DIABETES PREDICTION USING MACHINE LEANING

Presented By,
Abhishek Sumeet Toppo
MT/CS/10001/21

OUTLINE

1. Abstract
2. Objective
3. Architecture
4. Machine Learning Algorithms
5. Results
6. Conclusion
7. References

ABSTRACT

Diabetes is considered as one the most dangerous threat to the human mankind. According to International Diabetes Federation 382 million people are living with diabetes across the world. By 2035, this will be doubled as 592 million. Diabetes is a disease that is caused due to the increase in the level of blood glucose. If diabetes is not detected earlier then suffering person in future might also suffer from several other diseases like heart stroke, kidney failure and blindness. At present with the advancement in the field of Data Science we can predict through machine learning models at a very early stage whether a person is having or going to have diabetes in near future or not based on his/her medical reports.

OBJECTIVE

The objective of this project is to develop a system which can perform early prediction of diabetes for a patient with a higher accuracy by combining the results of different machine learning techniques. The objective of the dataset is to diagnostically predict whether or not a patient has diabetes based on certain diagnostic measurements included in the dataset.

ARCHITECTURE

The system will detect whether the person has diabetes or not using the dataset. If diabetes is detected the classification value will be 1 and if not the value will be 0 as per the used dataset. I am using 6 machine learning classifier model in order to detect the disease. The models used for prediction are logistic regression, KNN(k-Nearest Neighbours), Support Vector Machine(SVM), Random forest and Decision Tree. The diagram given in the next slide tell us what's the order in which the execution begins.

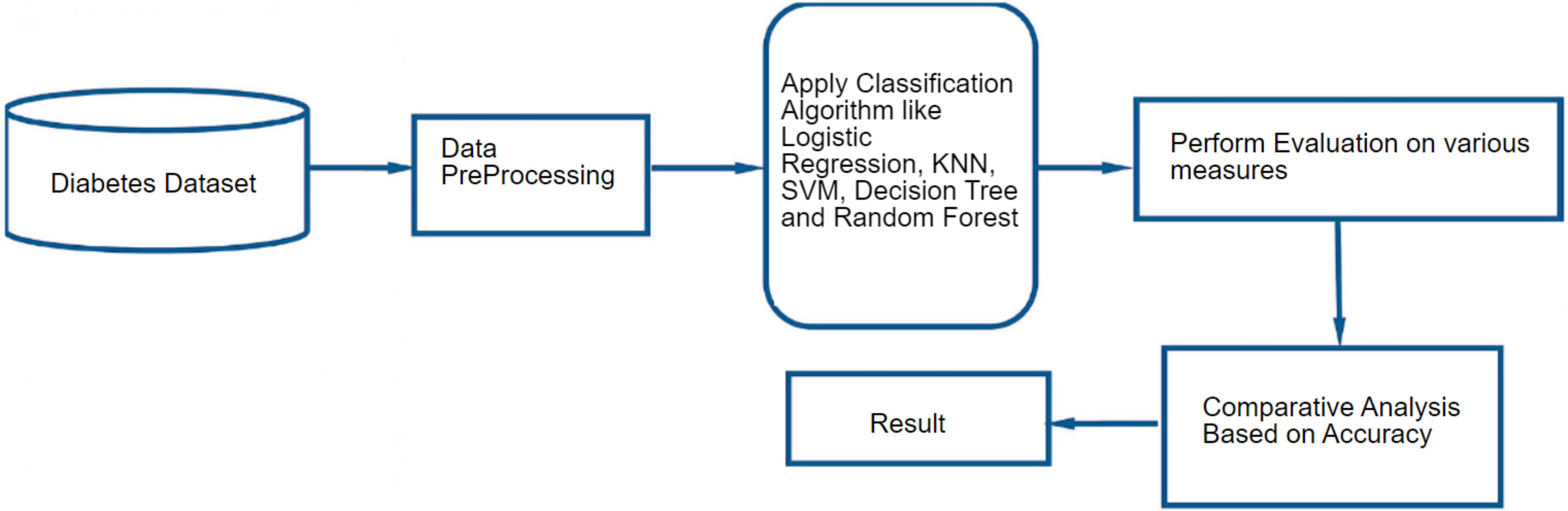


Fig. 1. Proposed Model Diagram

1. **<u>Steps of detection</u>**

Data collection

Defining data

Pre-processing

Building model

Analysis

Results

2. **<u>Algorithm</u>**

Importing the libraries

Dataset importing

Defining dataset

Training and testing on dataset

Performing the algorithms

Evaluation and comparison of results

DATASET

- The dataset that has been used in this project is the **“Pima Indian Diabetes Dataset”**.
- This dataset is originally collected from the National Institute of Diabetes and Digestive and Kidney Diseases.
- This dataset contains attributes like Pregnancies, Glucose, Blood Pressure, Skin Thickness, Insulin, BMI, Diabetes Pedigree Function, Age, Outcome.
- In particular, all patients here are females at least 21 years old of Pima Indian heritage

DATA PREPROCESSING

- Data pre-processing is crucial step.
- If the data collected contains any missing attributes or attribute values contains any noisy or wrong data then it can affect the resultant accuracy so need to check for whether the dataset contains any null values or not.
- Moreover, the inconsistencies in the collected data may also affect the subsequent work.
- That’s why I have applied pre-processing on the gathered data.

EVALUATIONS BEGINS

Step 1 Import the python libraries like numpy, pandas, matplotlib, seaborn and warnings

Importing Libraries ¶

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

Step 2 Reading from the dataset

Reading From Dataset

```
data=pd.read_csv('diabetes.csv')
```

```
# Displaying the CSV dataset
data
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

768 rows × 9 columns

Step 3 Displaying the whole dataset with its datatypes

```
# Displaying how many rows and columns are present in the dataset
data.shape
```

```
(768, 9)
```

```
# Display the data types of each columns present here in the dataset
data.dtypes
```

```
Pregnancies                   int64
Glucose                       int64
BloodPressure                 int64
SkinThickness                 int64
Insulin                       int64
BMI                         float64
DiabetesPedigreeFunction    float64
Age                           int64
Outcome                       int64
dtype: object
```

Data Preprocessing

```
# Display everything about the dataset in one table
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   Pregnancies               768 non-null    int64
 1   Glucose                   768 non-null    int64
 2   BloodPressure             768 non-null    int64
 3   SkinThickness             768 non-null    int64
 4   Insulin                   768 non-null    int64
 5   BMI                       768 non-null    float64
 6   DiabetesPedigreeFunction  768 non-null    float64
 7   Age                       768 non-null    int64
 8   Outcome                   768 non-null    int64
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

```
#Used for only displaying the top 5 rows of the dataset
data.head()
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

```python
#Used for only displaying the last 5 rows of the dataset
data.tail()
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1
767	1	93	70	31	0	30.4	0.315	23	0

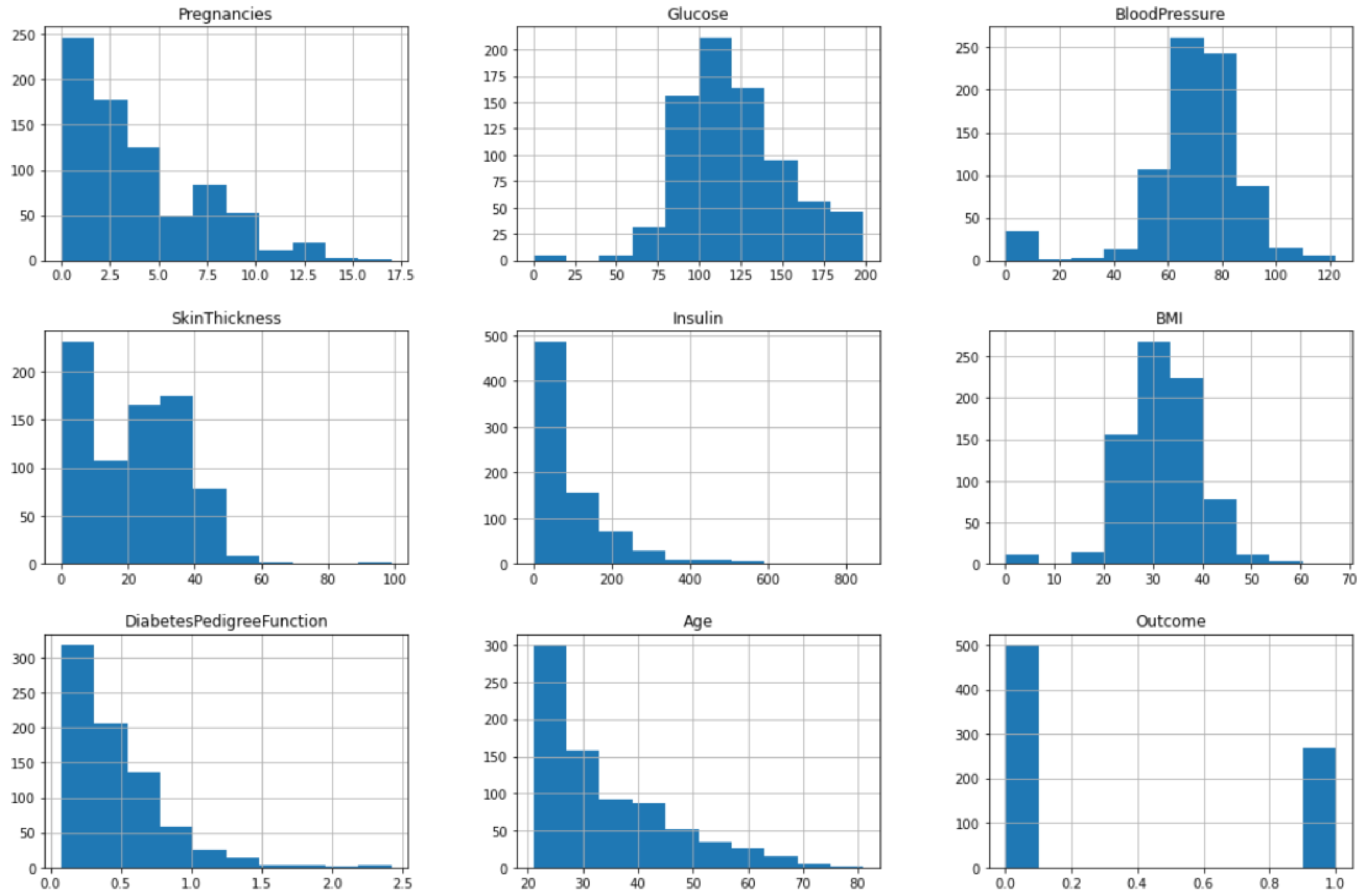
```python
#Display only the number of columns a dataset contain
data.columns
```

```
Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
       'BMI', 'DiabetesPedigreeFunction', 'Age', 'Outcome'],
      dtype='object')
```

```python
# Checking whether there are any null value present or not
data.isnull().sum()
```

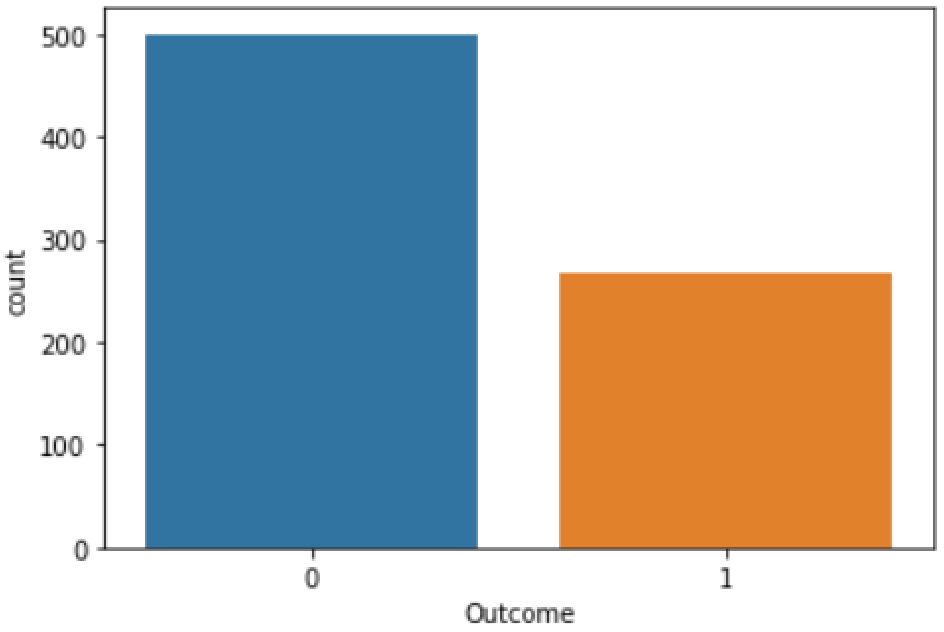
```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

```
#histograms
data.hist(figsize=(18,12))
plt.show()
```

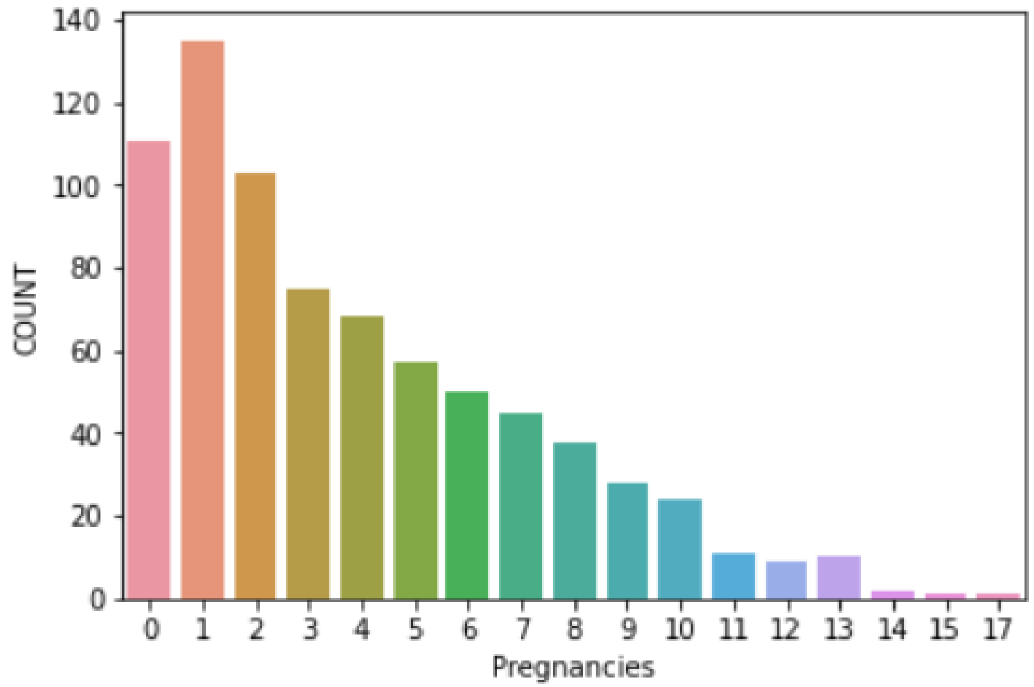


```
sns.countplot(data=data, x = 'Outcome', label='Count')
D, ND = data['Outcome'].value_counts()
print('Number of patients who are suffer from Diabetes are: {0}({1:2.2f}%)'.format(D,(D/(D+ND))*100))
print('Number of patients who are do not suffer from Diabetes are: {0}({1:2.2f}%)'.format(ND,(ND/(D+ND))*100))
```

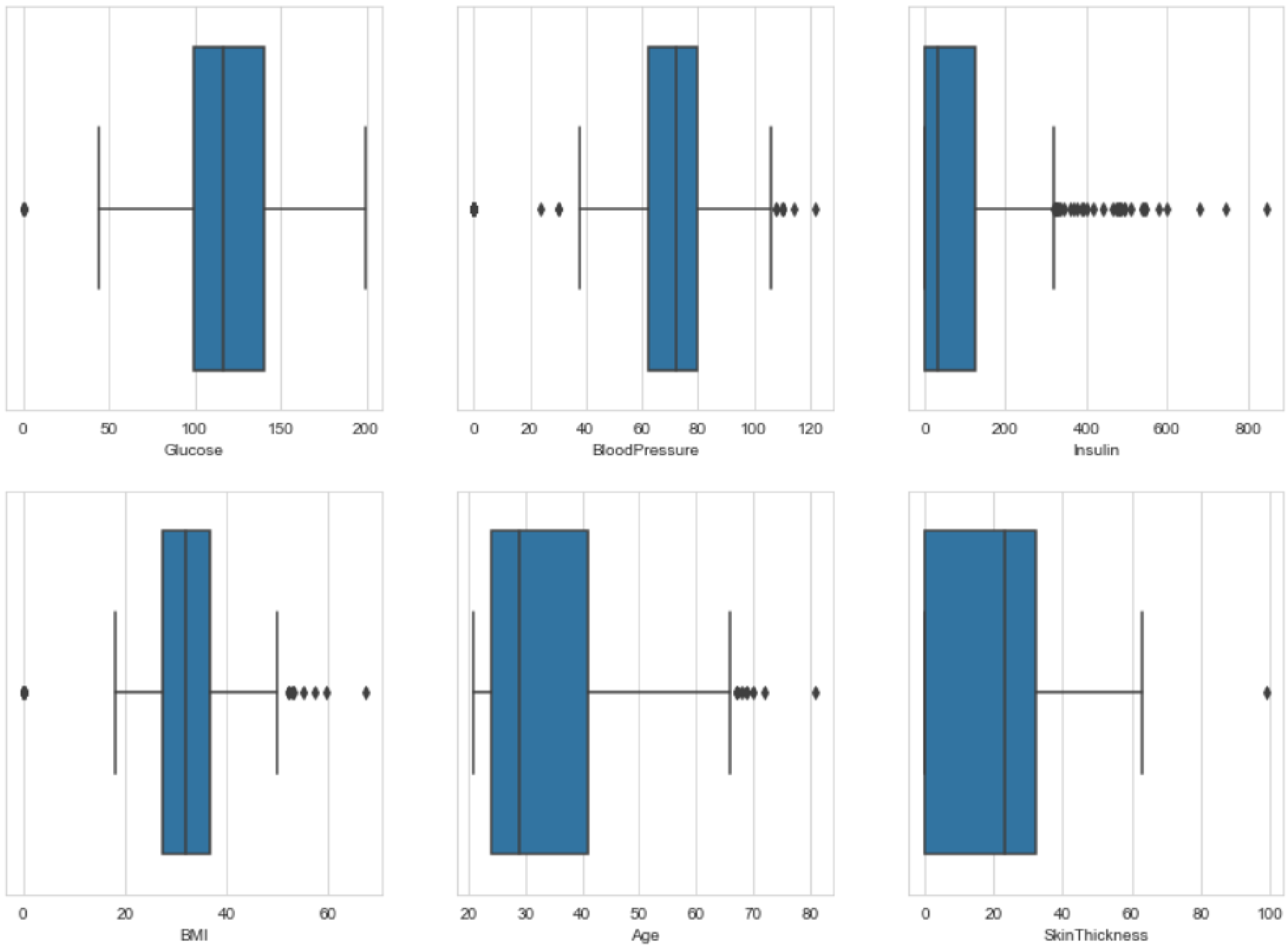
```
Number of patients who are suffer from Diabetes are: 500(65.10%)
Number of patients who are do not suffer from Diabetes are: 268(34.90%)
```



```
sns.barplot(x=data.Pregnancies.value_counts().index,y=data.Pregnancies.value_counts().values)
plt.xlabel('Pregnancies')
plt.ylabel('COUNT')
plt.show()
```

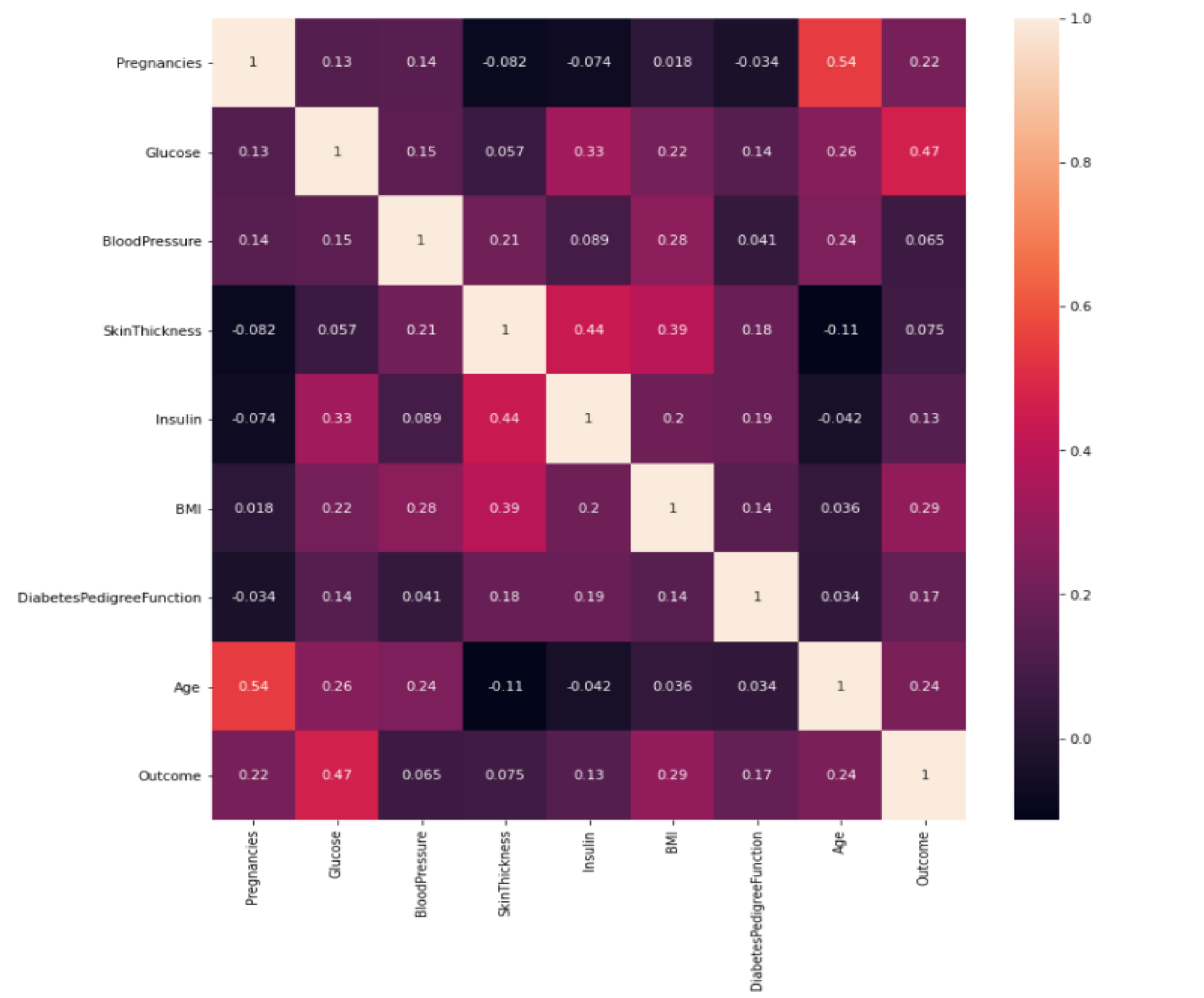


```python
plt.figure(figsize=(14,10))
sns.set_style(style='whitegrid')
plt.subplot(2,3,1)
sns.boxplot(x='Glucose',data=data)
plt.subplot(2,3,2)
sns.boxplot(x='BloodPressure',data=data)
plt.subplot(2,3,3)
sns.boxplot(x='Insulin',data=data)
plt.subplot(2,3,4)
sns.boxplot(x='BMI',data=data)
plt.subplot(2,3,5)
sns.boxplot(x='Age',data=data)
plt.subplot(2,3,6)
sns.boxplot(x='SkinThickness',data=data)
```



Step 5 Generating Correlation Matrix

```
In [12]: #corelation matrix
         plt.figure(figsize = (12,12))
         sns.heatmap(data.corr(), annot =True)
```



Step 6 Training and Testing Begins

Training and Testing Data

```
#train_test_splitting of the dataset
x = data.drop(columns = 'Outcome')
# Getting Predicting Value
y = data['Outcome']
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.1,random_state=0)
print(len(x_train))
print(len(x_test))
print(len(y_train))
print(len(y_test))
```

```
691
77
691
77
```

MACHINE LEARNING ALGORITHMS

Implementation of Logistic Regression

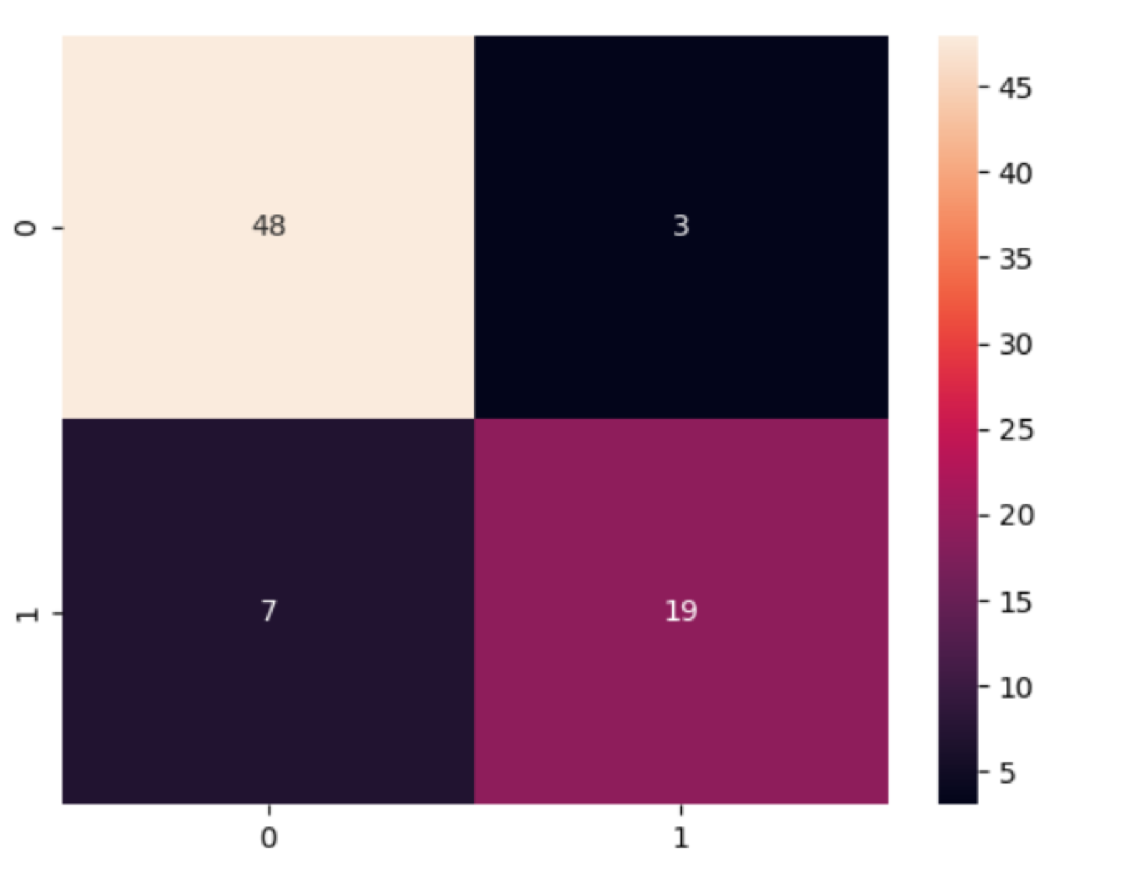
1 Logistic Regression

```
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score,classification_report,confusion_matrix
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error
#Creating logistic regression object
lr = LogisticRegression()
#Train the model using the training sets and check score
lr.fit(x_train,y_train)
#Predict the Output
y_pred=lr.predict(x_test)
y_score1= round(lr.score(x_train,y_train)*100,2)
y_score1_test=round(lr.score(x_test,y_test)*100,2)
y_accuracy1=round(accuracy_score(y_test,y_pred)*100,2)
print('-----------------------------------------------------------------------------------------
print('Logistic Regression Training Score: \n', y_score1)
print('-----------------------------------------------------------------------------------------
print('Logistic Regression Test Score: \n', y_score1_test)
print('-----------------------------------------------------------------------------------------
print('Coefficient: \n', lr.coef_)
print('-----------------------------------------------------------------------------------------
print('Intercept: \n', lr.intercept_)
print('-----------------------------------------------------------------------------------------
print('Mean Squared Error:\n',mean_squared_error(y_test,y_pred))
print('-----------------------------------------------------------------------------------------
print('R2 score is:\n',r2_score(y_test,y_pred))
print('-----------------------------------------------------------------------------------------
print('Accuracy:\n', y_accuracy1)
print('-----------------------------------------------------------------------------------------
print('Confusion Matrix:\n',confusion_matrix(y_test,y_pred))
print('-----------------------------------------------------------------------------------------
print('Classification Report is:\n',classification_report(y_test,y_pred))
print('-----------------------------------------------------------------------------------------
sns.heatmap(confusion_matrix(y_test,y_pred),annot=True,fmt="d")
```

```
--------------------------------------------------------------------------------
Logistic Regression Training Score:
 76.99
--------------------------------------------------------------------------------
Logistic Regression Test Score:
 87.01
--------------------------------------------------------------------------------
Coefficient:
 [[ 1.16362634e-01  3.33819080e-02 -1.37896163e-02  6.21453466e-04
  -1.16996204e-03  9.26125195e-02  9.93822853e-01  1.82877287e-02]]
--------------------------------------------------------------------------------
Intercept:
 [-8.32965412]
--------------------------------------------------------------------------------
Mean Squared Error:
 0.12987012987012986
--------------------------------------------------------------------------------
R2 score is:
 0.41930618401206665
--------------------------------------------------------------------------------
Accuracy:
 87.01
--------------------------------------------------------------------------------
Confusion Matrix:
 [[48  3]
 [ 7 19]]
--------------------------------------------------------------------------------
Classification Report is:
               precision    recall  f1-score   support

           0       0.87      0.94      0.91        51
           1       0.86      0.73      0.79        26

    accuracy                           0.87        77
   macro avg       0.87      0.84      0.85        77
weighted avg       0.87      0.87      0.87        77
```



Implementation of KNN

2 KNN(K Nearest Neighbor)

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score,confusion_matrix
#Creating KNN object
knn= KNeighborsClassifier(n_neighbors=7)
#Train the model using the training sets and check score
knn.fit(x_train,y_train)
#Predict the Output
y_pred= knn.predict(x_test)
y_score2 = round(knn.score(x_train, y_train) * 100,2)
y_score2_test = round(knn.score(x_test, y_test) * 100,2)
y_accuracy2=round(accuracy_score(y_test,y_pred)*100,2)
print('---------------------------------------------------------------------------------
print('KNN Training Score: \n', y_score2)
print('---------------------------------------------------------------------------------
print('KNN Test Score: \n', y_score2_test)
print('---------------------------------------------------------------------------------
print('Accuracy:\n', y_accuracy2)
print('---------------------------------------------------------------------------------
print('Confusion Matrix:\n',confusion_matrix(y_test,y_pred))
print('---------------------------------------------------------------------------------
print('Classification Report is:\n',classification_report(y_test,y_pred))
print('---------------------------------------------------------------------------------
sns.heatmap(confusion_matrix(y_test,y_pred),annot=True,fmt="d")
```

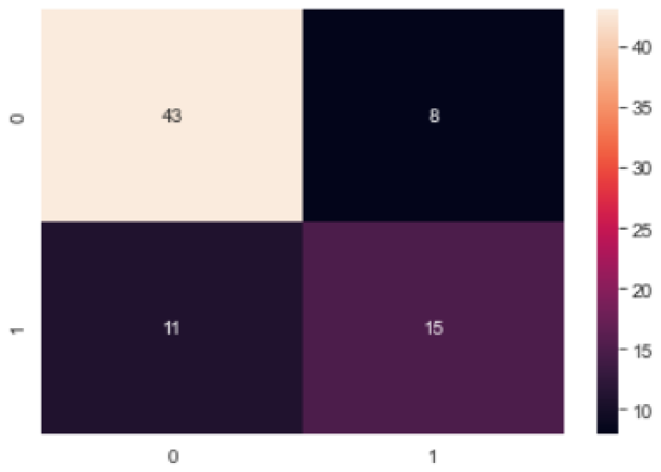
```
--------------------------------------------------------------------------------
KNN Training Score:
 78.15
--------------------------------------------------------------------------------
KNN Test Score:
 75.32
--------------------------------------------------------------------------------
Accuracy:
 75.32
--------------------------------------------------------------------------------
Confusion Matrix:
 [[43  8]
 [11 15]]
--------------------------------------------------------------------------------
Classification Report is:
               precision    recall  f1-score   support

           0       0.80      0.84      0.82        51
           1       0.65      0.58      0.61        26

    accuracy                           0.75        77
   macro avg       0.72      0.71      0.72        77
weighted avg       0.75      0.75      0.75        77

--------------------------------------------------------------------------------

<AxesSubplot:>
```



Implementation of SVM

3 Support vector machine(SVM)

```
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score,confusion_matrix
#Creating SVM object
svm= SVC(random_state=1)
#Train the model using the training sets and check score
svm.fit(x_train,y_train)
#Predict the Output
y_pred= svm.predict(x_test)
y_score3 = round(svm.score(x_train, y_train) * 100,2)
y_score3_test = round(svm.score(x_test, y_test) * 100,2)
y_accuracy3=round(accuracy_score(y_test,y_pred)*100,2)
print('--------------------------------------------------------------------------------------------------
print('SVM Training Score: \n', y_score3)
print('--------------------------------------------------------------------------------------------------
print('SVM Test Score: \n', y_score3_test)
print('--------------------------------------------------------------------------------------------------
print('Accuracy:\n', y_accuracy3)
print('--------------------------------------------------------------------------------------------------
print('Confusion Matrix:\n',confusion_matrix(y_test,y_pred))
print('--------------------------------------------------------------------------------------------------
print('Classification Report is:\n',classification_report(y_test,y_pred))
print('--------------------------------------------------------------------------------------------------
sns.heatmap(confusion_matrix(y_test,y_pred),annot=True,fmt="d")
```

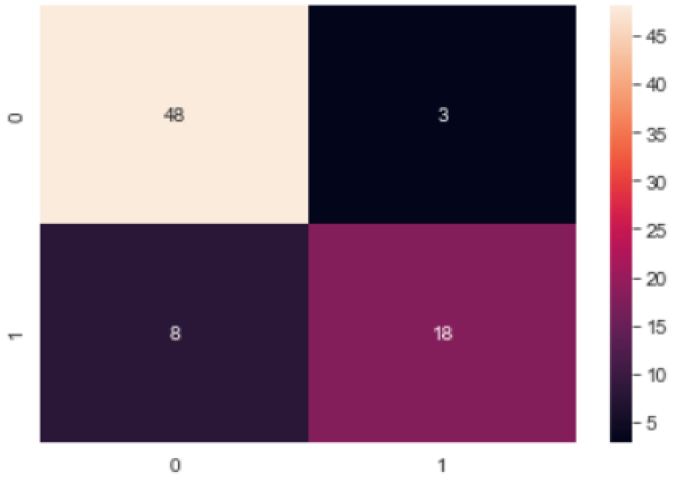
```
------------------------------------------------------------------------
SVM Training Score:
 75.25
------------------------------------------------------------------------
SVM Test Score:
 85.71
------------------------------------------------------------------------
Accuracy:
 85.71
------------------------------------------------------------------------
Confusion Matrix:
 [[48  3]
 [ 8 18]]
------------------------------------------------------------------------
Classification Report is:
               precision    recall  f1-score   support

           0       0.86      0.94      0.90        51
           1       0.86      0.69      0.77        26

    accuracy                           0.86        77
   macro avg       0.86      0.82      0.83        77
weighted avg       0.86      0.86      0.85        77

------------------------------------------------------------------------
```

```
<AxesSubplot:>
```



Decision Tree

4 Decision Tree

```
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score,confusion_matrix
dtree = DecisionTreeClassifier(max_depth=6, random_state=123,criterion='entropy')
dtree.fit(x_train,y_train)
y_pred=dtree.predict(x_test)
y_score5 = round(dtree.score(x_train, y_train) * 100,2)
y_score5_test = round(dtree.score(x_test, y_test) * 100,2)
y_accuracy5=round(accuracy_score(y_test,y_pred)*100,2)
print('-----------------------------------------------------------------------------
print('Decision Tree Training Score: \n', y_score5)
print('-----------------------------------------------------------------------------
print('Decision Tree Test Score: \n', y_score5_test)
print('-----------------------------------------------------------------------------
print('Accuracy:\n', y_accuracy5)
print('-----------------------------------------------------------------------------
print('Confusion Matrix:\n',confusion_matrix(y_test,y_pred))
print('-----------------------------------------------------------------------------
print('Classification Report is:\n',classification_report(y_test,y_pred))
print('-----------------------------------------------------------------------------
sns.heatmap(confusion_matrix(y_test,y_pred),annot=True,fmt="d")
```

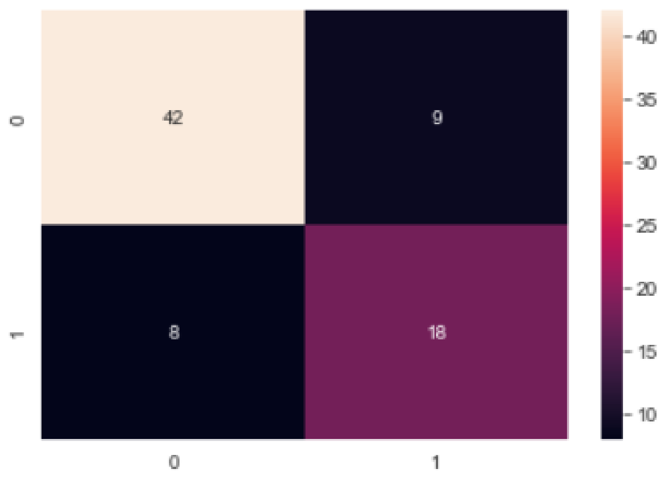
```
Decision Tree Training Score:
 83.79
---------------------------------------------------------------------------
Decision Tree Test Score:
 77.92
---------------------------------------------------------------------------
Accuracy:
 77.92
---------------------------------------------------------------------------
Confusion Matrix:
 [[42  9]
 [ 8 18]]
---------------------------------------------------------------------------
Classification Report is:
               precision    recall  f1-score   support

           0       0.84      0.82      0.83        51
           1       0.67      0.69      0.68        26

    accuracy                           0.78        77
   macro avg       0.75      0.76      0.76        77
weighted avg       0.78      0.78      0.78        77

---------------------------------------------------------------------------

<AxesSubplot:>
```



Random Forest

6 Random Forest

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score,confusion_matrix
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
y_pred=rfc.predict(x_test)
y_score6 = round(rfc.score(x_train, y_train) * 100,2)
y_score6_test = round(rfc.score(x_test, y_test) * 100,2)
y_accuracy6=round(accuracy_score(y_test,y_pred)*100,2)
print('---------------------------------------------------------------------------------------------
print('Random Forest Training Score: \n', y_score6)
print('---------------------------------------------------------------------------------------------
print('Random Forest Test Score: \n', y_score6_test)
print('---------------------------------------------------------------------------------------------
print('Accuracy:\n', y_accuracy6)
print('---------------------------------------------------------------------------------------------
print('Confusion Matrix:\n',confusion_matrix(y_test,y_pred))
print('---------------------------------------------------------------------------------------------
print('Classification Report is:\n',classification_report(y_test,y_pred))
print('---------------------------------------------------------------------------------------------
sns.heatmap(confusion_matrix(y_test,y_pred),annot=True,fmt="d")
```

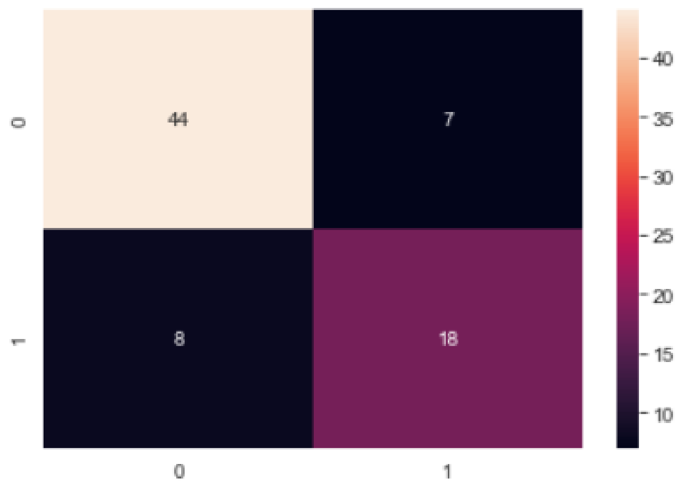
```
Random Forest Training Score:
 100.0
-----------------------------------------------------------------------
Random Forest Test Score:
 80.52
-----------------------------------------------------------------------
Accuracy:
 80.52
-----------------------------------------------------------------------
Confusion Matrix:
 [[44  7]
 [ 8 18]]
-----------------------------------------------------------------------
Classification Report is:
              precision    recall  f1-score   support

           0       0.85      0.86      0.85        51
           1       0.72      0.69      0.71        26

    accuracy                           0.81        77
   macro avg       0.78      0.78      0.78        77
weighted avg       0.80      0.81      0.80        77

-----------------------------------------------------------------------

<AxesSubplot:>
```



RESULTS

The results have been collected of from all the used algorithms. Based on the accuracy we come to found that Logistic Regression outperforms than the rest and has best accuracy.

Classification Model	Accuracy(%)
Logistic regression	87.01
K-nearest neighbor(KNN),	75.32
Support vector machine (SVM	85.71
Decision Tree	77.92
Random Forest	81.82

CONCLUSION

Thus at last I can conclude that with the advancement in the field of data science the detection of any diseases at its earlier stages can be done easily.

Detection of diabetes in its early stages is the key for treatment. This project has described a machine learning approach for predicting diabetes levels. The technique may also help researchers to develop an accurate and effective tool that will reach at the table of clinicians to help them make better decision about the disease status.

REFERENCES

[1] Aishwarya, R., Gayathri, P., Jaishankar, N., 2013. A Method for Classification Using Machine Learning Technique for Diabetes. International Journal of Engineering and Technology (IJET) 5, 2903–2908

[2] Arora, R., Suman, 2012. Comparative Analysis of Classification Algorithms on Different Datasets using WEKA. International Journal of Computer Applications 54, 21–25. doi:10.5120/8626-2492

[3] Choubey, D.K., Paul, S., Kumar, S., Kumar, S., 2017. Classification of Pima Indian diabetes dataset using naive bayes with genetic algorithm as an attribute selection, in: Communication and Computing Systems: Proceedings of the International Conference on Communication and Computing System (ICCCS 2016), pp. 451–455.

[4] Prediction of Diabetes using Classification Algorithms by Deepti Sisodia, Dilip Singh Sisodia

[5] Diabetes prediction using machine learning algorithms **by** Muhammad Daniyal Baig, Muhammad Farrukh Nadeem