")
print(f"Maximum radius_mean: {max_radius}")
```

```
Minimum radius_mean: 6.981
Maximum radius_mean: 28.11
```

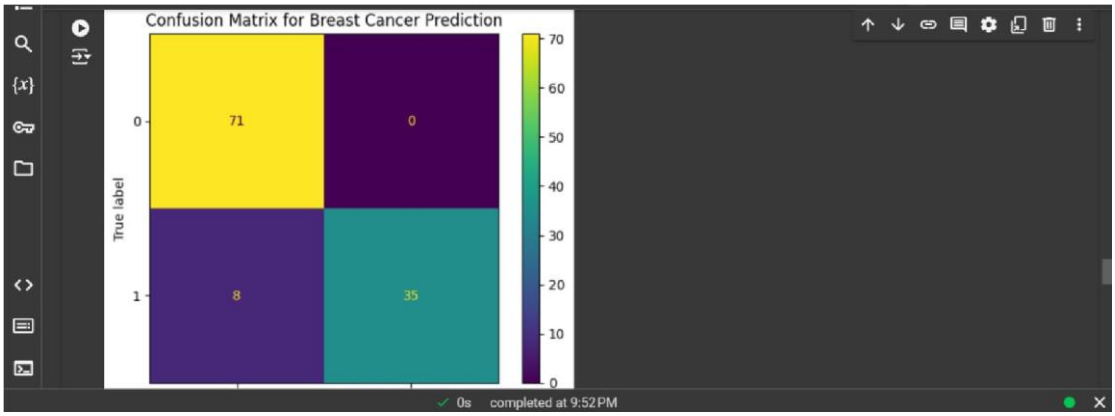


```
# Use 'radius_mean' as the feature (X) and 'Diagnosis' as the target (y)
X = df['radius_mean'].values.reshape(-1, 1)
y = df['Diagnosis_Encoded'].values

# Import the logistic regression model
from sklearn.linear_model import LogisticRegression

# Create a logistic regression model and fit it to the data
logr = LogisticRegression() # Removed linear_model. from this line
logr.fit(X, y)

# Predict if a tumor is cancerous (1) or benign (0) for a given size, e.g., 15.0 mm (1), 14.0 mm(0)
predicted = logr.predict(np.array([14.0]).reshape(-1, 1))
print(predicted)
```

```
[0]
```

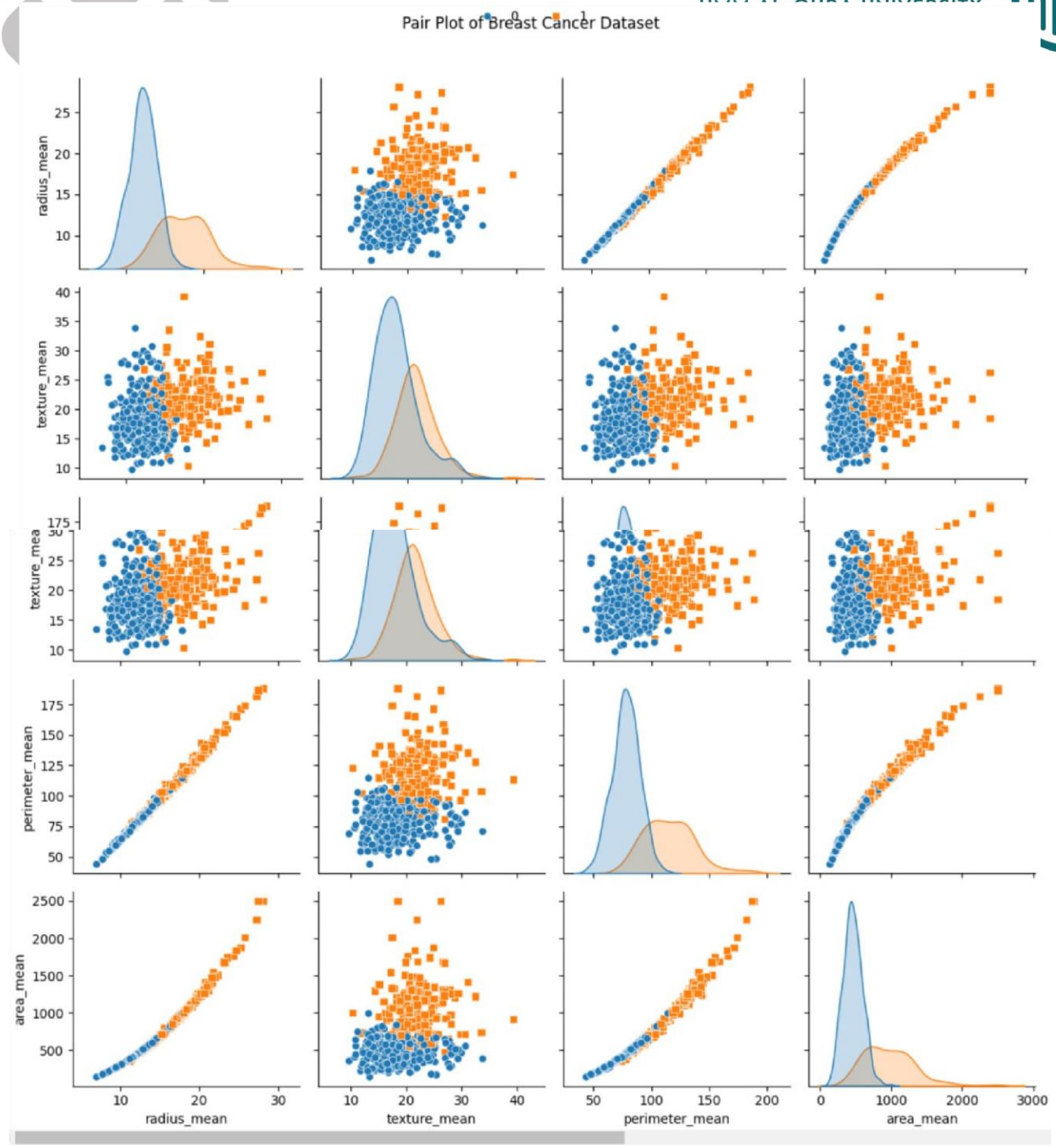
Analysis:

visualize the performance of a classification model through a confusion matrix.which is can quickly assess how well the model is performing in distinguishing between benign and malignant tumors.



Analysis:

generates a pair plot to visualize key features in our Dataset, enabling easy examination of potential relationships and trends between features, which is essential for understanding the data and guiding further analysis or model development.


Pair Plot of Breast Cancer Dataset
0
1
radius_mean
texture_mean
texture_mea
perimeter_mean
area_mean
radius_mean
texture_mean
perimeter_mean
area_mean

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