Diabetes Classification and Prediction

Predict whether a person has diabetes or not.

Dataset Link: https://www.kaggle.com/johndasilva/diabetes

```
# Importing essential libraries
import numpy as np
import pandas as pd

# Loading the dataset
df = pd.read_csv('diabetes.csv')
```

Exploring the dataset

```
# Returns number of rows and columns of the dataset
df.shape
```

```
(2000, 9)
```

```
# Returns an object with all of the column headers
df.columns
```

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

```
# Returns different datatypes for each columns (float, int, string, bool,
etc.)
df.dtypes
```

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

```
# Returns the first x number of rows when head(num). Without a number it
returns 5
df.head()
```

```
# Returns basic information on all columns
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2000 entries, 0 to 1999
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Pregnancies               2000 non-null   int64  
 1   Glucose                   2000 non-null   int64  
 2   BloodPressure             2000 non-null   int64  
 3   SkinThickness             2000 non-null   int64  
 4   Insulin                   2000 non-null   int64  
 5   BMI                       2000 non-null   float64
 6   DiabetesPedigreeFunction  2000 non-null   float64
 7   Age                       2000 non-null   int64  
 8   Outcome                   2000 non-null   int64  
dtypes: float64(2), int64(7)
memory usage: 140.8 KB
```

```
# Returns basic statistics on numeric columns
df.describe().T
```

```
# Returns true for a column having null values, else false
df.isnull().any()
```

```
Pregnancies                 False
Glucose                     False
BloodPressure               False
SkinThickness               False
Insulin                     False
BMI                         False
DiabetesPedigreeFunction    False
Age                         False
Outcome                     False
dtype: bool
```

```
df = df.rename(columns={'DiabetesPedigreeFunction':'DPF'})
df.head()
```

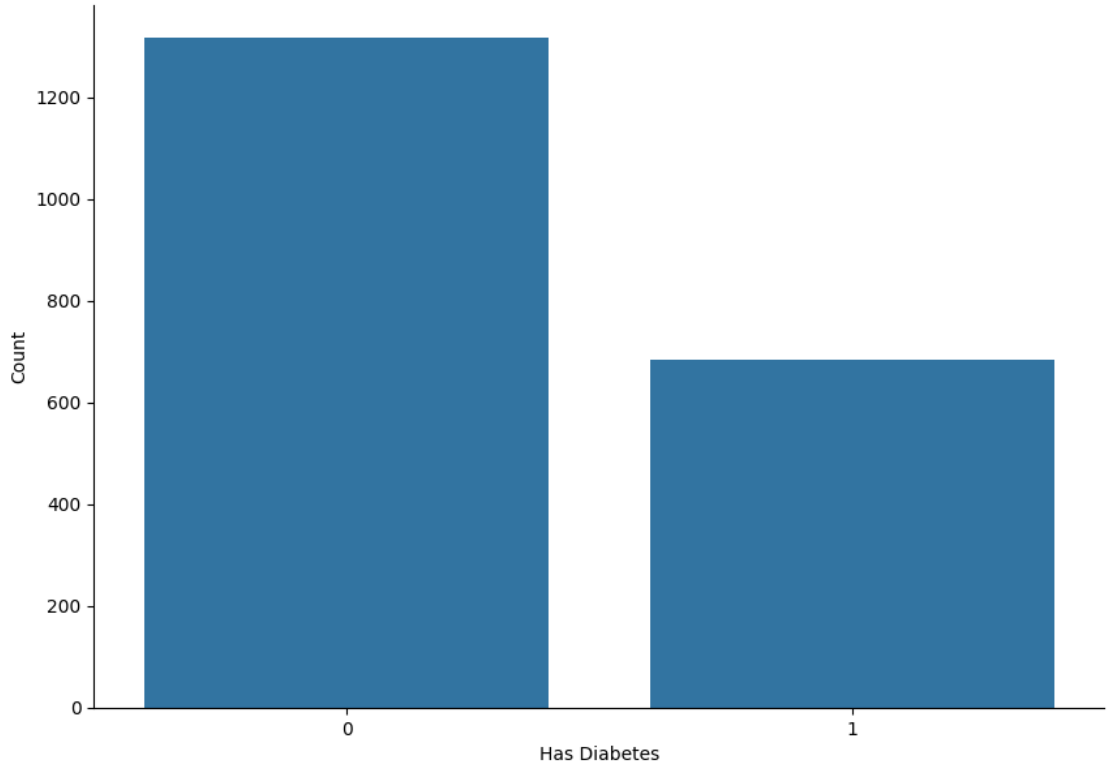
```
# Importing essential libraries for visualization
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
# Plotting the Outcomes based on the number of dataset entries
plt.figure(figsize=(10,7))
sns.countplot(x='Outcome', data=df)
```

```
# Removing the unwanted spines
plt.gca().spines['top'].set_visible(False)
plt.gca().spines['right'].set_visible(False)
```

```
plt.xlabel('Has Diabetes')
plt.ylabel('Count')

plt.show()
```

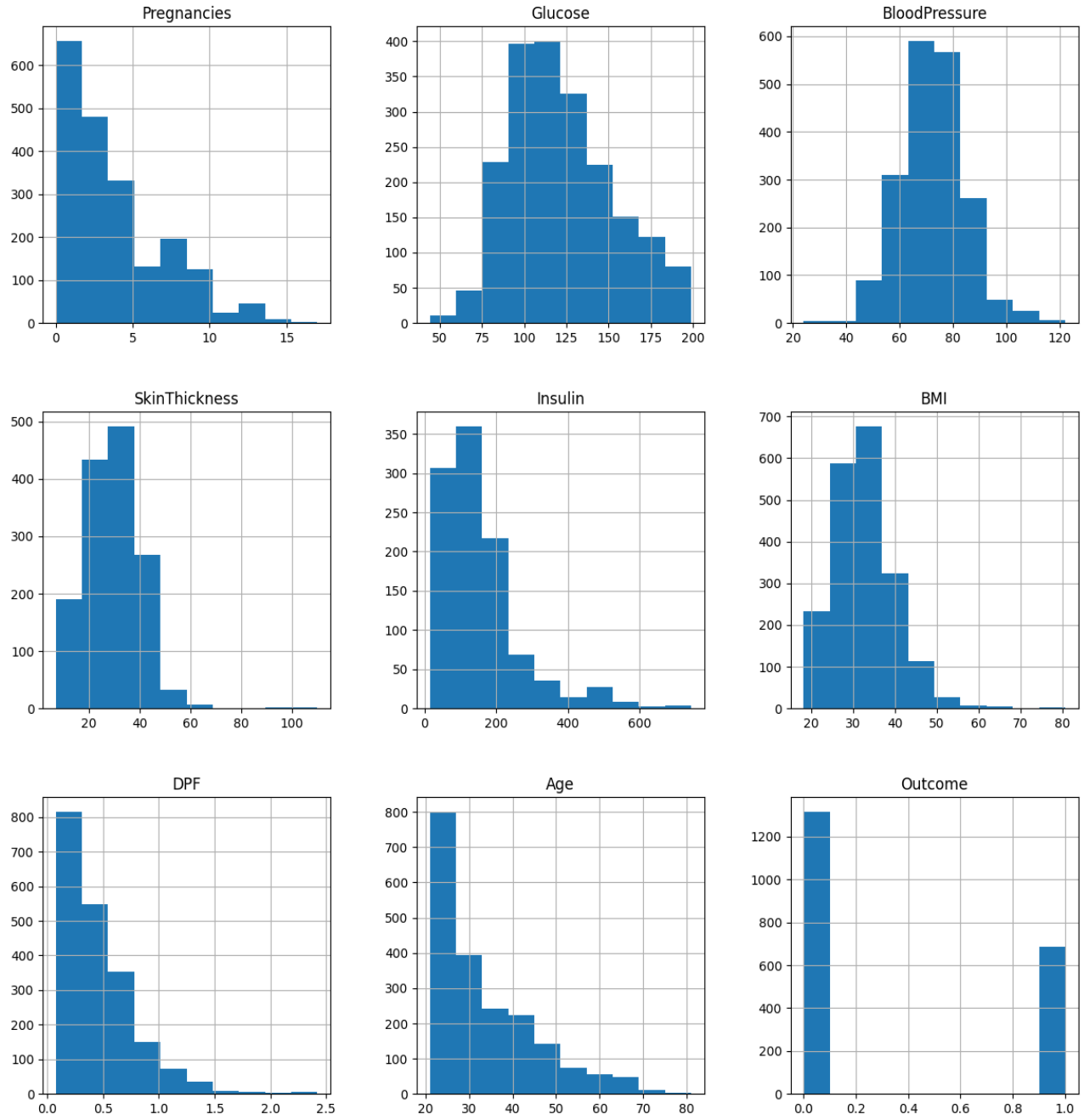


Data Cleaning

```
# Replacing the 0 values from
['Glucose','BloodPressure','SkinThickness','Insulin','BMI'] by NaN
df_copy = df.copy(deep=True)
df_copy[['Glucose','BloodPressure','SkinThickness','Insulin','BMI']] =
df_copy[['Glucose','BloodPressure','SkinThickness','Insulin','BMI']].replace(
0,np.nan)
df_copy.isnull().sum()
```

```
Pregnancies        0
Glucose           13
BloodPressure     90
SkinThickness    573
Insulin          956
BMI               28
DPF                0
Age                0
Outcome            0
dtype: int64
```

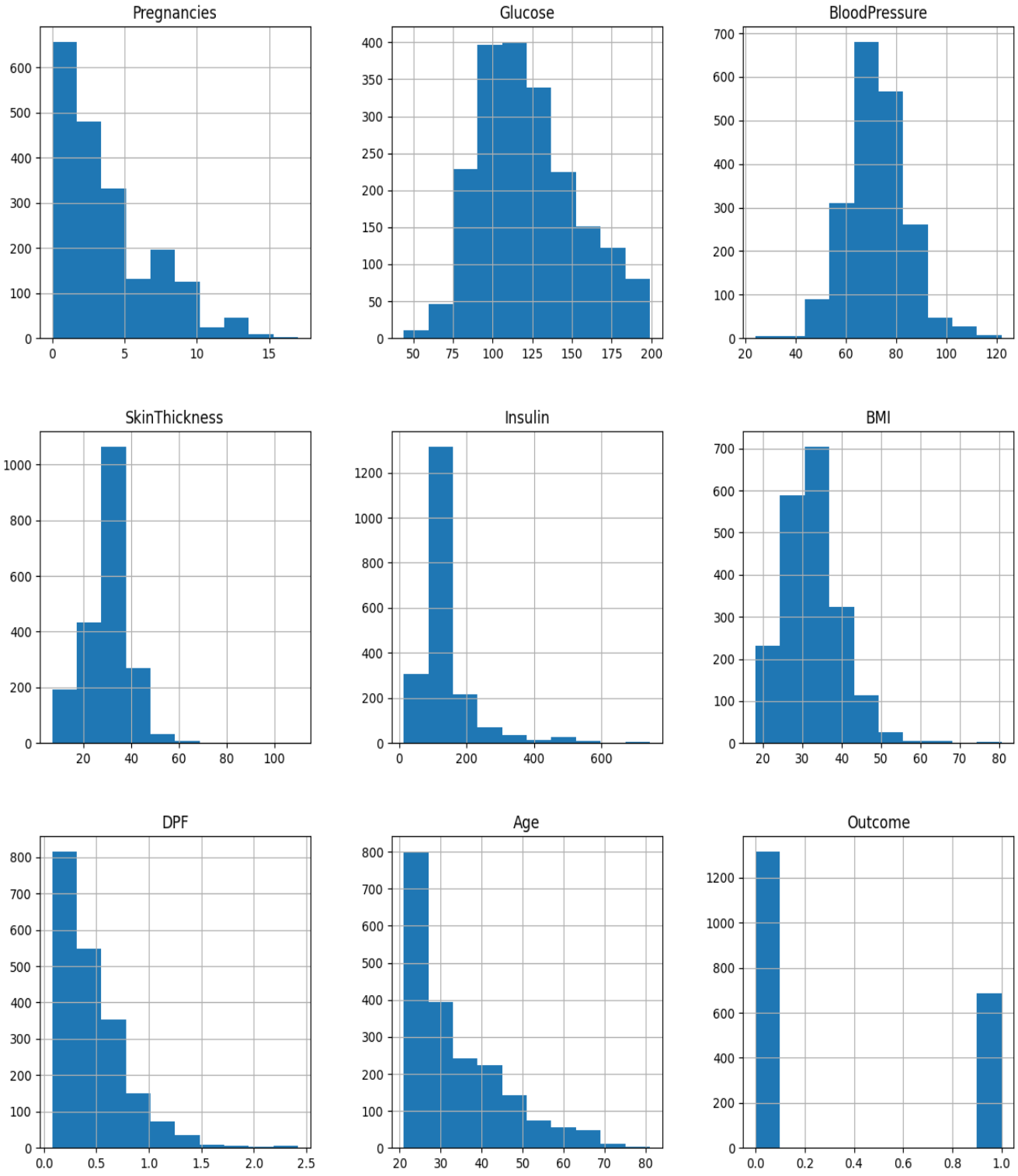
```
# To fill these Nan values the data distribution needs to be understood
# Plotting histogram of dataset before replacing NaN values
p = df_copy.hist(figsize = (15,15))
```




```
# Replacing NaN value by mean, median depending upon distribution
df_copy['Glucose'].fillna(df_copy['Glucose'].mean(), inplace=True)
df_copy['BloodPressure'].fillna(df_copy['BloodPressure'].mean(),
inplace=True)
df_copy['SkinThickness'].fillna(df_copy['SkinThickness'].median(),
inplace=True)
```

```
df_copy['Insulin'].fillna(df_copy['Insulin'].median(), inplace=True)
df_copy['BMI'].fillna(df_copy['BMI'].median(), inplace=True)

# Plotting histogram of dataset after replacing NaN values
p = df_copy.hist(figsize=(15,15))
```



```
df_copy.isnull().sum()
```

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

Model Building

```
from sklearn.model_selection import train_test_split

X = df.drop(columns='Outcome')
y = df['Outcome']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20,
random_state=0)
print('X_train size: {}, X_test size: {}'.format(X_train.shape,
X_test.shape))
```

```
X_train size: (1600, 8), X_test size: (400, 8)
```

```
# Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)

# Using GridSearchCV to find the best algorithm for this problem
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import ShuffleSplit
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC

# Creating a function to calculate best model for this problem
def find_best_model(X, y):
    models = {
        'logistic_regression': {
            'model': LogisticRegression(solver='lbfgs', multi_class='auto'),
            'parameters': {
                'C': [1,5,10]
              }
        },
```

```
        'decision_tree': {
            'model': DecisionTreeClassifier(splitter='best'),
            'parameters': {
                'criterion': ['gini', 'entropy'],
                'max_depth': [5,10]
            }
        },

        'random_forest': {
            'model': RandomForestClassifier(criterion='gini'),
            'parameters': {
                'n_estimators': [10,15,20,50,100,200]
            }
        },

        'svm': {
            'model': SVC(gamma='auto'),
            'parameters': {
                'C': [1,10,20],
                'kernel': ['rbf','linear']
            }
        }

    }

    scores = []
    cv_shuffle = ShuffleSplit(n_splits=5, test_size=0.20, random_state=0)

    for model_name, model_params in models.items():
        gs = GridSearchCV(model_params['model'], model_params['parameters'],
cv = cv_shuffle, return_train_score=False)
        gs.fit(X, y)
        scores.append({
            'model': model_name,
            'best_parameters': gs.best_params_,
            'score': gs.best_score_
        })

    return pd.DataFrame(scores, columns=['model','best_parameters','score'])

find_best_model(X_train, y_train)
```

Note: Since the Random Forest algorithm has the highest accuracy, we futher fine tune the model using hyperparameter optimization.

```
# Using cross_val_score for gaining average accuracy
from sklearn.model_selection import cross_val_score
scores = cross_val_score(RandomForestClassifier(n_estimators=20,
random_state=0), X_train, y_train, cv=5)
print('Average Accuracy : {}%'.format(round(sum(scores)*100/len(scores)), 3))
```

Average Accuracy : 95%

```
# Creating Random Forest Model
classifier = RandomForestClassifier(n_estimators=20, random_state=0)
classifier.fit(X_train, y_train)
```

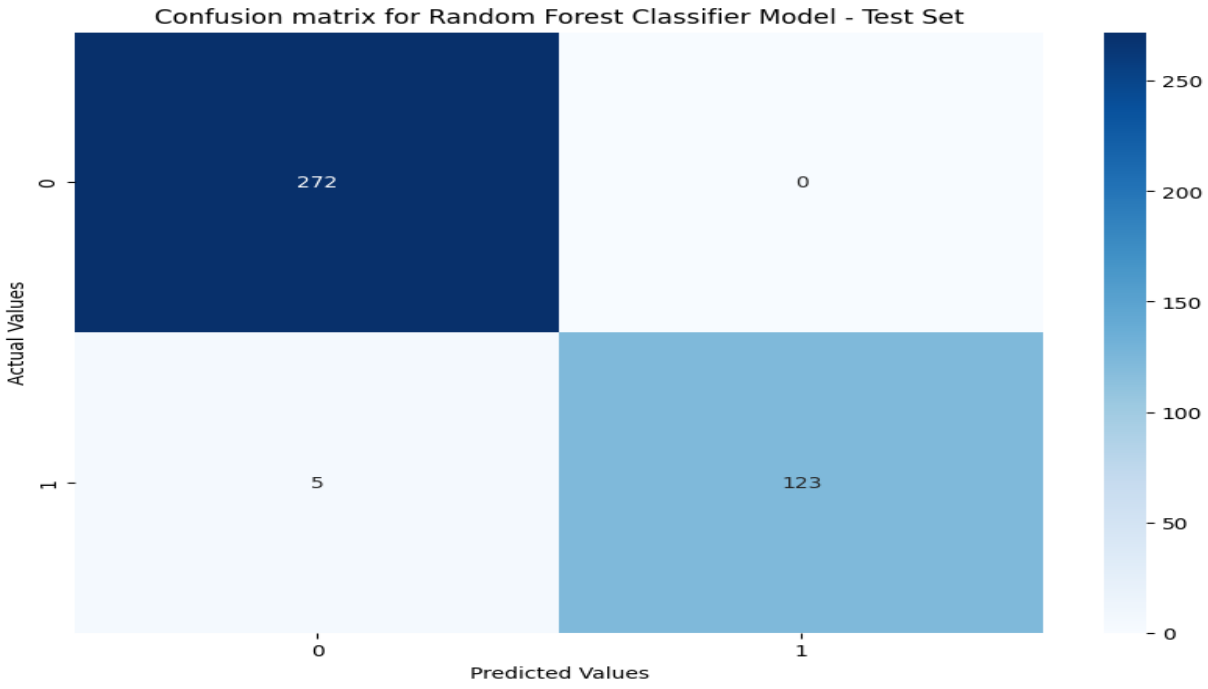
```
RandomForestClassifier(n_estimators=20, random_state=0)
```

Model Evaluation

```
# Creating a confusion matrix
from sklearn.metrics import confusion_matrix, classification_report,
accuracy_score
y_pred = classifier.predict(X_test)
cm = confusion_matrix(y_test, y_pred)
cm
```

```
array([[272,   0],
       [  5, 123]])
```

```
# Plotting the confusion matrix
plt.figure(figsize=(10,7))
p = sns.heatmap(cm, annot=True, cmap="Blues", fmt='g')
plt.title('Confusion matrix for Random Forest Classifier Model - Test Set')
plt.xlabel('Predicted Values')
plt.ylabel('Actual Values')
plt.show()
```



```
# Accuracy Score
score = round(accuracy_score(y_test, y_pred),4)*100
print("Accuracy on test set: {}%".format(score))
```

```
Accuracy on test set: 98.75%
```

```
# Classification Report
print(classification_report(y_test, y_pred))
```

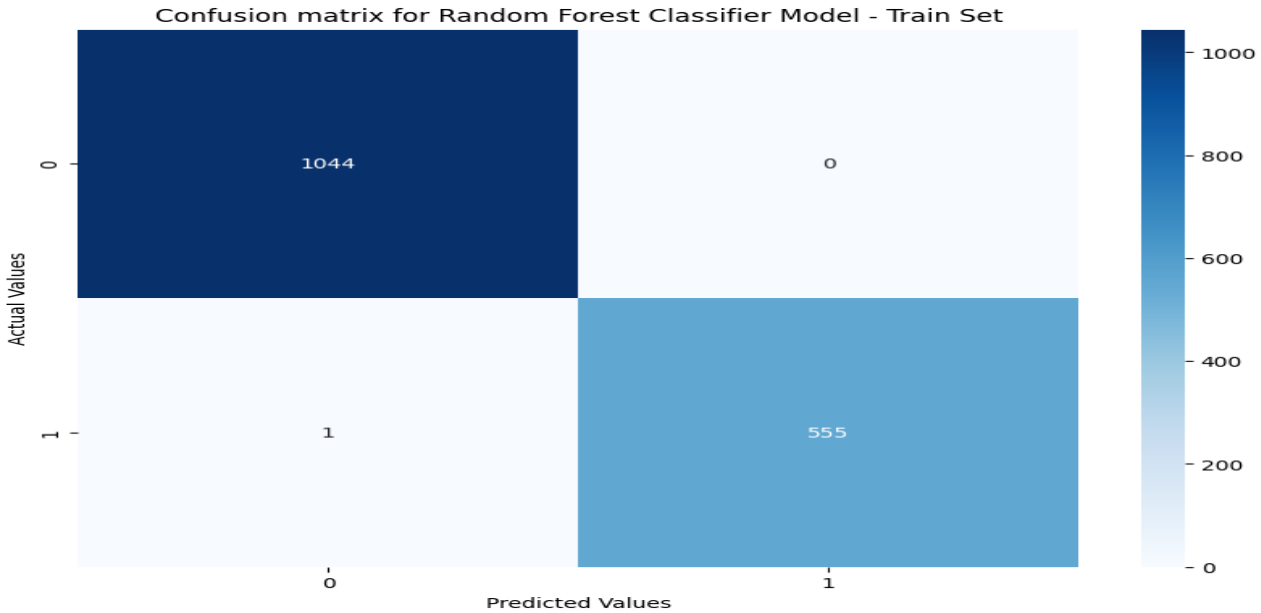
```
              precision    recall  f1-score   support

           0       0.98      1.00      0.99       272
           1       1.00      0.96      0.98       128

    accuracy                           0.99       400
   macro avg       0.99      0.98      0.99       400
weighted avg       0.99      0.99      0.99       400
```

```
# Creating a confusion matrix for training set
y_train_pred = classifier.predict(X_train)
cm = confusion_matrix(y_train, y_train_pred)

# Plotting the confusion matrix
plt.figure(figsize=(10,7))
p = sns.heatmap(cm, annot=True, cmap="Blues", fmt='g')
plt.title('Confusion matrix for Random Forest Classifier Model - Train Set')
plt.xlabel('Predicted Values')
plt.ylabel('Actual Values')
plt.show()
```



```
# Accuracy Score
score = round(accuracy_score(y_train, y_train_pred),4)*100
print("Accuracy on trainning set: {}%".format(score))
```

```
Accuracy on trainning set: 99.94%
```

```
# Classification Report
print(classification_report(y_train, y_train_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      1044
           1       1.00      1.00      1.00       556

    accuracy                           1.00      1600
   macro avg       1.00      1.00      1.00      1600
weighted avg       1.00      1.00      1.00      1600
```

Predictions

```
# Creating a function for prediction
def predict_diabetes(Pregnancies, Glucose, BloodPressure, SkinThickness,
Insulin, BMI, DPF, Age):
    preg = int(Pregnancies)
    glucose = float(Glucose)
    bp = float(BloodPressure)
    st = float(SkinThickness)
    insulin = float(Insulin)
    bmi = float(BMI)
    dpf = float(DPF)
    age = int(Age)

    x = [[preg, glucose, bp, st, insulin, bmi, dpf, age]]
    x = sc.transform(x)

    return classifier.predict(x)
```

```
# Prediction 1
# Input sequence: Pregnancies, Glucose, BloodPressure, SkinThickness,
Insulin, BMI, DPF, Age
prediction = predict_diabetes(2, 81, 72, 15, 76, 30.1, 0.547, 25)[0]
if prediction:
  print('So Sorry! You have diabetes.')
else:
  print("Great! You don't have diabetes.")
```

```
Great! You don't have diabetes.
```

```
# Prediction 2
# Input sequence: Pregnancies, Glucose, BloodPressure, SkinThickness,
Insulin, BMI, DPF, Age
prediction = predict_diabetes(1, 117, 88, 24, 145, 34.5, 0.403, 40)[0]
if prediction:
  print('So Sorry! You have diabetes.')
else:
  print("Great! You don't have diabetes.")
```

```
So Sorry! You have diabetes.
```

```
# Prediction 2
# Input sequence: Pregnancies, Glucose, BloodPressure, SkinThickness,
Insulin, BMI, DPF, Age
prediction = predict_diabetes(5, 120, 92, 10, 81, 26.1, 0.551, 67)[0]
if prediction:
  print('So Sorry! You have diabetes.')
else:
  print("Great! You don't have diabetes.")
```

```
Great! You don't have diabetes.
```