diabetes prediction using ML

November 11, 2021

[1]:
```
#!pip install pandas
#!pip install matplotlib.pyplot
#!pip install scikit-learn
#!pip install sklearn.prepocessing

import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
df=pd.read_csv(r'D:\diabetes.csv')
```

[3]:
```
df.head()
```

[3]:

	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

1 Exploratory data analysis

[4]:
```
df.shape
```

[4]:
```
(768, 9)
```

[5]:
```
df.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
```

[6]:
```
df.isnull().sum()
```

[6]:
```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

[7]:
```
df.describe()
```

[7]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	\
count	768.000000	768.000000	768.000000	768.000000	768.000000	
mean	3.845052	120.894531	69.105469	20.536458	79.799479	
std	3.369578	31.972618	19.355807	15.952218	115.244002	
min	0.000000	0.000000	0.000000	0.000000	0.000000	
25%	1.000000	99.000000	62.000000	0.000000	0.000000	
50%	3.000000	117.000000	72.000000	23.000000	30.500000	
75%	6.000000	140.250000	80.000000	32.000000	127.250000	
max	17.000000	199.000000	122.000000	99.000000	846.000000	

	BMI	DiabetesPedigreeFunction	Age	Outcome
count	768.000000	768.000000	768.000000	768.000000
mean	31.992578	0.471876	33.240885	0.348958
std	7.884160	0.331329	11.760232	0.476951
min	0.000000	0.078000	21.000000	0.000000
25%	27.300000	0.243750	24.000000	0.000000
50%	32.000000	0.372500	29.000000	0.000000
75%	36.600000	0.626250	41.000000	1.000000
max	67.100000	2.420000	81.000000	1.000000

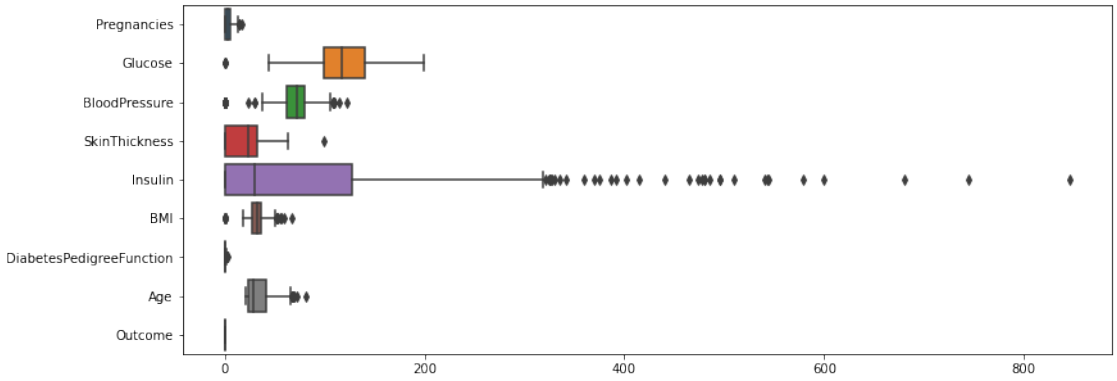
[8]:
```
df['Outcome'].value_counts()
```

[8]:
```
0    500
1    268
Name: Outcome, dtype: int64
```

[ ]:
```

```

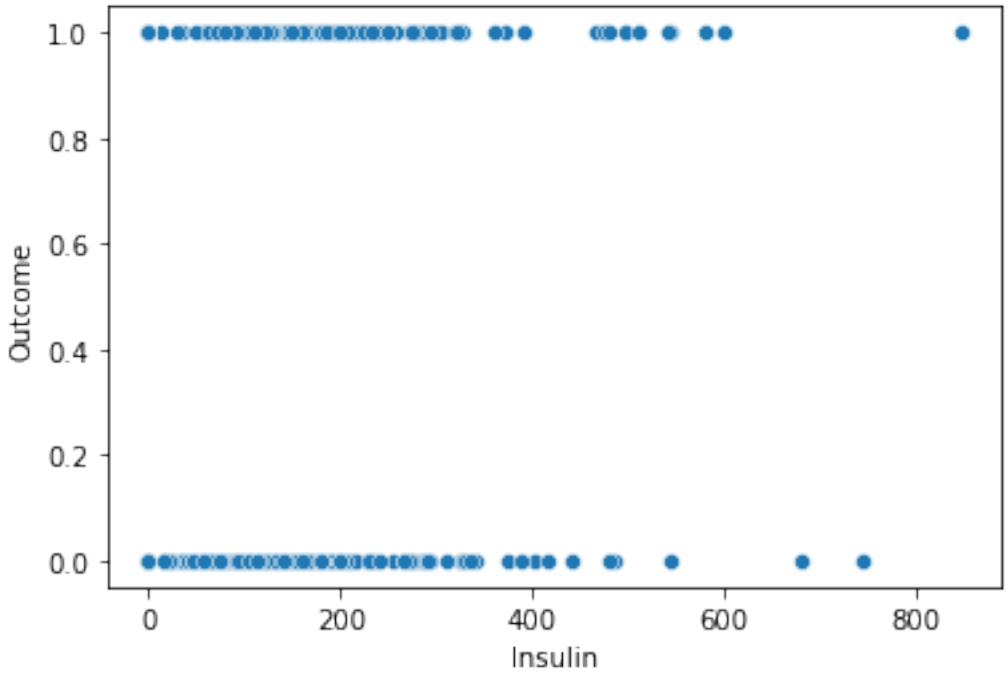
[ ]:
```

```

[9]:
```
plt.figure(figsize=(13,5))
sns.boxplot(data=df,orient='h')
plt.show()
```



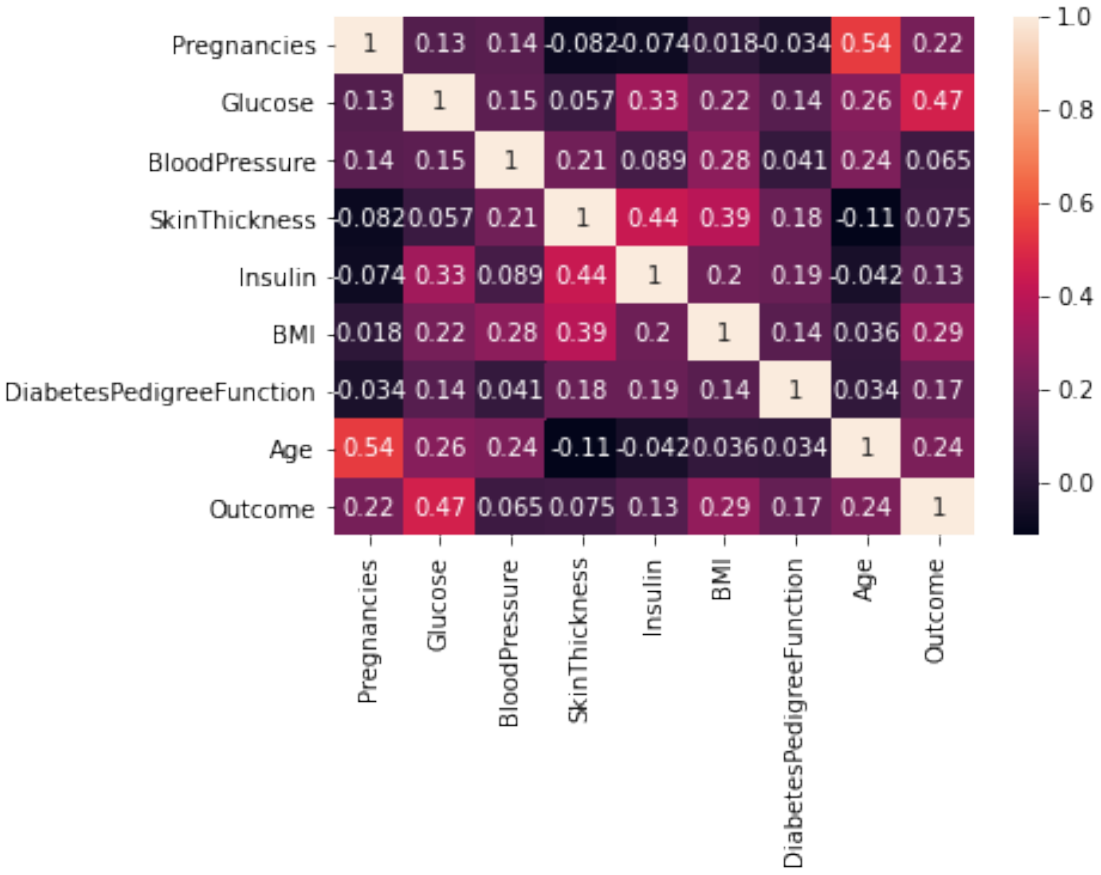
[10]:
```
sns.scatterplot(x=df['Insulin'],y=df['Outcome'])
```

[10]:
```
<AxesSubplot:xlabel='Insulin', ylabel='Outcome'>
```



[11]:
```
corr_mat=df.corr()
sns.heatmap(corr_mat, annot=True)
```

[11]: <AxesSubplot:>



[ ]:

2 replacing 0

[12]:
```
X=df.drop('Outcome',axis=1)
```

[13]:
```
Y=df['Outcome']
```

[14]:
```
X.describe()
```

[14]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	\
count	768.000000	768.000000	768.000000	768.000000	768.000000	
mean	3.845052	120.894531	69.105469	20.536458	79.799479	
std	3.369578	31.972618	19.355807	15.952218	115.244002	
min	0.000000	0.000000	0.000000	0.000000	0.000000	
25%	1.000000	99.000000	62.000000	0.000000	0.000000	
50%	3.000000	117.000000	72.000000	23.000000	30.500000	
75%	6.000000	140.250000	80.000000	32.000000	127.250000	

```
max      17.000000  199.000000     122.000000      99.000000  846.000000

              BMI  DiabetesPedigreeFunction         Age
count  768.000000                768.000000  768.000000
mean    31.992578                  0.471876   33.240885
std      7.884160                  0.331329   11.760232
min      0.000000                  0.078000   21.000000
25%     27.300000                  0.243750   24.000000
50%     32.000000                  0.372500   29.000000
75%     36.600000                  0.626250   41.000000
max     67.100000                  2.420000   81.000000
```

[15]:
```
X.replace(to_replace=0,value=df.mean(),inplace=True)
```

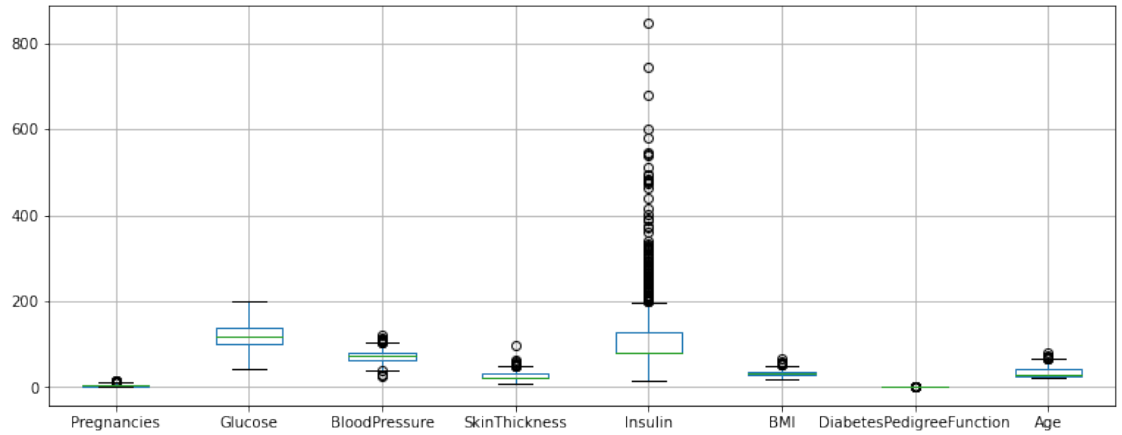
[16]:
```
X.describe()
```

[16]:
```
       Pregnancies     Glucose  BloodPressure  SkinThickness     Insulin  \
count   768.000000  768.000000     768.000000     768.000000  768.000000
mean      4.400782  121.681605      72.254807      26.606479  118.660163
std       2.984162   30.436016      12.115932       9.631241   93.080358
min       1.000000   44.000000      24.000000       7.000000   14.000000
25%       2.000000   99.750000      64.000000      20.536458   79.799479
50%       3.845052  117.000000      72.000000      23.000000   79.799479
75%       6.000000  140.250000      80.000000      32.000000  127.250000
max      17.000000  199.000000     122.000000      99.000000  846.000000

              BMI  DiabetesPedigreeFunction         Age
count  768.000000                768.000000  768.000000
mean    32.450805                  0.471876   33.240885
std      6.875374                  0.331329   11.760232
min     18.200000                  0.078000   21.000000
25%     27.500000                  0.243750   24.000000
50%     32.000000                  0.372500   29.000000
75%     36.600000                  0.626250   41.000000
max     67.100000                  2.420000   81.000000
```

[ ]:
```

```

[17]:
```
X.boxplot(figsize=(13,5))
```

[17]:
```
<AxesSubplot:>
```

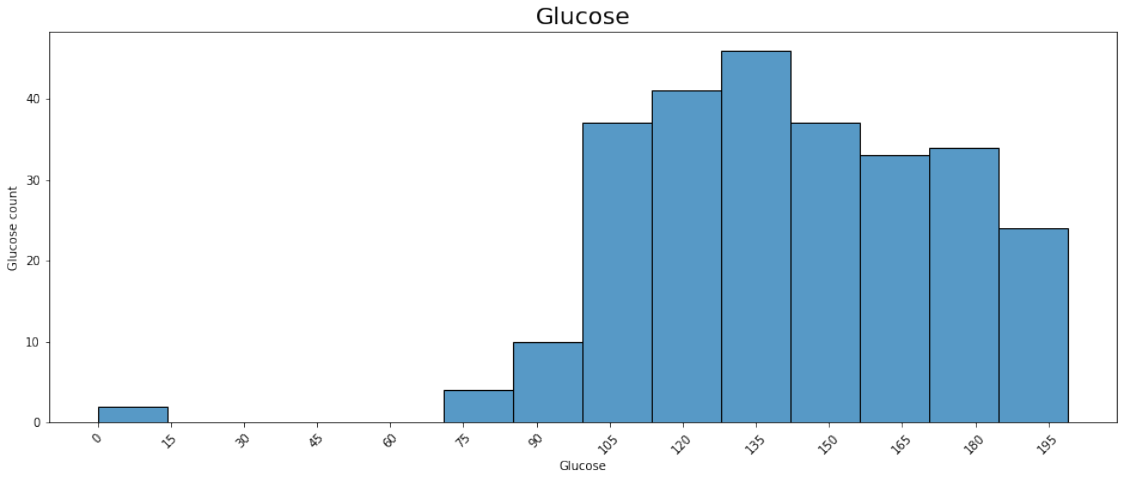


3 Exploring data

[18]:
```
import seaborn as sns
```

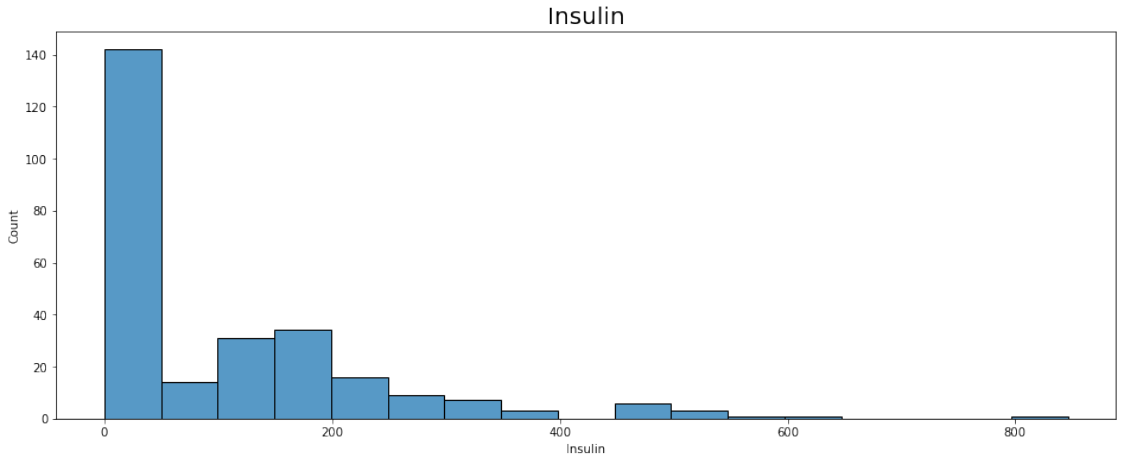
[19]:
```
#glucose for diabetic
fig = plt.figure(figsize =(16,6))

sns.histplot(df["Glucose"][df["Outcome"] == 1])
plt.xticks([i for i in range(0,201,15)],rotation = 45)
plt.ylabel("Glucose count")
plt.title("Glucose",fontsize = 20)
```

[19]:
```
Text(0.5, 1.0, 'Glucose')
```



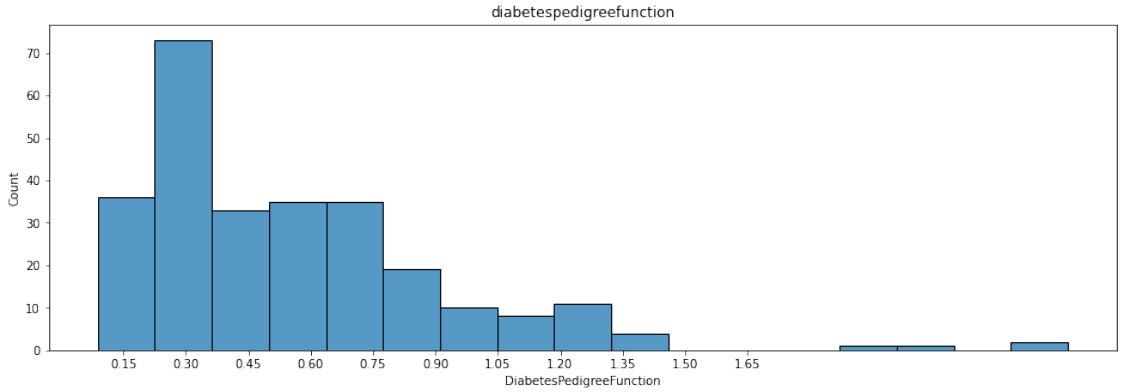
[20]:
```
#insulin for diabetic

fig = plt.figure(figsize = (16,6))

sns.histplot(df["Insulin"][df["Outcome"]==1])
plt.xticks()
plt.title("Insulin",fontsize = 20)
```

[20]: Text(0.5, 1.0, 'Insulin')



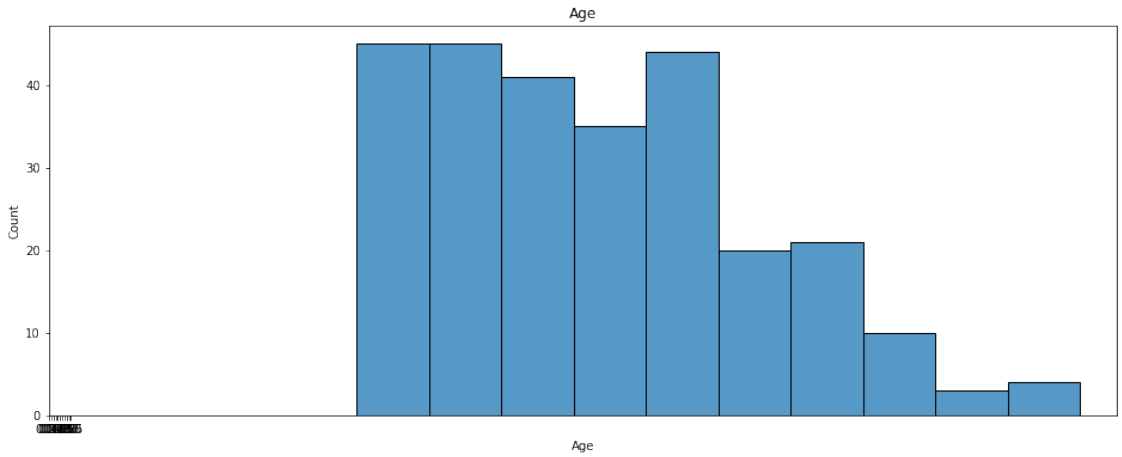
[21]:
```
#diabeticpedigreefunction for diabetic
fig = plt.figure(figsize = (16,5))
sns.histplot(df["DiabetesPedigreeFunction"][df["Outcome"] == 1])
plt.xticks([i*0.15 for i in range(1,12)])
plt.title("diabetespedigreefunction")
```

[21]: Text(0.5, 1.0, 'diabetespedigreefunction')



[22]:
```
#Age for diabetic
fig = plt.figure(figsize = (16,6))

sns.histplot(df["Age"][df["Outcome"] == 1])
plt.xticks([i*0.15 for i in range(1,12)])
plt.title("Age")
```

[22]:
```
Text(0.5, 1.0, 'Age')
```



4 splitting of data for training and testing

[ ]:
```
```

[23]:
```
X
```

[23]:
```
     Pregnancies  Glucose  BloodPressure  SkinThickness     Insulin   BMI  \
0       6.000000    148.0           72.0      35.000000   79.799479  33.6
1       1.000000     85.0           66.0      29.000000   79.799479  26.6
2       8.000000    183.0           64.0      20.536458   79.799479  23.3
3       1.000000     89.0           66.0      23.000000   94.000000  28.1
4       3.845052    137.0           40.0      35.000000  168.000000  43.1
..           …        …              …            …           …    …
763    10.000000    101.0           76.0      48.000000  180.000000  32.9
764     2.000000    122.0           70.0      27.000000   79.799479  36.8
765     5.000000    121.0           72.0      23.000000  112.000000  26.2
766     1.000000    126.0           60.0      20.536458   79.799479  30.1
767     1.000000     93.0           70.0      31.000000   79.799479  30.4

     DiabetesPedigreeFunction  Age
0                       0.627   50
```

```
1                          0.351   31
2                          0.672   32
3                          0.167   21
4                          2.288   33
..                           …   …
763                        0.171   63
764                        0.340   27
765                        0.245   30
766                        0.349   47
767                        0.315   23

[768 rows x 8 columns]
```

[24]:
```
Y
```

[24]:
```
0      1
1      0
2      1
3      0
4      1
      ..
763    0
764    0
765    0
766    1
767    0
Name: Outcome, Length: 768, dtype: int64
```

[25]:
```
from sklearn.model_selection import train_test_split
```

[26]:
```
X_train , X_test , Y_train, Y_test = train_test_split(X,Y,test_size=0.
↪3,random_state=25)
```

[27]:
```
X_train
```

[27]:
```
     Pregnancies  Glucose  BloodPressure  SkinThickness     Insulin   BMI  \
584     8.000000    124.0           76.0      24.000000  600.000000  28.7
237     3.845052    179.0           90.0      27.000000   79.799479  44.1
715     7.000000    187.0           50.0      33.000000  392.000000  33.9
758     1.000000    106.0           76.0      20.536458   79.799479  37.5
189     5.000000    139.0           80.0      35.000000  160.000000  31.6
..           …      …             …            …          …   …
317     3.000000    182.0           74.0      20.536458   79.799479  30.5
143    10.000000    108.0           66.0      20.536458   79.799479  32.4
474     4.000000    114.0           64.0      20.536458   79.799479  28.9
318     3.000000    115.0           66.0      39.000000  140.000000  38.1
132     3.000000    170.0           64.0      37.000000  225.000000  34.5
```

```
     DiabetesPedigreeFunction  Age
584                     0.687   52
237                     0.686   23
715                     0.826   34
758                     0.197   26
189                     0.361   25
..                        …  …
317                     0.345   29
143                     0.272   42
474                     0.126   24
318                     0.150   28
132                     0.356   30

[537 rows x 8 columns]
```

[28]:
```
Y_train
```

[28]:
```
584    1
237    1
715    1
758    0
189    1
      ..
317    1
143    1
474    0
318    0
132    1
Name: Outcome, Length: 537, dtype: int64
```

[ ]:
```

```

5 standard scaler

[ ]:
```

```

[29]:
```
from sklearn.preprocessing import StandardScaler
std=StandardScaler()
```

[30]:
```
X_train_std=std.fit_transform(X_train)
X_test_std=std.transform(X_test)
```

[31]:
```
X_train_std
```

[31]:
```
array([[ 1.21940301,  0.04193333,  0.27734426, …, -0.53084385,
         0.6259847 ,  1.59136025],
```

```
       [-0.17485054,  1.82800441,  1.4549702 , …,  1.72036006,
         0.62305622, -0.90433494],
       [ 0.88383838,  2.08779657, -1.90967535, …,  0.22930292,
         1.03304271,  0.04230807],
       …,
       [-0.1228555 , -0.28280687, -0.73204941, …, -0.50160744,
        -1.01688975, -0.81827648],
       [-0.45842013, -0.25033285, -0.56381713, …,  0.84326762,
        -0.94660635, -0.47404266],
       [-0.45842013,  1.53573823, -0.73204941, …,  0.31701216,
        -0.34334051, -0.30192575]])
```

[ ]:

6 Train our Model

7 LOGISTIC REGRESSION

[32]:
```
from sklearn.linear_model import LogisticRegression
lr=LogisticRegression()
```

[33]:
```
lr.fit(X_train_std,Y_train)
```

[33]:
```
LogisticRegression()
```

[34]:
```
Y_pred=lr.predict(X_test_std)
```

[35]:
```
Y_pred
```

[35]:
```
array([1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0,
       0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1,
       0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1,
       1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0,
       0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,
       0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0,
       1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1,
       0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0], dtype=int64)
```

[36]:
```
X_test
```

[36]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	\
459	9.000000	134.0	74.0	33.000000	60.000000	25.9	
39	4.000000	111.0	72.0	47.000000	207.000000	37.1	
344	8.000000	95.0	72.0	20.536458	79.799479	36.8	

```
84      5.000000    137.0           108.0       20.536458   79.799479  48.8
700     2.000000    122.0            76.0       27.000000  200.000000  35.9
..           …       …               …              …          …   …
288     4.000000     96.0            56.0       17.000000   49.000000  20.8
438     1.000000     97.0            70.0       15.000000   79.799479  18.2
660    10.000000    162.0            84.0       20.536458   79.799479  27.7
379     3.845052     93.0           100.0       39.000000   72.000000  43.4
594     6.000000    123.0            72.0       45.000000  230.000000  33.6

     DiabetesPedigreeFunction  Age
459                     0.460   81
39                      1.390   56
344                     0.485   57
84                      0.227   37
700                     0.483   26
..                        …   …
288                     0.340   26
438                     0.147   21
660                     0.182   54
379                     1.021   35
594                     0.733   34

[231 rows x 8 columns]
```

[37]:
```
Y_test
```

[37]:
```
459    0
39     1
344    0
84     1
700    0
      ..
288    0
438    0
660    0
379    0
594    0
Name: Outcome, Length: 231, dtype: int64
```

[38]:
```
from sklearn.metrics import accuracy_score
```

[39]:
```
accuracy_score(Y_test,Y_pred)
```

[39]:
```
0.8138528138528138
```

8 DECISION TREE

[40]:
```
from sklearn.tree import DecisionTreeClassifier
dt = DecisionTreeClassifier()
```

[41]:
```
dt.fit(X_train_std,Y_train)
```

[41]:
```
DecisionTreeClassifier()
```

[42]:
```
Y_pred=dt.predict(X_test_std)
```

[43]:
```
Y_pred
```

[43]:
```
array([1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0,
       0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1,
       0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1,
       0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 1,
       1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0,
       0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0,
       0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0,
       1, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0], dtype=int64)
```

[44]:
```
Y_test
```

[44]:
```
459    0
39     1
344    0
84     1
700    0
      ..
288    0
438    0
660    0
379    0
594    0
Name: Outcome, Length: 231, dtype: int64
```

[45]:
```
accuracy_score(Y_test,Y_pred)
```

[45]:
```
0.6883116883116883
```

9 DEEP LEARNING

[46]:
```
from sklearn.neural_network import MLPClassifier
mlp=MLPClassifier(hidden_layer_sizes=(8,8))
```

[48]:
```
mlp.fit(X_train_std,Y_train)
```

```
C:\Users\Mohana\anaconda3\lib\site-
packages\sklearn\neural_network\_multilayer_perceptron.py:614:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
```

[48]:
```
MLPClassifier(hidden_layer_sizes=(8, 8))
```

[49]:
```
Y_pred=mlp.predict(X_test_std)
```

[50]:
```
accuracy_score(Y_test,Y_pred)
```

[50]:
```
0.7705627705627706
```

[3]:
```
import pandas as pd
pd.show_versions()
```

```
INSTALLED VERSIONS
------------------
commit           : 2cb96529396d93b46abab7bbc73a208e708c642e
python           : 3.8.8.final.0
python-bits      : 64
OS               : Windows
OS-release       : 10
Version          : 10.0.19041
machine          : AMD64
processor        : Intel64 Family 6 Model 142 Stepping 12, GenuineIntel
byteorder        : little
LC_ALL           : None
LANG             : None
LOCALE           : English_India.1252

pandas           : 1.2.4
numpy            : 1.20.1
pytz             : 2021.1
dateutil         : 2.8.1
pip              : 21.0.1
setuptools       : 52.0.0.post20210125
Cython           : 0.29.23
pytest           : 6.2.3
hypothesis       : None
```

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sphinx           : 4.0.1
blosc            : None
feather          : None
xlsxwriter       : 1.3.8
lxml.etree       : 4.6.3
html5lib         : 1.1
pymysql          : None
psycopg2         : 2.8.5 (dt dec pq3 ext lo64)
jinja2           : 2.11.3
IPython          : 7.22.0
pandas_datareader: None
bs4              : 4.9.3
bottleneck       : 1.3.2
fsspec           : 0.9.0
fastparquet      : None
gcsfs            : None
matplotlib       : 3.3.4
numexpr          : 2.7.3
odfpy            : None
openpyxl         : 3.0.7
pandas_gbq       : None
pyarrow          : None
pyxlsb           : None
s3fs             : None
scipy            : 1.6.2
sqlalchemy       : 1.4.7
tables           : 3.6.1
tabulate         : None
xarray           : None
xlrd             : 2.0.1
xlwt             : 1.3.0
numba            : 0.53.1
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