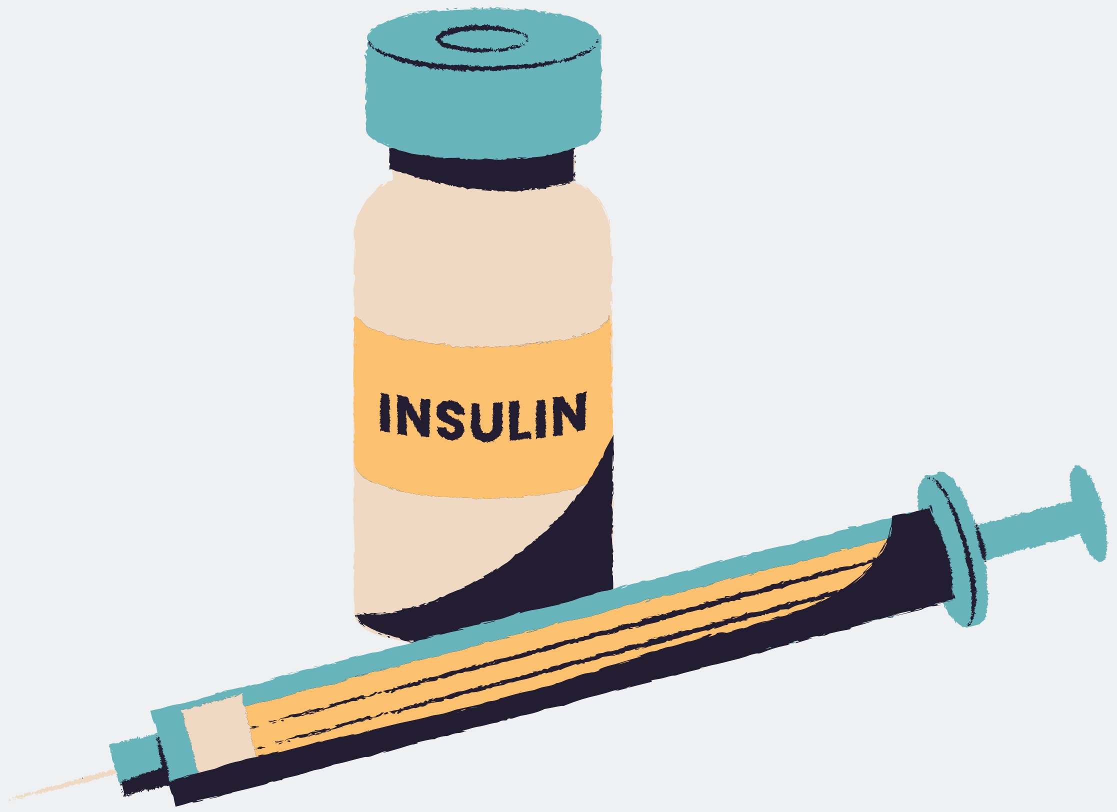
Title

VIT-AP

Diabetes Prediction

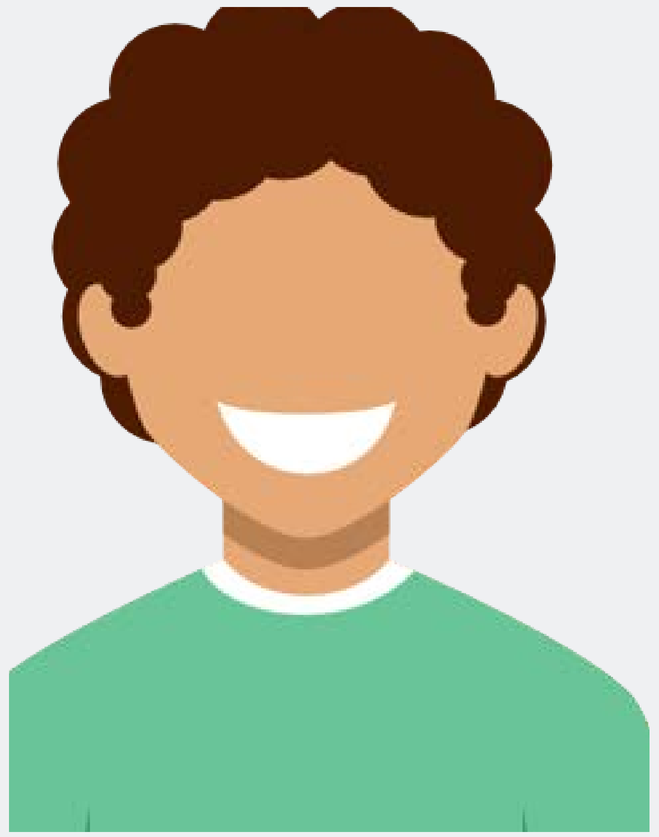


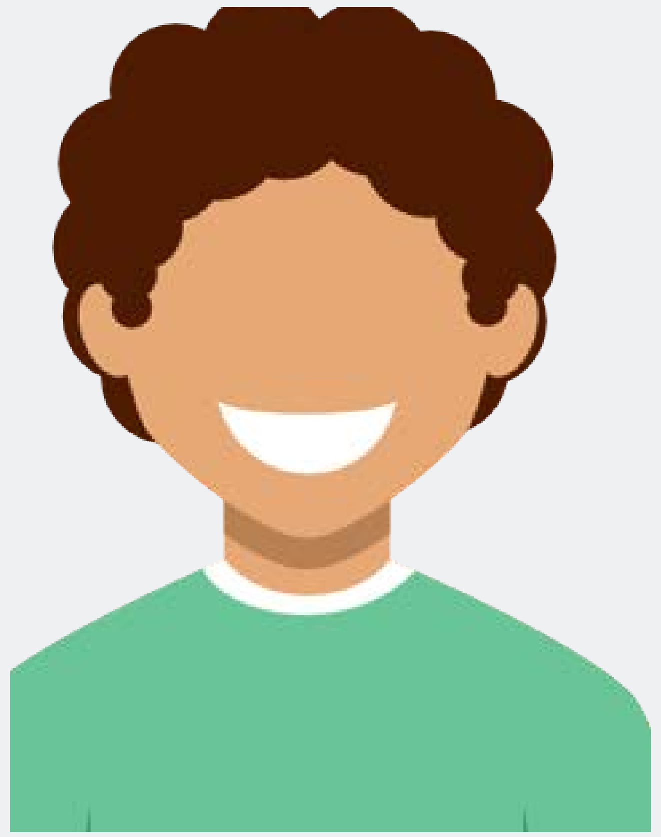
Group Insulin

Title Page Proprietors

Team Members

Group





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Title Page Proprietors Introduction

Diabetes Prediction

Introduction

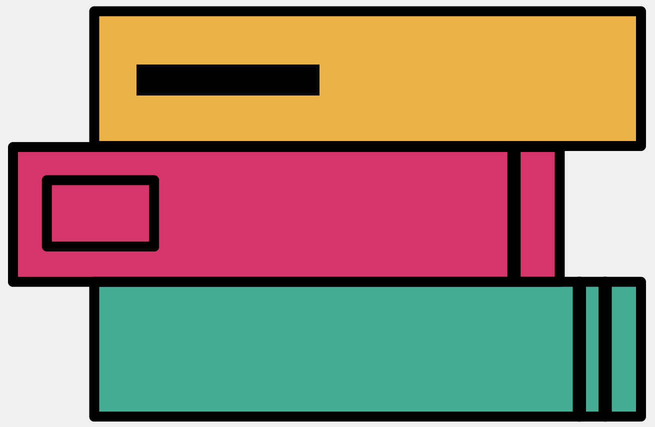
1. **Insulin-Dependent Diabetes Mellitus**

2. **Non-Insulin-Dependent Diabetes Mellitus**

3. **Gestational Diabetes**

Predictive analytics can be done using machine learning algorithms diagnosing the disease with the best possible accuracy, enhancing patient care, optimizing resources along with improving clinical outcomes.

Introduction



General Overview

In this project, our objective is to predict whether the patient has diabetes or not based on various features like *Glucose level, Insulin, Age, and BMI by* using various machine learning algorithms basing on accuracy score etc..

Motivation

Diabetes is an increasingly growing health issue due to our inactive lifestyle. It is detected through machine learning algorithms that can predict whether the patient is diabetes positive or not.

Title Page | Proprietors | Introduction | Review of Literature

Sources for prediction of diabetes

Review of Literature

Keywords

Diabetes,Prediction,Accuracy
SVM
Logistic Regression
Decision Tree
Random forest
Gaussian NB
KNN
XG Boost

The First Source

Mechine Specification
-RAM
-OS
-Graphics
-Editior

The Second Source

Dataset: KAGGLE

Diabetes.csv

Code: Github Link

Methodology for Diabetes Prediction

Methodology

Importing Libraries, Data Gathering

Numpy
pandas
Matplotlib
Seaborn,
Diabets.csv

Descriptive Analysis

Preview Data
Finding Null Values
Shape
Correlation

Data Visualizations

Countpot
Histogram
Pairplot
Heatmap

Methodology for Diabetes Prediction

Classification Algorithms

Logistic Regression Algorithm
KNN
SVC
Decision Tree
GaussianNB
Random Forest
Xgboot

Model Evaluation

svc

Accuracy Score Matrix
Confusion Matrix
Classification Report

Model Deployment

Flask

Title Page | Proprietors | Introduction | Review of Literature | Methodology | Results

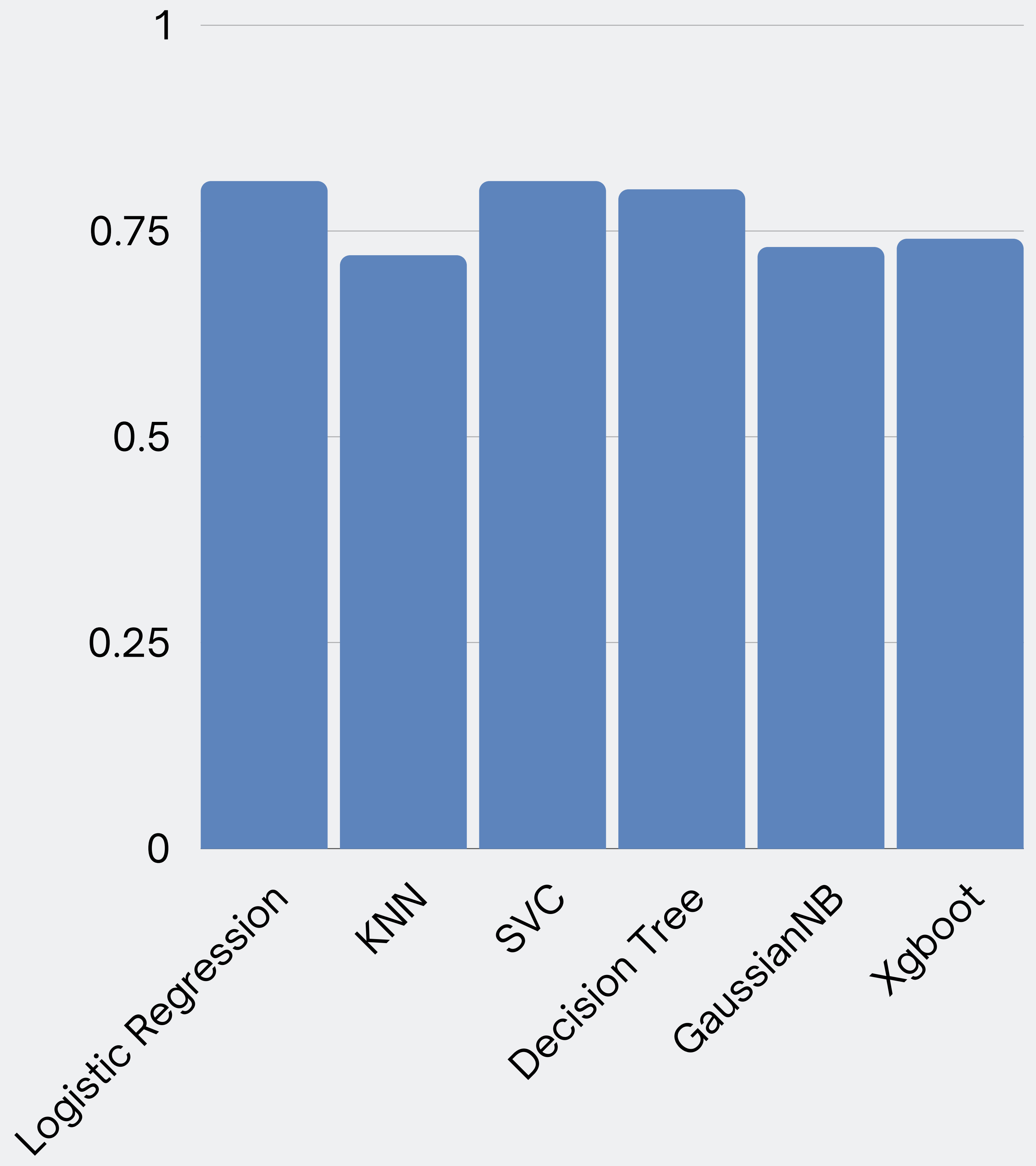
Output of Machine Learning

Results

Project Findings from Quantitative Methodology

Clearly from the graph, SVC and Logistic Regression has a high accuracy of 81%.

We use SVC for deployment for predicting whether the patient is having diabetes or not.



Results

Project Findings from Quantitative Methodology

Here, in SVM we have calculated all parameters that are precision, recall,f1-score, and support. We got support as 100% therefore, we can conclude that we can able to classify whether the person has diabetes or not by using SVM.

Analysi of the algorithms and

Analysis of Results

✓ **The First Analysis**

SVC and Logistic Regression
have high acuuracy.
Picking SVC for Deployment

✓ **The Second Analysis**

SVC
(Percision,Recall,f1score,support)

Conclusion

In this project, seven machine learning classification methods were implemented, and their results were compared with different statistical measures.

Various machine learning algorithms are applied to the data set and the classification has been done using various algorithms of which **Logistic Regression** and **support vector machine** give the highest accuracy of **81%**. We have used SVC for prediction of diabetes.

Diabetes Prediction

A Project Report

LONG SEM 2021-22

CSE3008

(Introduction to Machine Learning)

Submitted by

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VIT-AP UNIVERSITY

AMARAVATI

ANDHRA PRADESH, INDIA

2021-2022

Title: Predict Diabetes using Machine Learning.

Abstract:

In this project, our objective is to predict whether the patient has diabetes or not based on various features like *Glucose level, Insulin, Age, and BMI*. We will perform all the steps from *Data gathering to Model deployment.* During Model evaluation, we compare various machine learning algorithms on the basis of the accuracy_score metric and find the best one. Then we create a web app using Flask which is a python micro-framework.

Motivation:

International Diabetes Federation (IDF) stated that 382 million people are living with diabetes worldwide. Over the last few years, the impact of diabetes has increased drastically, which makes it a global threat. At present, Diabetes has steadily been listed in the top position as a major cause of death. The number of affected people will reach up to 629 million i.e. 48% increase by 2045. However, diabetes is largely preventable and can be avoided by making lifestyle changes. These changes can also lower the chances of developing heart disease and cancer. So, there is a dire need for a prognosis tool that can help the doctors with early detection of the disease and hence can recommend the lifestyle changes required to stop the progression of the deadly disease. Diabetes is an increasingly growing health issue due to our inactive lifestyle. If it is detected in time then through proper medical treatment, adverse effects can be prevented. To help in early detection, technology can be used very reliably and efficiently. Using machine learning we have built a predictive model that can predict whether the patient is diabetes positive or not.

Keywords :

Diabetes, Prediction, Accuracy

SVM

Logistic Regression

Decision Tree

Random forest

Gaussian NB

KNN

XG Boost

Code:

https://github.com/GUMMADIDALA-DILEEPCHANDU/Diabets_Prediction

Introduction:

Considering the current scenario, in developing countries like India, Diabetes has become a very severe disease. Around 425 million people suffer from diabetes. Approximately 2-5 million patients every year lose their lives due to diabetes. It is said that by 2045 this will rise to 629 million.

Diabetes is classified as-

Type-1 is known as Insulin-Dependent Diabetes Mellitus (IDDM). The Inability of the human body to generate sufficient insulin is the reason behind this type of Diabetes and hence it is required to inject insulin into a patient.

Type-2 is also known as Non-Insulin-Dependent Diabetes Mellitus (NIDDM). This type of Diabetes is seen when body cells are not able to use insulin properly.

Type-3 Gestational Diabetes, an increase in blood sugar level in a pregnant woman where diabetes is not detected earlier results in this type of diabetes.

A technique called, Predictive Analysis, incorporates a variety of machine learning algorithms, data mining techniques, and statistical methods that uses current and past data to find knowledge and predict future events. By applying predictive analysis to healthcare data, significant decisions can be taken and predictions can be made. Predictive analytics can be done using machine learning algorithms. Predictive analytic aims at diagnosing the disease with the best possible accuracy, enhancing patient care, optimizing resources along with improving clinical outcomes. Machine learning is considered to be one of the most important artificial intelligence features that support the development of computer systems having the ability to acquire knowledge from past experiences with no need for programming for every case. Machine learning is considered to be a dire need in today's situation to eliminate human efforts by supporting automation with minimum flaws. The Existing method for diabetes detection uses lab tests such as fasting blood glucose and oral glucose tolerance.

About the data: This dataset has various features like *Glucose level, Insulin, Age, and BMI.*

Data:

https://www.kaggle.com/datasets/uciml/pima-indians-diabetes-database

Machine Specifications:

Table of Content	**Description**
Operating system	Windows 10 & Windows 11 64-bit operating system
RAM	8GB or 16GB
GRAPHIS	Intel(R) Core(TM) i5-8265U CPU @ 1.60GHz 1.80 GHz
Editors	Jupyter Notebook, Spyder, Google Colab

Requirements:

`Dependencies include python libraries like`

```
sklearn

matplotlib

pandas

seaborn
```

Classification models used

```
Decision Trees

Random forest

Logistic Regression

SVM

Naive Bayes

Logistic Regression

Ensemble Modeling
```

Methodology:

Step 1:

Data gathering and Importing libraries.

All the standard libraries like NumPy, pandas, matplotlib and seaborn are imported in this step. We use NumPy for linear algebra operations, pandas for using data frames, and matplotlib and seaborn for plotting graphs. The dataset is imported using the panda’s command *read_csv()*.

#Importing dataset

```
import numpy as np

import matplotlib.pyplot as plt

import pandas as pd

import seaborn as sns

from warnings import filterwarnings

filterwarnings(action='ignore')
```

Loading data set

```
data = pd.read_csv("diabetes.csv")
print("Successfully Imported Data!")
```

output:

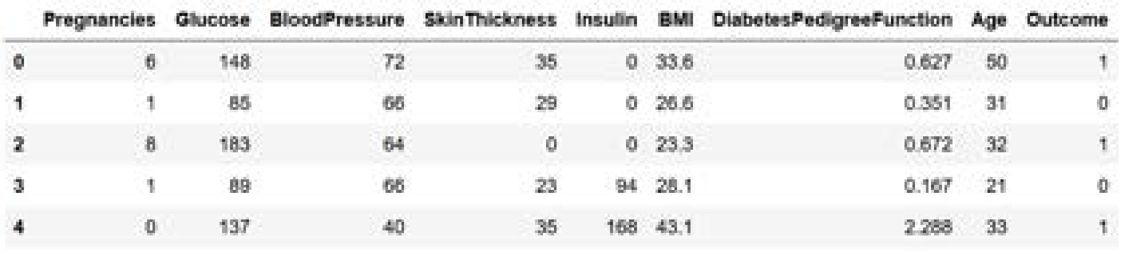
```
Successfully Imported Data!
```

Step 2:

Descriptive Analysis

```
# Preview data
dataset.head()
```

Output:

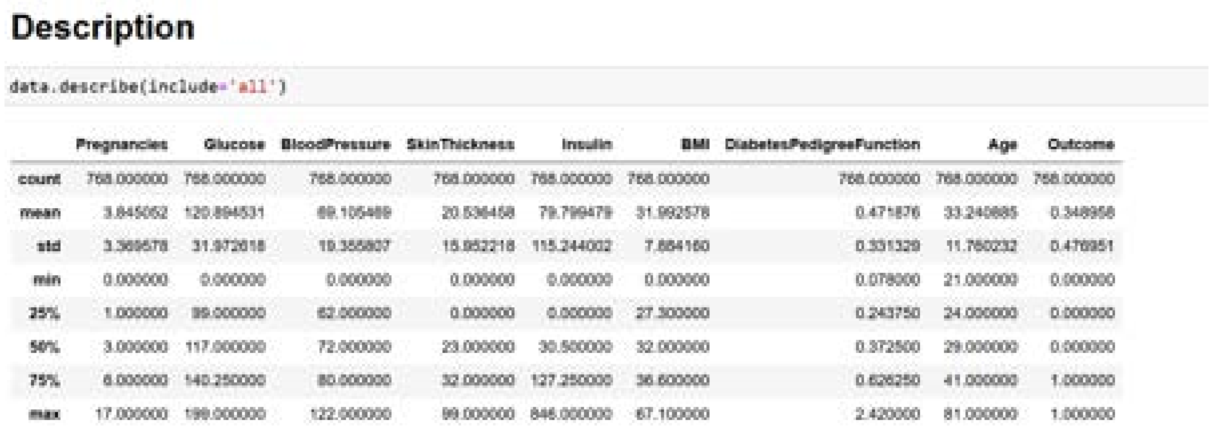


	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

```
print(data.shape)
```

output:

```
(768, 9)
```

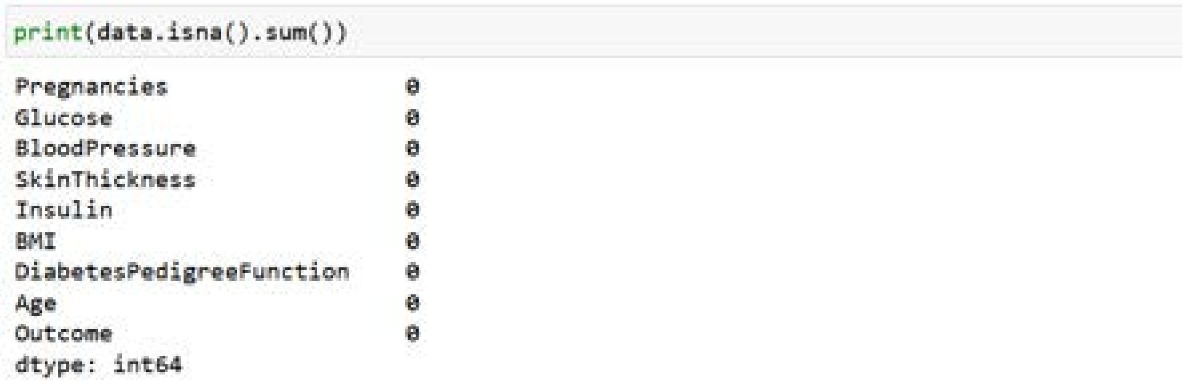


Description

```
data.describe(include='all')
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000
mean	3.845052	120.894531	69.105469	20.536458	79.799479	31.992578	0.471876	33.240885	0.348958
std	3.369578	31.972618	19.355807	15.952218	115.244002	7.884160	0.331329	11.760232	0.476951
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.078000	21.000000	0.000000
25%	1.000000	99.000000	62.000000	0.000000	0.000000	27.300000	0.243750	24.000000	0.000000
50%	3.000000	117.000000	72.000000	23.000000	30.500000	32.000000	0.372500	29.000000	0.000000
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	0.626250	41.000000	1.000000
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	2.420000	81.000000	1.000000

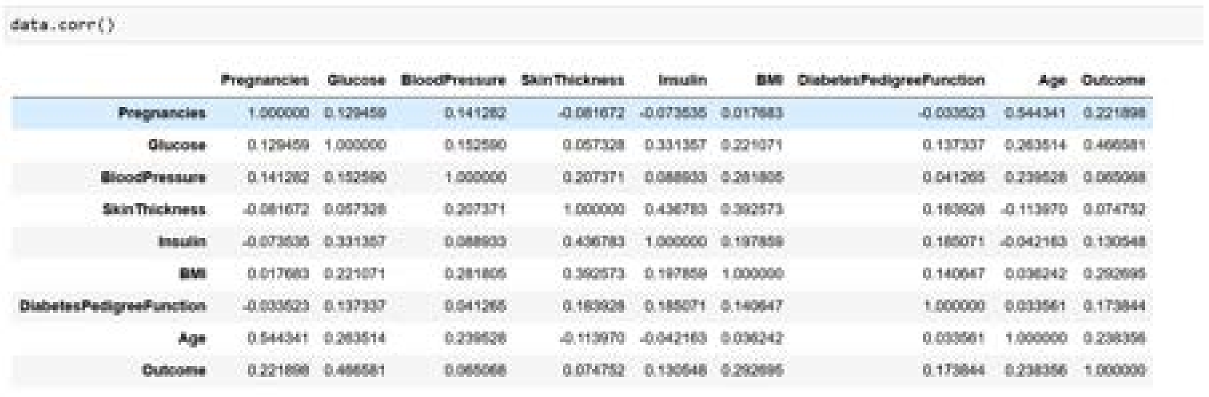
Finding Null Values



```
print(data.isna().sum())
```

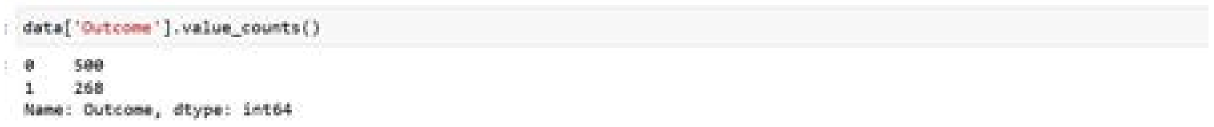
```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

- There are a total of 768 records and 9 features in the dataset.
- Each feature can be either of integer or float data type.
- Some features like Glucose, Blood pressure, Insulin, BMI have zero values which represent missing data.
- There are zero NaN values in the dataset.
- In the outcome column, 1 represents diabetes positive and 0 represents diabetes negative



```
data.corr()
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
Pregnancies	1.000000	0.129459	0.141282	-0.081672	-0.073535	0.017683	-0.033523	0.544341	0.221898
Glucose	0.129459	1.000000	0.152590	0.057328	0.331357	0.221071	0.137337	0.263514	0.466581
BloodPressure	0.141282	0.152590	1.000000	0.207371	0.088933	0.281805	0.041265	0.239528	0.065068
SkinThickness	-0.081672	0.057328	0.207371	1.000000	0.436783	0.392573	0.183928	-0.113970	0.074752
Insulin	-0.073535	0.331357	0.088933	0.436783	1.000000	0.197859	0.185071	-0.042163	0.130548
BMI	0.017683	0.221071	0.281805	0.392573	0.197859	1.000000	0.140647	0.036242	0.292695
DiabetesPedigreeFunction	-0.033523	0.137337	0.041265	0.183928	0.185071	0.140647	1.000000	0.033561	0.173844
Age	0.544341	0.263514	0.239528	-0.113970	-0.042163	0.036242	0.033561	1.000000	0.238356
Outcome	0.221898	0.466581	0.065068	0.074752	0.130548	0.292695	0.173844	0.238356	1.000000



```
data['Outcome'].value_counts()
```

```
0    500
1    268
Name: Outcome, dtype: int64
```

0 means no DIABETED

1 means patient with DIABETED

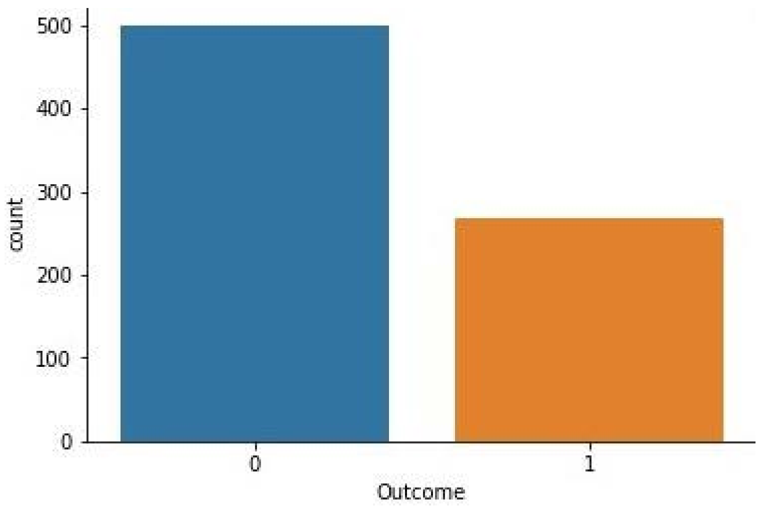
No.of 0 in dataset is 500

No.of 1 in the dataset is 268

Step 3:

Data Visualizations

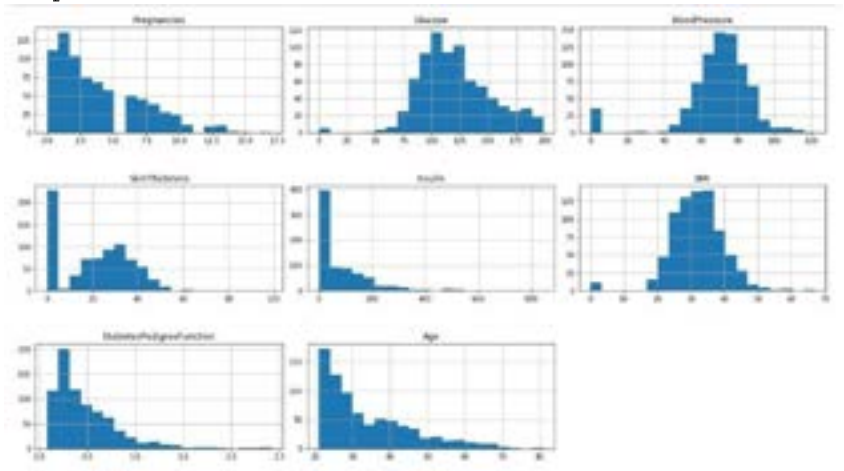
```
# Outcome counterplot
sns.countplot(x = 'Outcome',data = dataset)
```



Outcome Countplot

```
# Histogram of each feature

import itertoolscol = dataset.columns[:8]
plt.subplots(figsize = (20, 15))
length = len(col)for i, j in itertools.zip_longest(col, range(length)):
    plt.subplot((length/2), 3, j + 1)
    plt.subplots_adjust(wspace = 0.1,hspace = 0.5)
    dataset[i].hist(bins = 20)
    plt.title(i)
plt.show()
```

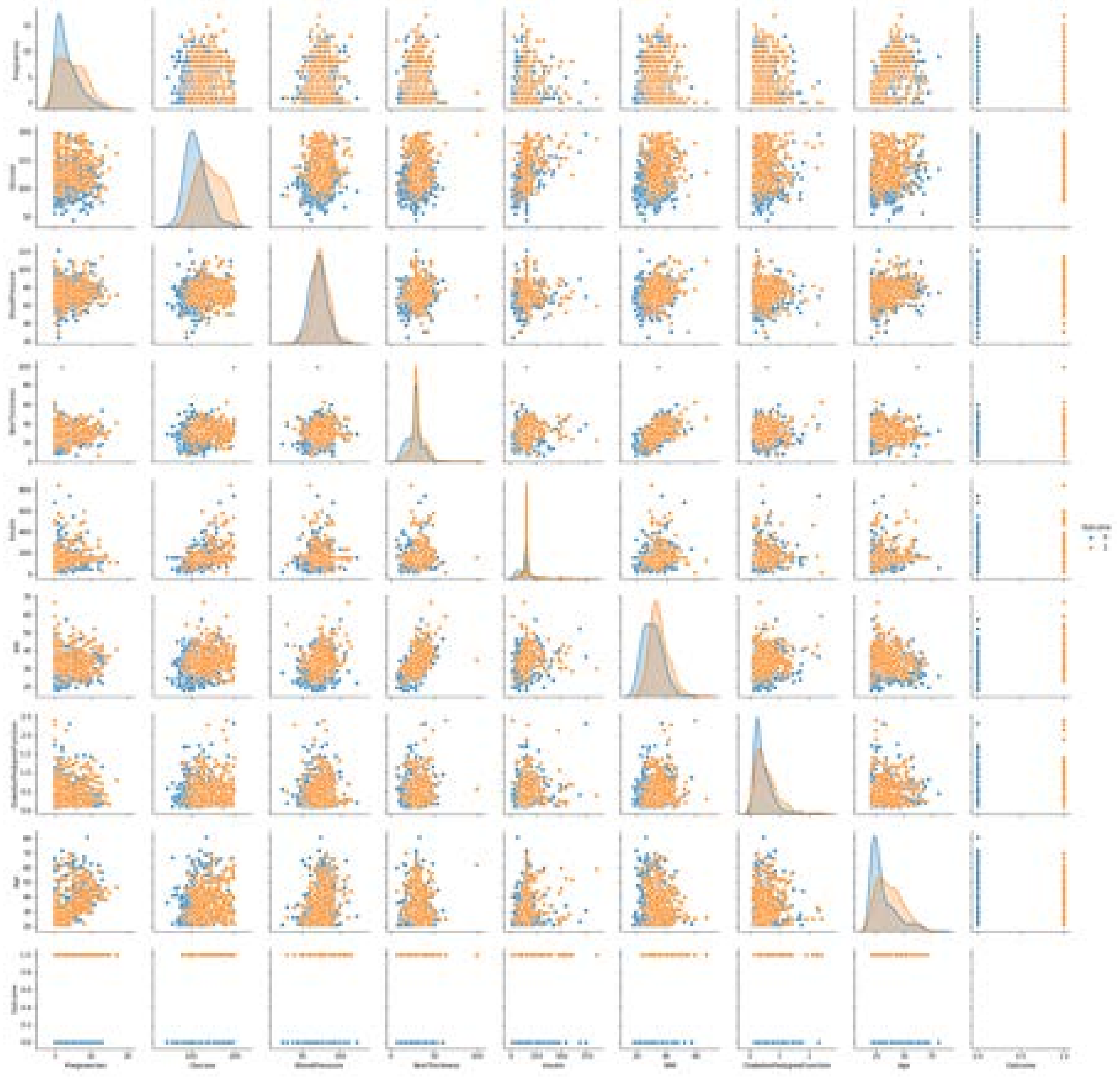
output:



Histogram of each Feature

```
# Pairplot
sns.pairplot(data = dataset, hue = 'Outcome')
plt.show()
```

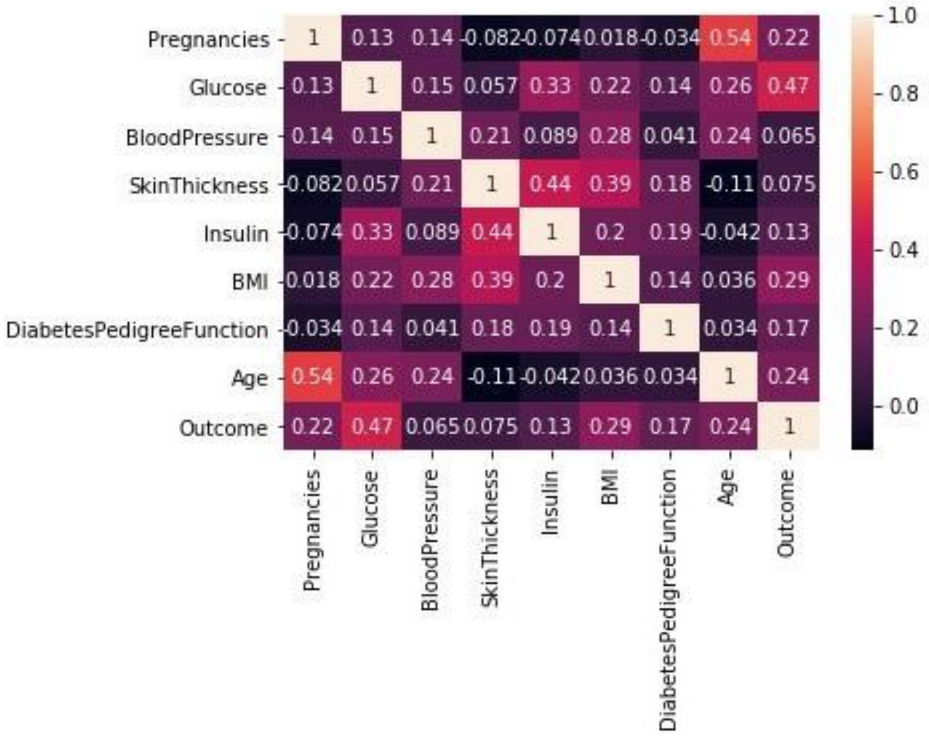
Output:



Pairplot of all features

```
# Heatmap
sns.heatmap(dataset.corr(), annot = True)
plt.show()
```

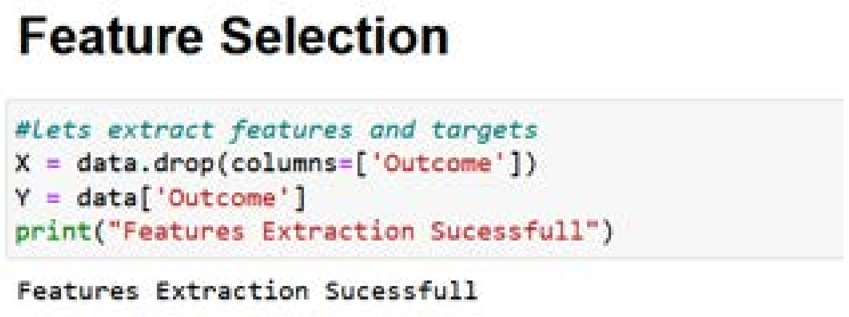
Output:



Heatmap of Feature correlation

- The counterplot tells us that the dataset is imbalanced, as the number of patients who don’t have diabetes is more than those who do.
- From the correlation heatmap, we can see that there is a high correlation between Outcome and [Glucose, BMI, Age, Insulin]. We can select these features to accept input from the user and predict the outcome.

Note: There are so many other plotting you can refer to on **Github.**

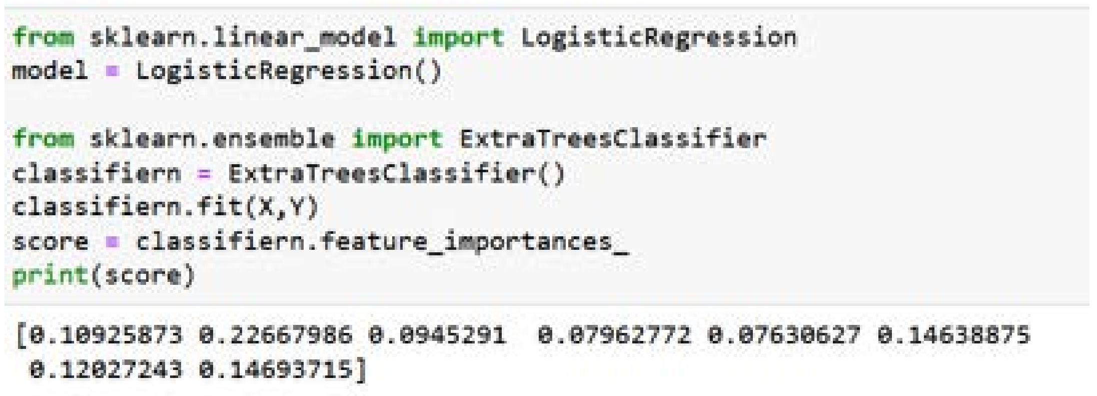


Feature Selection

```
#Lets extract features and targets
X = data.drop(columns=['Outcome'])
Y = data['Outcome']
print("Features Extraction Sucessfull")
```

```
Features Extraction Sucessfull
```

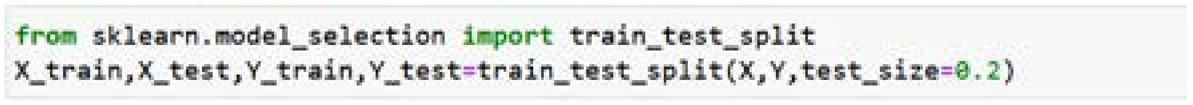
Feature Importance



```
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()

from sklearn.ensemble import ExtraTreesClassifier
classifiern = ExtraTreesClassifier()
classifiern.fit(X,Y)
score = classifiern.feature_importances_
print(score)
```

```
[0.10925873 0.22667986 0.0945291  0.07962772 0.07630627 0.14638875
 0.12027243 0.14693715]
```

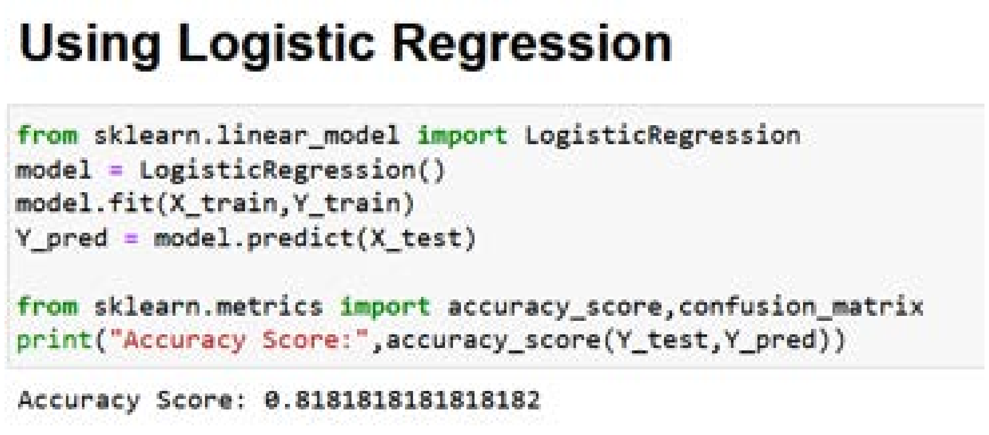
Splitting Dataset



```
from sklearn.model_selection import train_test_split
X_train,X_test,Y_train,Y_test=train_test_split(X,Y,test_size=0.2)
```

Step 4:

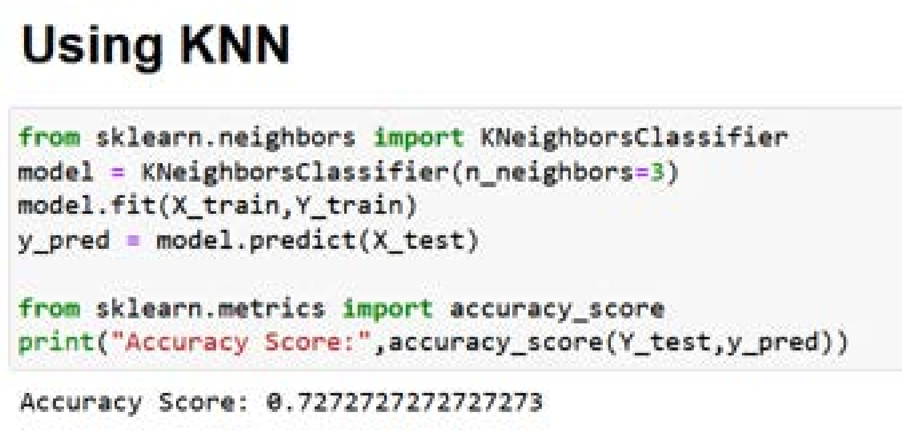
Applying classification algorithms



Using Logistic Regression

```
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(X_train,Y_train)
Y_pred = model.predict(X_test)

from sklearn.metrics import accuracy_score,confusion_matrix
print("Accuracy Score:",accuracy_score(Y_test,Y_pred))
```

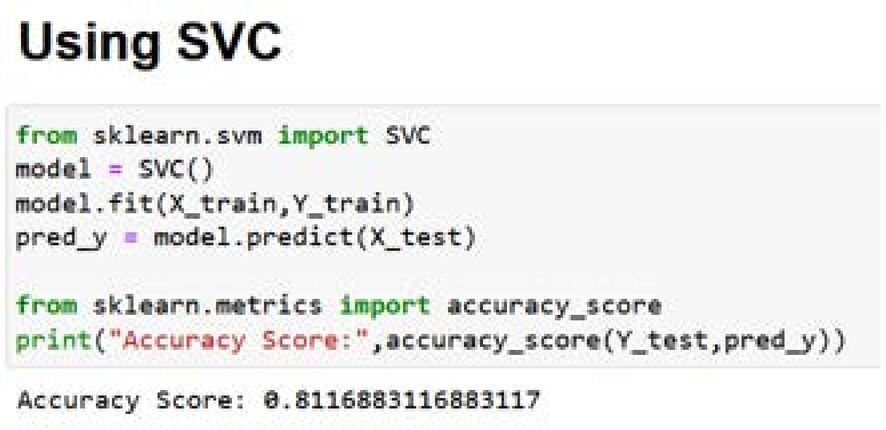
```
Accuracy Score: 0.8181818181818182
```



Using KNN

```
from sklearn.neighbors import KNeighborsClassifier
model = KNeighborsClassifier(n_neighbors=3)
model.fit(X_train,Y_train)
y_pred = model.predict(X_test)

from sklearn.metrics import accuracy_score
print("Accuracy Score:",accuracy_score(Y_test,y_pred))
```

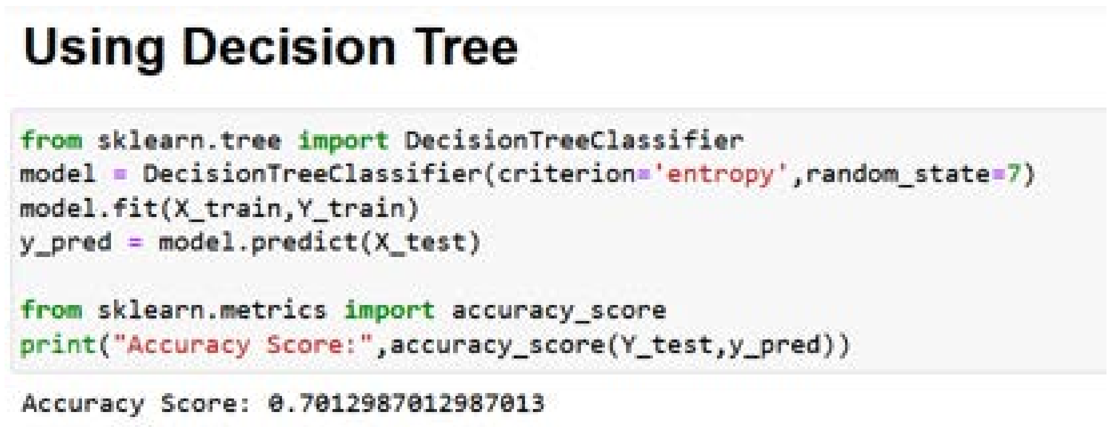
```
Accuracy Score: 0.7272727272727273
```



Using SVC

```
from sklearn.svm import SVC
model = SVC()
model.fit(X_train,Y_train)
pred_y = model.predict(X_test)

from sklearn.metrics import accuracy_score
print("Accuracy Score:",accuracy_score(Y_test,pred_y))
```

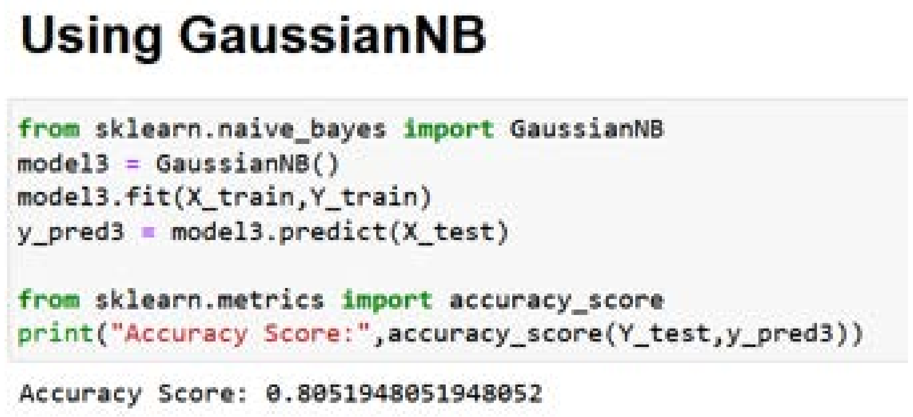
```
Accuracy Score: 0.8116883116883117
```



Using Decision Tree

```
from sklearn.tree import DecisionTreeClassifier
model = DecisionTreeClassifier(criterion='entropy',random_state=7)
model.fit(X_train,Y_train)
y_pred = model.predict(X_test)

from sklearn.metrics import accuracy_score
print("Accuracy Score:",accuracy_score(Y_test,y_pred))
```

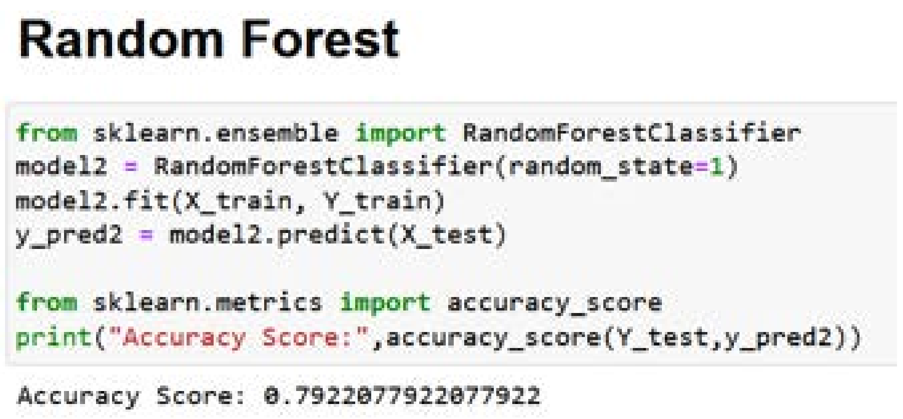
```
Accuracy Score: 0.7012987012987013
```



Using GaussianNB

```
from sklearn.naive_bayes import GaussianNB
model3 = GaussianNB()
model3.fit(X_train,Y_train)
y_pred3 = model3.predict(X_test)

from sklearn.metrics import accuracy_score
print("Accuracy Score:",accuracy_score(Y_test,y_pred3))
```

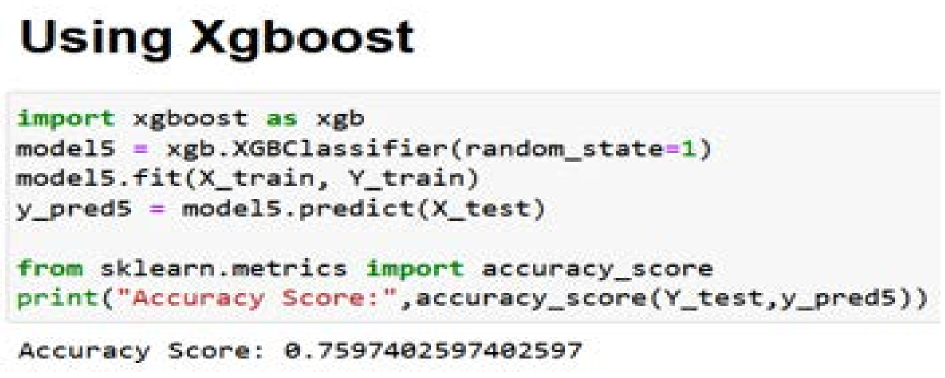
```
Accuracy Score: 0.8051948051948052
```



Random Forest

```
from sklearn.ensemble import RandomForestClassifier
model2 = RandomForestClassifier(random_state=1)
model2.fit(X_train, Y_train)
y_pred2 = model2.predict(X_test)

from sklearn.metrics import accuracy_score
print("Accuracy Score:",accuracy_score(Y_test,y_pred2))
```

```
Accuracy Score: 0.7922077922077922
```

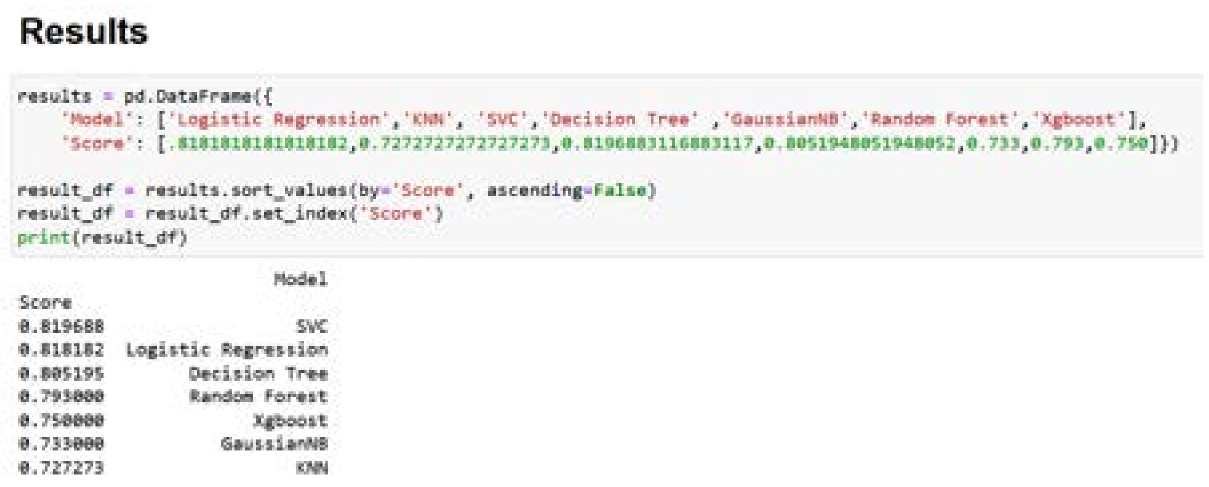


Using Xgboost

```
import xgboost as xgb
model5 = xgb.XGBClassifier(random_state=1)
model5.fit(X_train, Y_train)
y_pred5 = model5.predict(X_test)

from sklearn.metrics import accuracy_score
print("Accuracy Score:",accuracy_score(Y_test,y_pred5))
```

```
Accuracy Score: 0.7597402597402597
```

Comparing the accuracy:

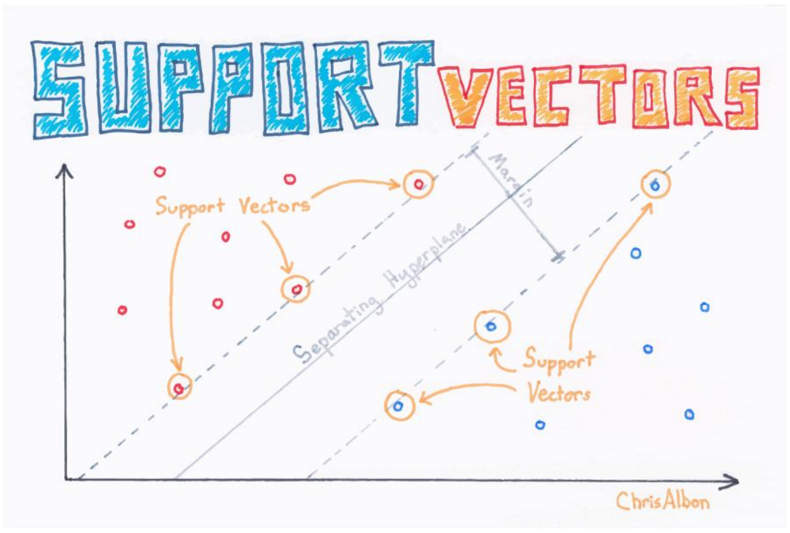


Results

```
results = pd.DataFrame({
    'Model': ['Logistic Regression','KNN', 'SVC','Decision Tree' ,'GaussianNB','Random Forest','Xgboost'],
    'Score': [.8181818181818182,0.7272727272727273,0.8196883116883117,0.8051948051948052,0.733,0.793,0.750]})

result_df = results.sort_values(by='Score', ascending=False)
result_df = result_df.set_index('Score')
print(result_df)
```

```
                         Model
Score
0.819688                   SVC
0.818182   Logistic Regression
0.805195         Decision Tree
0.793000         Random Forest
0.750000               Xgboost
0.733000            GaussianNB
0.727273                   KNN
```

The Algorithm selected for deployment:



Support Vector Classifier(SVC) is a type of supervised classification model whose objective is to classify the data based on a maximal margin hyperplane build using support vectors. This hyperplane is a decision boundary that classifies various classes. It is built using support vectors, which are the outliers. The hyperplane which has the highest margin is selected as the decision boundary.

SVCs can classify linear as well as non-linear data using a kernel trick that implicitly maps the input to high-dimensional vector spaces. This kernel trick converts the lower-dimensional feature space into higher-dimensional feature space which is linearly separable. For example, data in a 2D may not be linearly separable but when it is converted into 3D using the kernel function it becomes linearly separable.

SVC has three main parameters that affect the performance of the model which are the kernel, gamma, and C. The kernel parameter signifies the type of kernel which can be “Linear” for linearly separable data or “RBF”, or “poly” for non-linearly separable data. The Gamma parameter is the kernel coefficient. As the value of gamma increases, it tries to exactly fit the dataset which gives generalization error and causes overfitting. C parameter is the cost of misclassification of the model. The high value of C gives you low bias and high variance whereas the low value of C gives you high bias and low variance.

Step 5:

Model Evaluation and Flask code

```
# Evaluating using accuracy_score metric
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(Y_test, Y_pred)print("Accuracy: " + str(accuracy
* 100))
```

Output:

```
Accuracy: 73.37662337662337# Confusion matrix
```

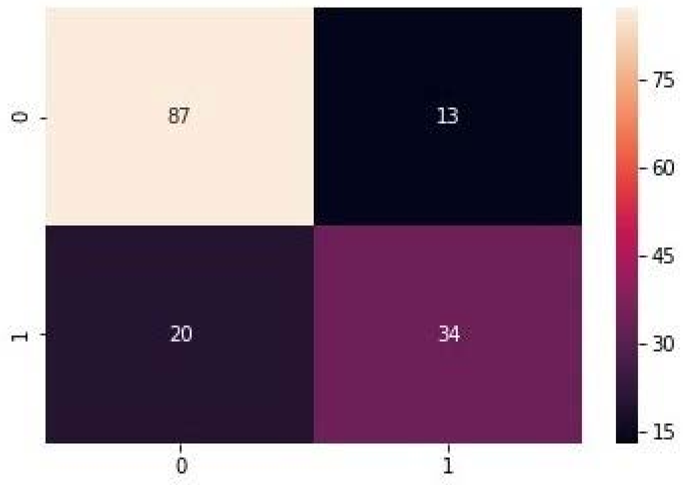
```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(Y_test, Y_pred)
cm
```

Output:

```
array([[87, 13],
       [20, 34]], dtype=int64)
```

```
# Heatmap of Confusion matrix
sns.heatmap(pd.DataFrame(cm), annot=True)
```

Output:



Heatmap of Confusion Matrix

```
# Classification report

from sklearn.metrics import classification_report
print(classification_report(Y_test, Y_pred))
```

```
Output:
              precision    recall  f1-score   support

         0.0       0.81      0.87      0.84       100
         1.0       0.72      0.63      0.67        54

   micro avg       0.79      0.79      0.79       154
   macro avg       0.77      0.75      0.76       154
weighted avg       0.78      0.79      0.78       154
```

We have chosen three metrics accuracy_score, confusion matrix, and classification report for evaluating our model.

Flask code:

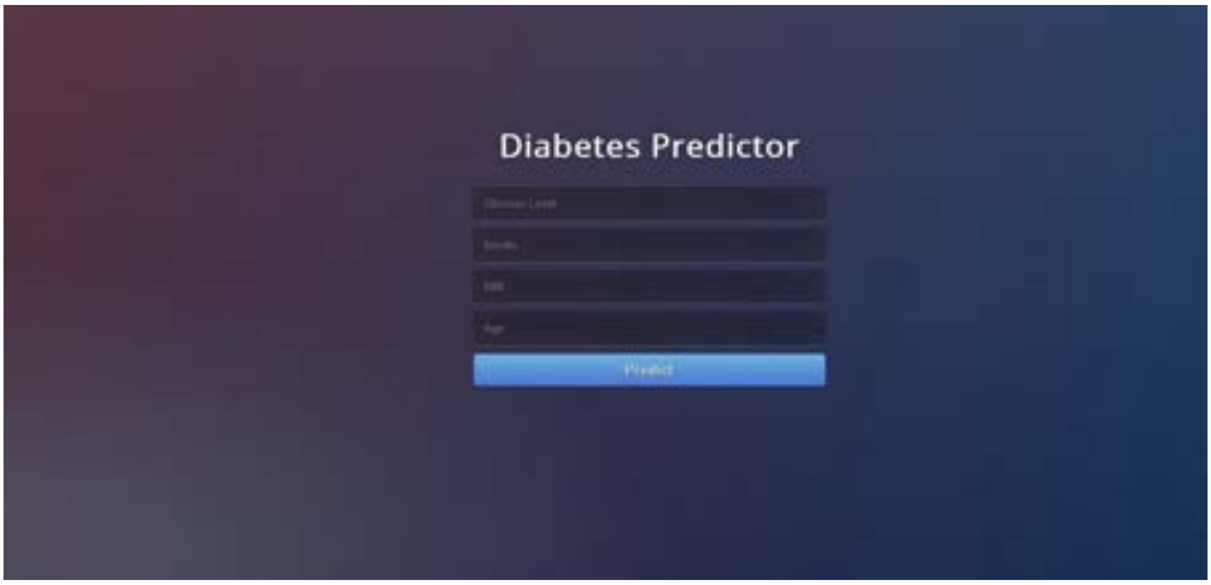
```
import numpy as np

import pandas as pd

from flask import Flask, request, jsonify, render_template

import pickle


app = Flask(__name__)

model = pickle.load(open('model.pkl', 'rb'))


dataset = pd.read_csv('diabetes.csv')


dataset_X = dataset.iloc[:,[1, 2, 5, 7]].values


from sklearn.preprocessing import MinMaxScaler

sc = MinMaxScaler(feature_range = (0,1))

dataset_scaled = sc.fit_transform(dataset_X)
```

```
@app.route('/')

def home():

    return render_template('index.html')


@app.route('/predict',methods=['POST'])

def predict():

    '''

    For rendering results on HTML GUI

    '''

    float_features = [float(x) for x in request.form.values()]

    final_features = [np.array(float_features)]

    prediction = model.predict( sc.transform(final_features) )


    if prediction == 1:

        pred = "You have Diabetes, please consult a Doctor."

    elif prediction == 0:

        pred = "You don't have Diabetes."

    output = pred


    return render_template('index.html',
prediction_text='{}'.format(output))


if __name__ == "__main__":

    app.run(debug=True)
```

Step 6:

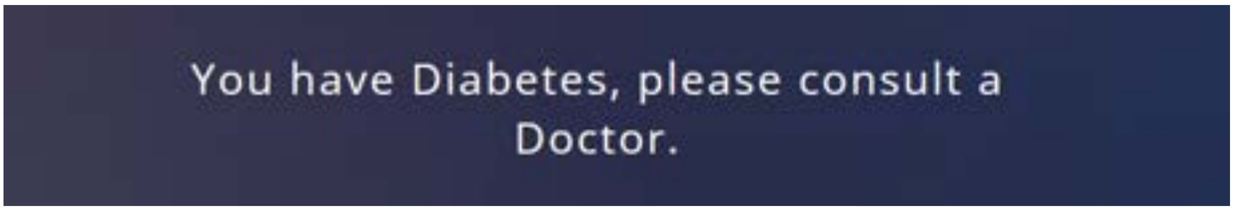
Model Deployment

http://127.0.0.1:5000/



For input [150,0,35,45]

Output:



You have Diabetes, please consult a Doctor.

Results:

Machine learning algorithm report-

Model	score
SVC	**0.81**
Logistic Regression	**0.81**
Decision Tree	**0.80**
Random Forest	**0.75**
GaussionNB	**0.73**
KNN	**0.72**
XGBoot	**0.74**

SVC classification report-

```
             precision    recall  f1-score   support

        0.0       0.81      0.87      0.84       100
        1.0       0.72      0.63      0.67        54

  micro avg       0.79      0.79      0.79       154
  macro avg       0.77      0.75      0.76       154
weighted avg      0.78      0.79      0.78       154
```

Conclusion:

In this project, seven machine learning classification methods were implemented, and their results were compared with different statistical measures. various machine learning algorithms are applied to the data set and the classification has been done using various algorithms of which Logistic Regression and support vector machine gives the highest accuracy of 81%. It is clear that the model improves the accuracy and precision of diabetes prediction with this data set. Further, this work can be extended to find how likely non-diabetic people can have diabetes in the next few years.