```
import pandas as pd
import numpy as np
from sklearn import svm
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split, cross_val_predict
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from imblearn.over_sampling import SMOTENC
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import classification_report, accuracy_score, recall_score, precision_score, confusion_matrix, roc_curve, roc_auc_score,
import imblearn
from sklearn.metrics import confusion_matrix
import warnings
warnings.filterwarnings('ignore')
plt.style.use('fivethirtyeight')


data=pd.read_csv('Dataset Diabetes Type1 (Total)-11.csv')


data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 306 entries, 0 to 305
Data columns (total 17 columns):
 #   Column                                  Non-Null Count  Dtype
---  ------                                  --------------  -----
 0   Age                                     306 non-null    object
 1   Sex                                     306 non-null    object
 2   Height                                  306 non-null    float64
 3   Weight                                  306 non-null    float64
 4   BMI                                     306 non-null    float64
 5   Adequate Nutrition                      306 non-null    object
 6   Adequate Nutrition .1                   306 non-null    object
 7   Education of Mother                     306 non-null    object
 8   Autoantibodies                          306 non-null    object
 9   Impaired glucose metabolism             306 non-null    object
 10  Insulin taken                           306 non-null    object
 11  How Taken                               306 non-null    object
 12  Family History affected in Type 1 Diabetes  306 non-null    object
 13  Family History affected in Type 2 Diabetes  306 non-null    object
 14  Hypoglycemis                            306 non-null    object
 15  pancreatic disease affected in child    306 non-null    object
 16  Affected                                306 non-null    object
dtypes: float64(3), object(14)
memory usage: 40.8+ KB
```

```
print("Number of null values :" , data.isnull().sum().sum())
```

```
Number of null values : 0
```

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

	Age	Sex	Height	Weight	BMI	Adequate Nutrition	Adequate Nutrition .1	Educ of M

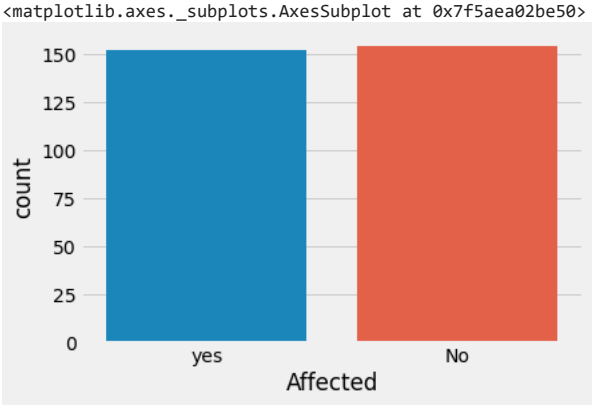
```
{ column: len(data[column].unique())for column in data.columns}
```

```
{'Age': 4,
 'Sex': 2,
 'Height': 71,
 'Weight': 68,
 'BMI': 257,
 'Adequate Nutrition ': 2,
 'Adequate Nutrition .1': 2,
 'Education of Mother': 2,
 'Autoantibodies': 2,
 'Impaired glucose metabolism ': 2,
 'Insulin taken': 2,
 'How Taken': 2,
 'Family History affected in Type 1 Diabetes': 2,
 'Family History affected in Type 2 Diabetes': 2,
 'Hypoglycemis': 2,
 'pancreatic disease affected in child ': 2,
 'Affected': 2}
```

75%	NaN	NaN	1.560000	50.000000	23.711124	NaN	NaN	

```
sns.countplot(x='Affected',data=data)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5aea02be50>
```




```
def preprocessing(df):
    df= df.copy()

    # Gender column Binary Encoding
    df['Sex'] = df ['Sex'].replace({'Female':0,'Male':1 })
    df['Age'] = df ['Age'].replace({'Less then 11': 10, 'Less then 15': 13, 'greater then 15': 50, 'Less then 5': 4})


    #Symptom Column Binary Encoding
    for column in df.columns.drop(['Age','Sex','Affected']):
     df[column]= df[column].replace({'No':0 , 'Yes': 1,'no':0,'none':1,'Injection':1})

    #train
    y=df["Affected"]
    X=df.drop("Affected", axis=1)

    #test_train_split
    X_train, X_test,y_train,y_test = train_test_split(X,y,train_size=0.7,shuffle=True,random_state=1)

    #StandardScaler
    scaler=StandardScaler()
    scaler.fit(X_train)
    X_train=pd.DataFrame(scaler.transform(X_train),index=X_train.index , columns=X_train.columns)
    X_test=pd.DataFrame(scaler.transform(X_test),index=X_test.index, columns=X_test.columns)

    return X_train,X_test,y_train,y_test


X_train,X_test,y_train,y_test= preprocessing(data)


X_train
```

	Age	Sex	Height	Weight	BMI	Adequate Nutrition	Adequate Nutrition .1	Educ of M
34	1.351707	-1.077783	0.668493	1.431559	0.921028	0.588143	0.588143	-1.3
191	-0.590023	0.927831	0.489223	0.348293	-0.123582	0.588143	0.588143	0.7
261	-0.747460	0.927831	-2.630075	-1.457150	3.118825	0.588143	0.588143	0.7
150	-0.747460	-1.077783	0.345807	0.589019	0.382639	-1.700267	-1.700267	0.7
208	-0.590023	0.927831	0.560931	1.852829	1.609675	0.588143	0.588143	0.7
...	...	...	...	...	...	...	...	
203	-0.747460	-1.077783	-0.909083	-1.096061	-0.594160	0.588143	0.588143	0.7
255	-0.590023	0.927831	-0.622251	-0.554428	0.101334	0.588143	0.588143	0.7
72	1.351707	-1.077783	0.632639	2.755550	2.541192	-1.700267	-1.700267	-1.3
235	-0.747460	-1.077783	-0.801521	-0.915517	-0.355112	0.588143	0.588143	0.7
37	-0.590023	0.927831	0.274099	0.950107	0.980669	-1.700267	-1.700267	-1.3

214 rows × 16 columns

```
y_test
```

```
89     yes
58     yes
70     yes
305     No
112    yes
      ...
107    yes
106    yes
67     yes
139    yes
188     No
Name: Affected, Length: 92, dtype: object
```

```
model=SVC().fit(X_train,y_train)
print('SVC(): trained')
```

```
SVC(): trained
```

```
print("Accuracy of SVM: {:.2f}%".format(model.score(X_test,y_test) * 100))
```

```
Accuracy of SVM: 100.00%
```

```
scaler = StandardScaler()
```

```
#X=df.drop("Affected", axis=1)
scaler.fit(X_train)
```

```
StandardScaler()
```

```
standardized_data = scaler.transform(X_train)
```

```
print(standardized_data)
```

```
[[ 1.35170653 -1.07778298  0.66849275 ... -0.94541277  1.44963764
  -0.57375304]
 [-0.59002284  0.92783057  0.48922277 ... -0.94541277 -0.68982756
  -0.57375304]
 [-0.74746036  0.92783057 -2.63007499 ... -0.94541277 -0.68982756
  -0.57375304]
 ...
 [ 1.35170653 -1.07778298  0.63263875 ... -0.94541277  1.44963764
  -0.57375304]
 [-0.74746036 -1.07778298 -0.80152113 ...  1.05773904 -0.68982756
  -0.57375304]
```

```
        [-0.59002284  0.92783057  0.27409878 ...  1.05773904  1.44963764
          1.74291017]]
```

```
X = standardized_data
Y = data['Affected']
```

```
print(X)
print(Y)
```

```
     [[ 1.35170653 -1.07778298  0.66849275 ... -0.94541277  1.44963764
       -0.57375304]
      [-0.59002284  0.92783057  0.48922277 ... -0.94541277 -0.68982756
       -0.57375304]
      [-0.74746036  0.92783057 -2.63007499 ... -0.94541277 -0.68982756
       -0.57375304]
      ...
      [ 1.35170653 -1.07778298  0.63263875 ... -0.94541277  1.44963764
       -0.57375304]
      [-0.74746036 -1.07778298 -0.80152113 ...  1.05773904 -0.68982756
       -0.57375304]
      [-0.59002284  0.92783057  0.27409878 ...  1.05773904  1.44963764
        1.74291017]]
     0      yes
     1      yes
     2      yes
     3      yes
     4      yes
           ...
     301     No
     302     No
     303     No
     304     No
     305     No
     Name: Affected, Length: 306, dtype: object
```

```
classifier = svm.SVC(kernel='linear')
```

```
classifier.fit(X_train, y_train)
```

```
     SVC(kernel='linear')
```

```
data.drop("Affected", axis=1)
```

	Age	Sex	Height	Weight	BMI	Adequate Nutrition	Adequate Nutrition .1	Education of Mother	Au
0	greater then 15	Female	1.50	56.0	24.888889	No	No	No	

greater

```
input_data = (50,0,1.4,45,22.95918367,0,0,0,0,0,1,1,0,0,1,1)

# changing the input_data to numpy array
input_data_as_numpy_array = np.asarray(input_data)

# reshape the array as we are predicting for one instance
input_data_reshaped = input_data_as_numpy_array.reshape(1,-1)

# standardize the input data
std_data = scaler.transform(input_data_reshaped)
print(std_data)

prediction = classifier.predict(std_data)
print(prediction)

if (prediction[0] == 'no'):
  print('The person is not diabetic')
else:
  print('The person is type-1 diabetic')
```

```
[[ 5.00000000e+01 -1.66014658e-17  1.40000000e+00  4.50000000e+01
   2.29591837e+01  5.81051303e-17  5.81051303e-17  1.24510993e-17
  -5.39547638e-17  2.49021987e-17  1.00000000e+00  1.00000000e+00
  -3.32029316e-17  3.32029316e-17  1.00000000e+00  1.00000000e+00]]
['yes']
The person is type-1 diabetic
```

11

then 5

```
data1=pd.read_csv('diabetes_dataset__2019_Type2.csv')
```

```
for col in data1.columns:
    print(col)
    print(data1[col].value_counts())
    print(f'-'*20)
```

```
Age
less than 40    488
40-49           164
50-59           156
60 or older     144
Name: Age, dtype: int64
--------------------
Gender
Male      580
Female    372
Name: Gender, dtype: int64
--------------------
Family_Diabetes
no     498
yes    454
Name: Family_Diabetes, dtype: int64
--------------------
highBP
no     724
yes    228
Name: highBP, dtype: int64
--------------------
PhysicallyActive
less than half an hr    336
more than half an hr    272
one hr or more          212
none                    132
Name: PhysicallyActive, dtype: int64
--------------------
BMI
```

```
24.0    111
21.0     88
23.0     76
28.0     71
26.0     66
33.0     64
27.0     63
22.0     58
20.0     48
19.0     36
25.0     34
30.0     33
18.0     32
29.0     28
38.0     28
36.0     20
17.0     16
32.0     16
31.0     16
34.0     12
35.0     12
15.0      8
39.0      4
40.0      4
42.0      3
45.0      1
Name: BMI, dtype: int64
```

```
data1['RegularMedicine'].replace('o','no', inplace=True)
data1['BPLevel'] = data1['BPLevel'].str.lower().str.strip()
data1['Pdiabetes'].replace('0', 'no', inplace=True)
data1['Diabetic'] = data1['Diabetic'].str.strip()
# there is nan value at pregancies column where gender is male
# if these values are replaced with 0, there's only 26 values, so all nan values will be replaced with 0.
data1[data1['Gender']=='Male']['Pregancies'].isna().sum()
```

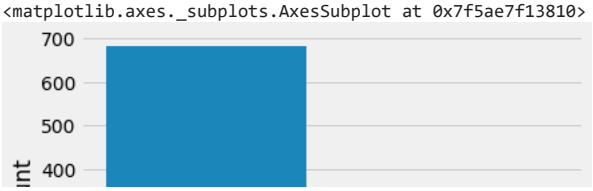
```
16
```

```
data1['Pregancies'].replace(np.nan, 0, inplace=True)
# will drop all na's
data1.dropna(inplace=True)
data1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 947 entries, 0 to 951
Data columns (total 18 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   Age               947 non-null    object 
 1   Gender            947 non-null    object 
 2   Family_Diabetes   947 non-null    object 
 3   highBP            947 non-null    object 
 4   PhysicallyActive  947 non-null    object 
 5   BMI               947 non-null    float64
 6   Smoking           947 non-null    object 
 7   Alcohol           947 non-null    object 
 8   Sleep             947 non-null    int64  
 9   SoundSleep        947 non-null    int64  
 10  RegularMedicine   947 non-null    object 
 11  JunkFood          947 non-null    object 
 12  Stress            947 non-null    object 
 13  BPLevel           947 non-null    object 
 14  Pregancies        947 non-null    float64
 15  Pdiabetes         947 non-null    object 
 16  UriationFreq      947 non-null    object 
 17  Diabetic          947 non-null    object 
dtypes: float64(2), int64(2), object(14)
memory usage: 140.6+ KB
```

```
sns.countplot(x='Diabetic',data=data1)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5ae7f13810>
```




```
num_cols = ['BMI', 'Sleep', 'SoundSleep', 'Pregancies']
category_cols = list(set(data1.columns).difference(set(num_cols)))

data_clean = pd.DataFrame()
for col in num_cols:
    data_clean[col] = data1[col].astype('int')

for col in category_cols:
    data_clean[col] = data1[col].astype('category')

# categorical variables in pandas is a little tricky.
# I want to order the categorical variables according to the risks.
data_clean['Age'] = pd.Categorical(data1['Age'], ordered=True,
                                   categories=['less than 40', '40-49', '50-59', '60 or older'])
data_clean['PhysicallyActive'] = pd.Categorical(data1['PhysicallyActive'], ordered=True,
                                                categories=['one hr or more', 'more than half an hr', 'less than half an hr', 'none'])
data_clean['JunkFood'] = pd.Categorical(data1['JunkFood'], ordered=True, categories=['occasionally', 'often', 'very often', 'always'])
data_clean['BPLevel'] = pd.Categorical(data1['BPLevel'], ordered=True,
                                       categories=['low', 'normal', 'high'])
data_clean['Stress'] = pd.Categorical(data1['Stress'], ordered=True,
                                      categories=['not at all', 'sometimes', 'very often', 'always'])

# sklearn cannot map according to this order and so do it manually.
category_mapping = {
    'Age':{'less than 40':0, '40-49':1, '50-59':2, '60 or older':3},
    'Family_Diabetes':{'no':0, 'yes':1},
    'Gender':{'Female':0, 'Male':1},
    'Smoking':{'no':0, 'yes':1},
    'Pdiabetes':{'no':0, 'yes':1},
    'RegularMedicine':{'no':0, 'yes':1},
    'PhysicallyActive':{'one hr or more':0, 'more than half an hr':1, 'less than half an hr':2, 'none':3},
    'JunkFood':{'occasionally':0, 'often':1, 'very often':2, 'always':3},
    'BPLevel':{'low':0, 'normal':1, 'high':2},
    'highBP':{'no':0, 'yes':1},
    'Alcohol':{'no':0, 'yes':1},
    'UriationFreq':{'not much':0, 'quite often':1},
    'Stress':{'not at all':0, 'sometimes':1, 'very often':2, 'always':3},
    'Diabetic':{'no':0, 'yes':1},
}

for col in category_cols:
    data_clean[col] = data_clean[col].map(category_mapping[col])


data_clean.head()
```

	BMI	Sleep	SoundSleep	Pregancies	highBP	Alcohol	Stress	Family_Diabetes	Ag
0	39	8	6	0	1	0	1	0	
1	28	8	6	0	1	0	1	0	
2	24	6	6	0	0	0	1	0	
3	23	8	6	0	0	0	1	0	
4	27	8	8	0	0	0	1	0	

```
data_clean['Diabetic'].value_counts()
```

```
0    682
1    265
Name: Diabetic, dtype: int64
```

```
# split the data
x = data_clean.drop('Diabetic', axis=1)
Y = data_clean['Diabetic']
x_train, x_test, Y_train, Y_test = train_test_split(x, Y, test_size=0.2, random_state=123, stratify=Y)
```

```
print(Y_train.value_counts())
print(Y_test.value_counts())
```

```
0    545
1    212
Name: Diabetic, dtype: int64
0    137
1     53
Name: Diabetic, dtype: int64
```

```
# The data is imbalanced and I will use smote
def smote_data(x, Y):
    smotenc = SMOTENC(random_state = 123, categorical_features = list(range(4, 17)), n_jobs=-1)
    x_smote, Y_smote = smotenc.fit_resample(x, Y)
    return x_smote, Y_smote

x_train_smote, Y_train_smote = smote_data(x_train, Y_train)
x_test_smote, Y_test_smote = smote_data(x_test, Y_test)
```

```
print(Y_train_smote.value_counts())
print(Y_test_smote.value_counts())
```

```
0    545
1    545
Name: Diabetic, dtype: int64
0    137
1    137
Name: Diabetic, dtype: int64
```

```
def grid_search(X_tr, X_te, y_tr, y_te, model, params, scoring='recall'):
    gs = GridSearchCV(estimator = model, param_grid = params, scoring = scoring, n_jobs=-1, cv=3)
    gs.fit(X_tr, y_tr)
    y_pred = gs.predict(X_te)
    print(f"{model}")
    print(f"Best parameter      : {gs.best_params_}")
    print(f"Test Accuracy Score : {accuracy_score(y_te, y_pred)}")
    print(f"Train Accuracy Score: {accuracy_score(y_tr, gs.predict(X_tr))}")
    print(f"Recall score        : {recall_score(y_te, y_pred)}")
    print(f"Classification Report \n{'-'*30}\n {classification_report(y_te, y_pred)}")
    return gs.best_params_
```

```
model = SVC(random_state=123)
params = {
    'C' : [0.001, 0.01, 0.1, 1, 10],
    'kernel' : ['linear', 'poly', 'rbf', 'sigmoid'],
    'degree' : [2, 3, 4, 5]
}
svc_best = grid_search(x_train_smote, x_test, Y_train_smote, Y_test, model, params, scoring='accuracy')
```

```
SVC(random_state=123)
Best parameter      : {'C': 10, 'degree': 4, 'kernel': 'poly'}
Test Accuracy Score : 0.8526315789473684
Train Accuracy Score: 0.9100917431192661
Recall score        : 0.8867924528301887
Classification Report
------------------------------
              precision    recall  f1-score   support

           0       0.95      0.84      0.89       137
           1       0.68      0.89      0.77        53

    accuracy                           0.85       190
   macro avg       0.82      0.86      0.83       190
weighted avg       0.88      0.85      0.86       190
```

```
Scaler = StandardScaler()
```

```
Scaler.fit(x_train_smote)
```

```
StandardScaler()
```

```
standardized__data = Scaler.transform(x_train_smote)
```

```
K = standardized_data
Z = data1['Diabetic']


print(K)
print(Z)
```

```
     [[ 1.35170653 -1.07778298  0.66849275 ... -0.94541277  1.44963764
       -0.57375304]
      [-0.59002284  0.92783057  0.48922277 ... -0.94541277 -0.68982756
       -0.57375304]
      [-0.74746036  0.92783057 -2.63007499 ... -0.94541277 -0.68982756
       -0.57375304]
      ...
      [ 1.35170653 -1.07778298  0.63263875 ... -0.94541277  1.44963764
       -0.57375304]
      [-0.74746036 -1.07778298 -0.80152113 ...  1.05773904 -0.68982756
       -0.57375304]
      [-0.59002284  0.92783057  0.27409878 ...  1.05773904  1.44963764
        1.74291017]]
     0       no
     1       no
     2       no
     3       no
     4       no
           ...
     947    yes
     948    yes
     949     no
     950     no
     951    yes
     Name: Diabetic, Length: 947, dtype: object
```

```
Classifier = svm.SVC(kernel='linear')


Classifier.fit(x_train, Y_train)
```

```
     SVC(kernel='linear')
```

```
input__data = (2,1,1,1,2,28,0,0,6,1,2,1,1,0,0,0,0)

# changing the input_data to numpy array
input_data_numpyarray = np.asarray(input__data)

# reshape the array as we are predicting for one instance
input__datareshaped = input_data_numpyarray.reshape(1,-1)

# standardize the input data
std__data = Scaler.transform(input__datareshaped)
print(std__data)

predictions = Classifier.predict(std__data)
print(predictions)

if (predictions[0] == 1):
  print('The person is not diabetic')
else:
  print('The person is type-2 diabetic')
```

```
     [[-4.42941635 -4.6078873  -2.31735064  0.59222614  3.58193294 69.13886886
       -1.51338628 -1.14854209  4.19641672  0.97642461  1.42047285  0.82746517
       -0.34633289 -0.52338689 -0.68773031 -0.11812488 -0.36638118]]
     [0]
     The person is type-2 diabetic
```

```
if prediction[0]=='no' and predictions[0]==1:
  print("Result --> Patient is not diabetic")
if prediction[0]=='no' and predictions[0]==0:
  print("Result --> Patient is Type-2 diabetic")
if prediction[0]=='yes' and predictions[0]==1:
  print("Result --> Patient is Type-1 diabetic")
if prediction[0]=='yes' and predictions[0]==0:
  print("Result --> Pateint is Double diabetic")
```

```
     Result --> Pateint is Double diabetic
```