```
#import the liabrary
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import sklearn
import matplotlib.pyplot as plt

#load the dataset
dataset = pd.read_csv('/Users/shraddhalipane/Downloads/Project
2/Healthcare - Diabetes/health care diabetes.csv')

#know dataset
data=pd.read_csv('/Users/shraddhalipane/Downloads/Project 2/Healthcare
- Diabetes/health care diabetes.csv')

# shape , info,describe , null values, neagtive values , head, tail

data.shape
```

```
(768, 9)
```

```
data.describe()
```

```
       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
```

```
data.isnull().sum()
```

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

```
data.head()
```

```
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin
BMI  \
0            6      148             72             35        0  33.6

1            1       85             66             29        0  26.6

2            8      183             64              0        0  23.3

3            1       89             66             23       94  28.1

4            0      137             40             35      168  43.1


   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
```

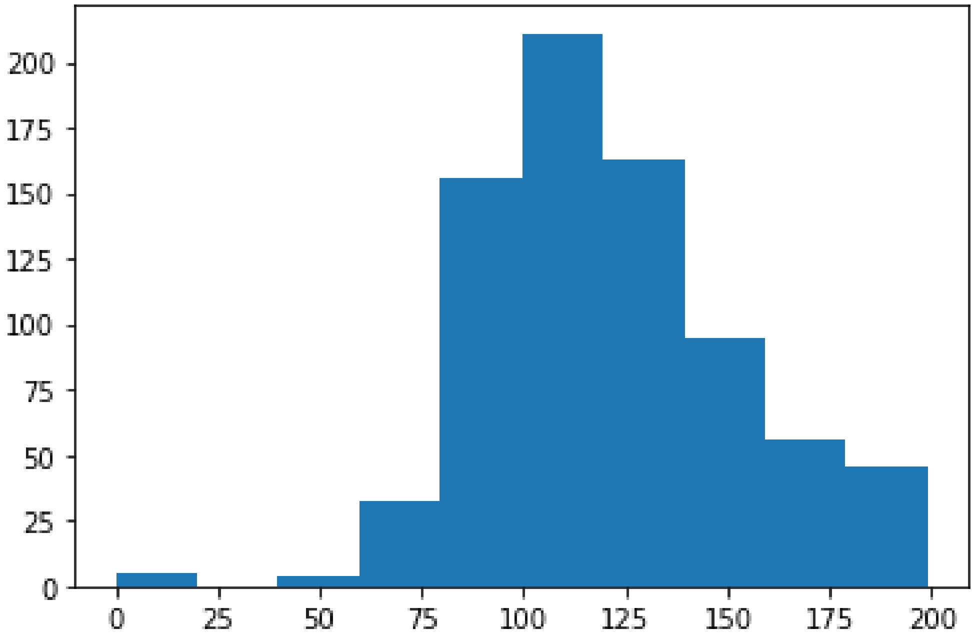
```
data.info()
```

```
<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
```

```
plt.hist(data['Glucose'])
```

```
(array([  5.,   0.,   4.,  32., 156., 211., 163.,  95.,  56.,  46.]),
 array([  0. ,  19.9,  39.8,  59.7,  79.6,  99.5, 119.4, 139.3, 159.2,
        179.1, 199. ]),
 <BarContainer object of 10 artists>)
```

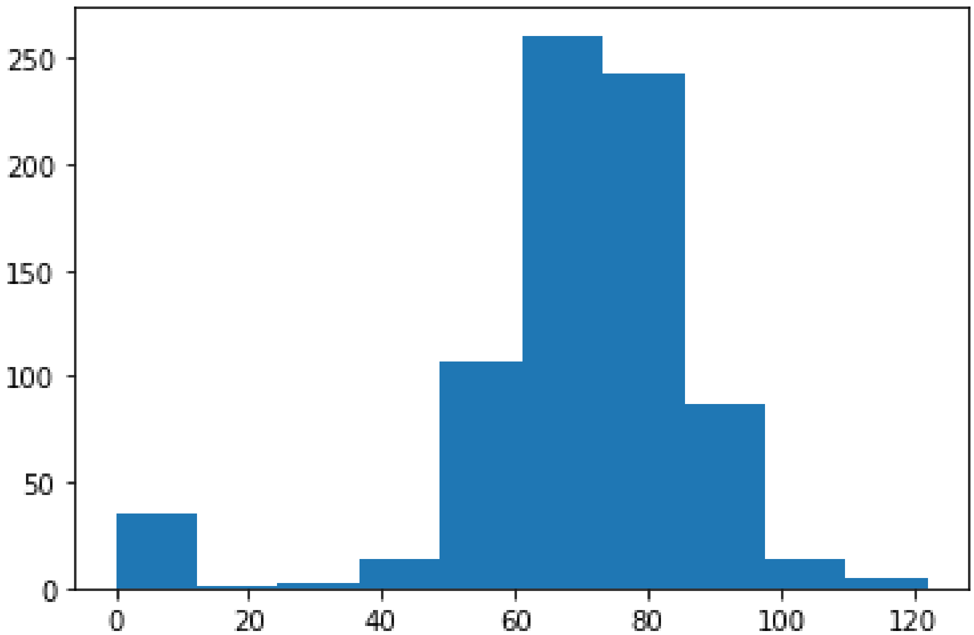



```
data['Glucose'].value_counts().head(7)
```

```
99     17
100    17
111    14
129    14
125    14
106    14
112    13
Name: Glucose, dtype: int64
```

```
plt.hist(data['BloodPressure'])
```

```
(array([ 35.,   1.,   2.,  13., 107., 261., 243.,  87.,  14.,   5.]),
 array([  0. ,  12.2,  24.4,  36.6,  48.8,  61. ,  73.2,  85.4,  97.6,
        109.8, 122. ]),
 <BarContainer object of 10 artists>)
```

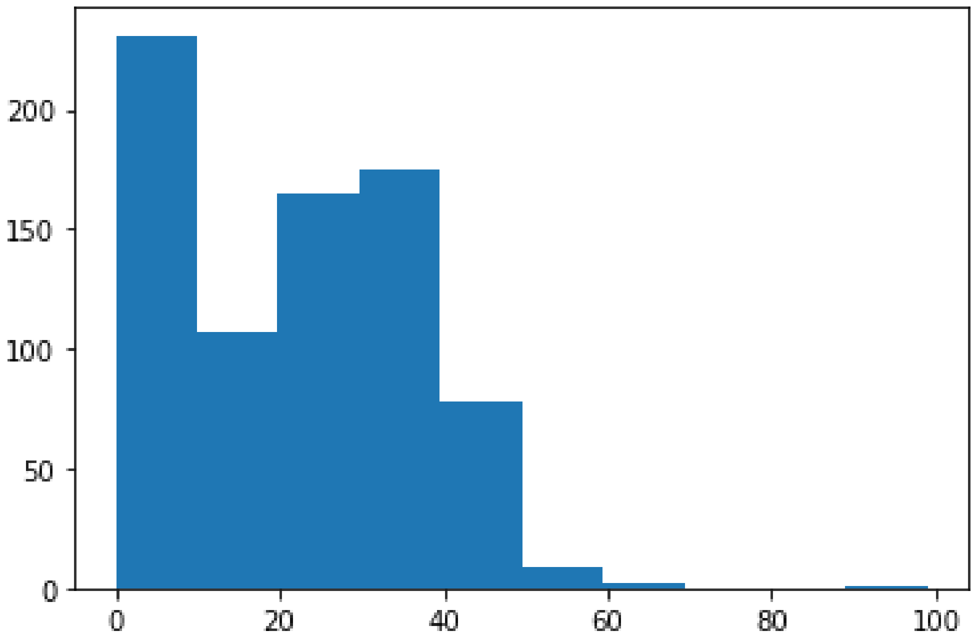



```
data['BloodPressure'].value_counts().head()
```

```
70    57
74    52
78    45
68    45
72    44
Name: BloodPressure, dtype: int64
```

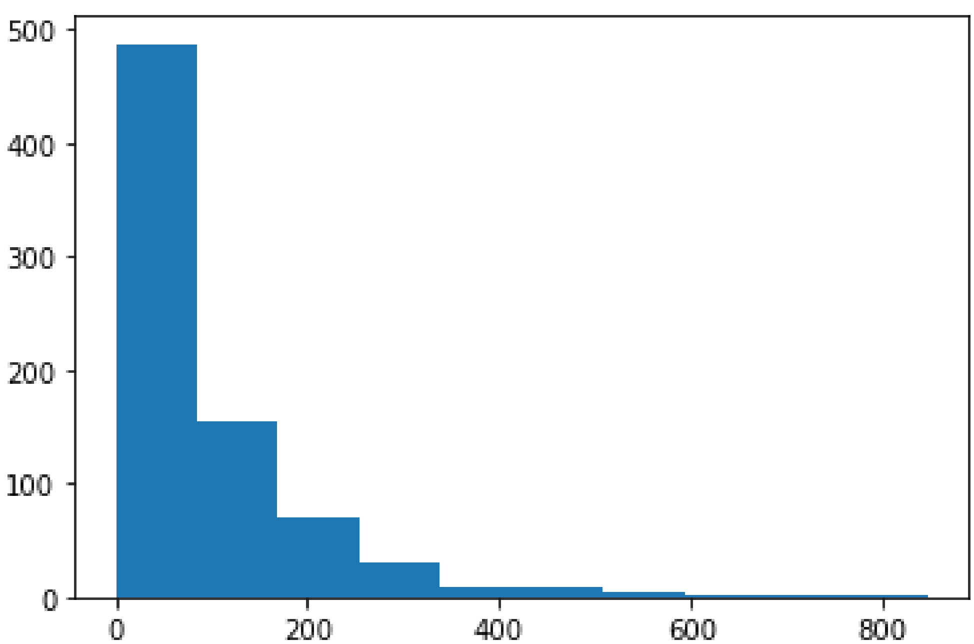
```
plt.hist(data['SkinThickness'])
```

```
(array([231., 107., 165., 175.,  78.,   9.,   2.,   0.,   0.,   1.]),
 array([ 0. ,  9.9, 19.8, 29.7, 39.6, 49.5, 59.4, 69.3, 79.2, 89.1,
99. ]),
 <BarContainer object of 10 artists>)
```




```
plt.hist(data['Insulin'])
```

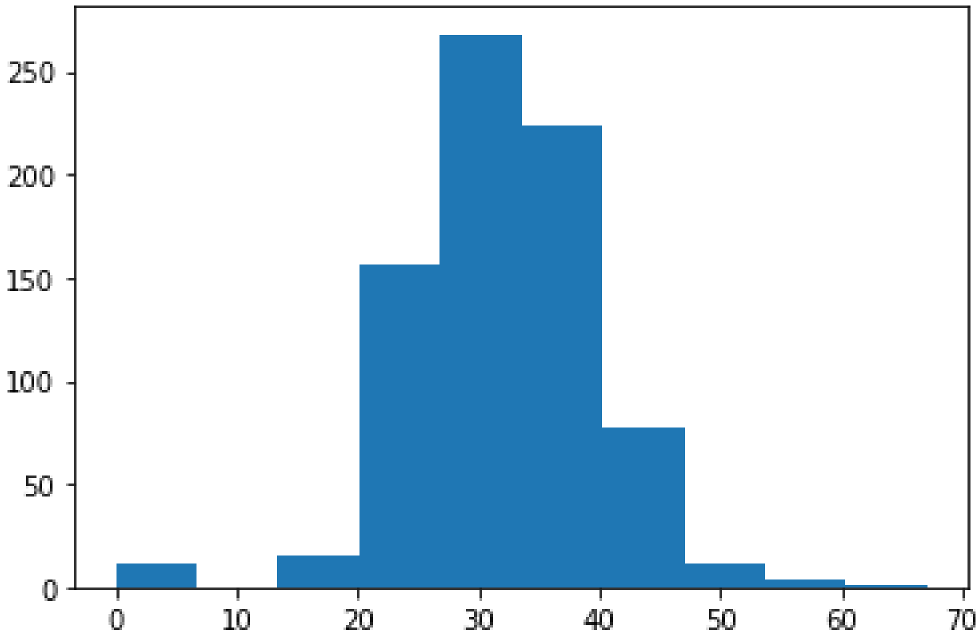
```
(array([487., 155.,  70.,  30.,   8.,   9.,   5.,   1.,   2.,   1.]),
 array([  0. ,  84.6, 169.2, 253.8, 338.4, 423. , 507.6, 592.2, 676.8,
        761.4, 846. ]),
 <BarContainer object of 10 artists>)
```




```
plt.hist(data['BMI'])
```

```
(array([ 11.,   0.,  15., 156., 268., 224.,  78.,  12.,   3.,   1.]),
 array([ 0.  ,  6.71, 13.42, 20.13, 26.84, 33.55, 40.26, 46.97, 53.68,
```

```
        60.39, 67.1 ]),
 <BarContainer object of 10 artists>)
```




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

```
99     17
100    17
111    14
129    14
125    14
       ..
191     1
177     1
44      1
62      1
190     1
Name: Glucose, Length: 136, dtype: int64
```

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

```
70     57
74     52
78     45
68     45
72     44
64     43
80     40
76     39
60     37
0      35
62     34
```

```
66     30
82     30
88     25
84     23
90     22
86     21
58     21
50     13
56     12
52     11
54     11
75      8
92      8
65      7
85      6
94      6
48      5
96      4
44      4
100     3
106     3
98      3
110     3
55      2
108     2
104     2
46      2
30      2
122     1
95      1
102     1
61      1
24      1
38      1
40      1
114     1
Name: BloodPressure, dtype: int64
```

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

```
0     227
32     31
30     27
27     23
23     22
33     20
28     20
18     20
31     19
19     18
39     18
```

```
29    17
40    16
25    16
26    16
22    16
37    16
41    15
35    15
36    14
15    14
17    14
20    13
24    12
42    11
13    11
21    10
46     8
34     8
12     7
38     7
11     6
43     6
16     6
45     6
14     6
44     5
10     5
48     4
47     4
49     3
50     3
8      2
7      2
52     2
54     2
63     1
60     1
56     1
51     1
99     1
Name: SkinThickness, dtype: int64
```

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

```
0      374
105     11
130      9
140      9
120      8
      ...
73       1
```

```
171      1
255      1
52       1
112      1
Name: Insulin, Length: 186, dtype: int64
```

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

```
32.0    13
31.6    12
31.2    12
0.0     11
32.4    10
        ..
36.7     1
41.8     1
42.6     1
42.8     1
46.3     1
Name: BMI, Length: 248, dtype: int64
```

```
data.describe()
```

```
       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

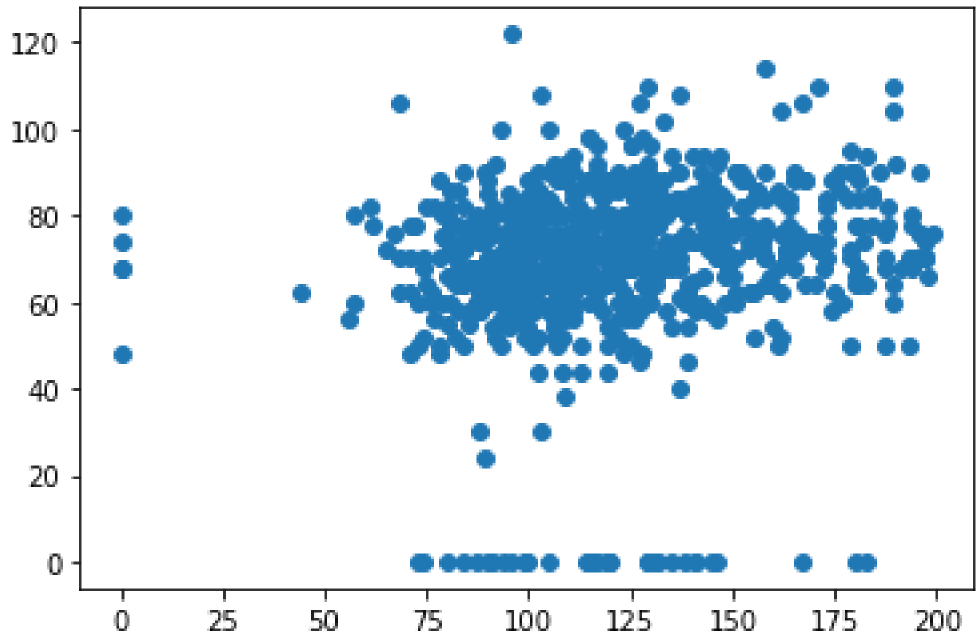
              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    31.992578                  0.471876   33.240885    0.348958
std      7.884160                  0.331329   11.760232    0.476951
min      0.000000                  0.078000   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
```

```
data ['Outcome'].value_counts().head(7)
```

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

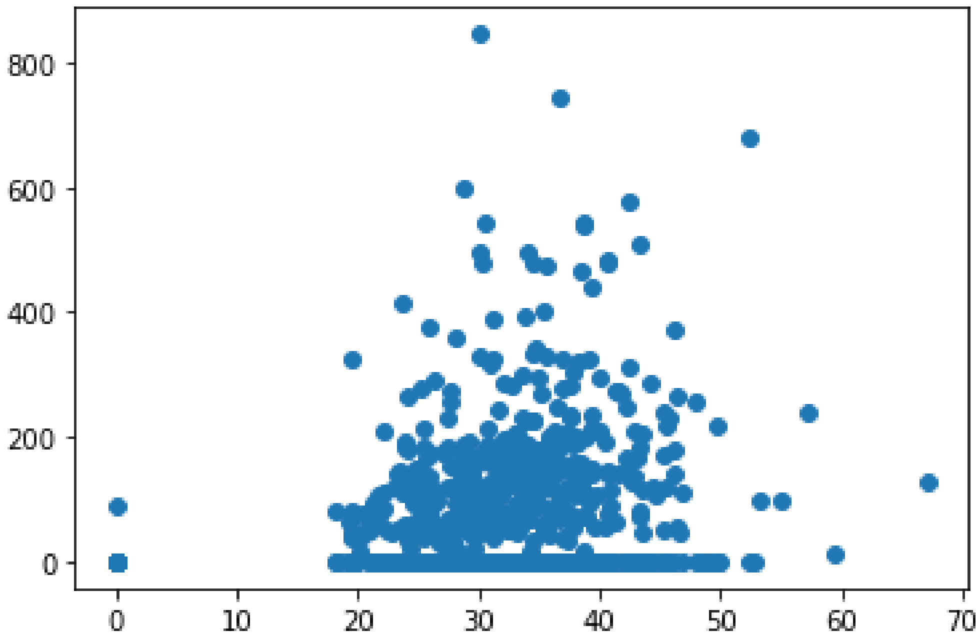
```
plt.scatter(data['Glucose'],data['BloodPressure'])
```

```
<matplotlib.collections.PathCollection at 0x7fc5dd60d310>
```



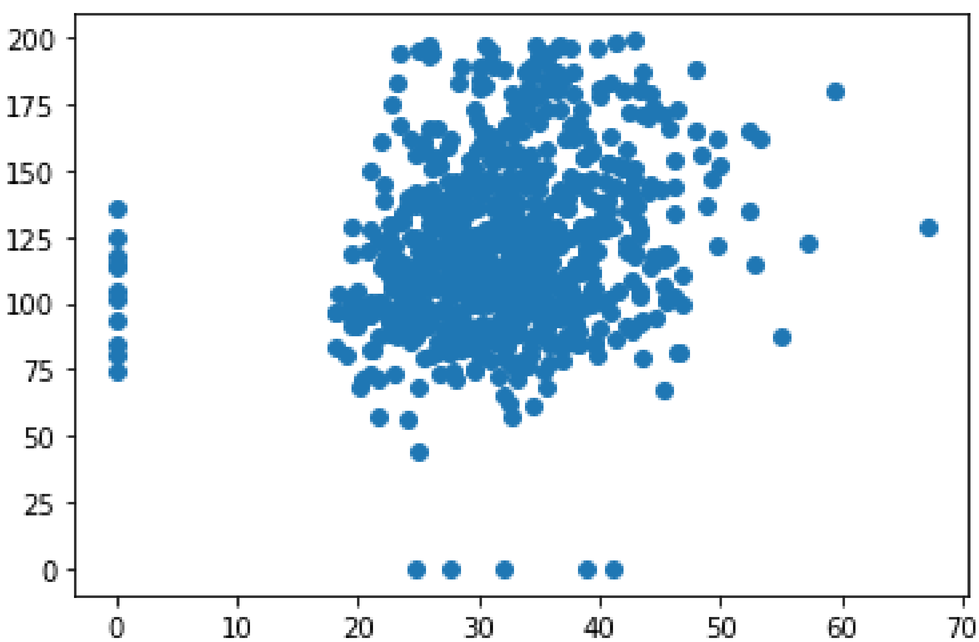

```
plt.scatter(data['BMI'],data['Insulin'])
```

```
<matplotlib.collections.PathCollection at 0x7fc5dd7e7e80>
```



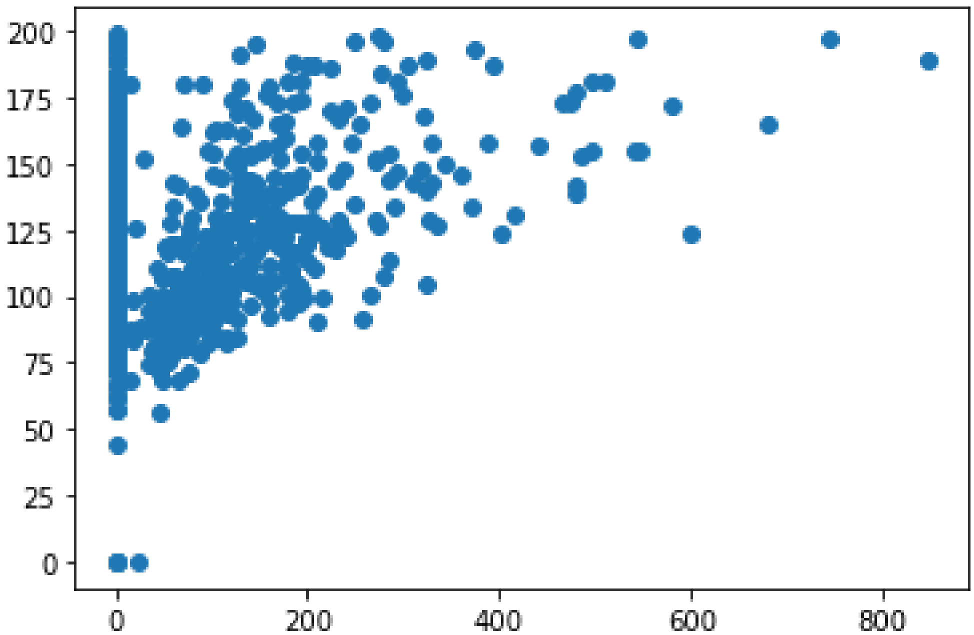

```
plt.scatter(data['BMI'],data['Glucose'])
```

```
<matplotlib.collections.PathCollection at 0x7fc5ca007910>
```



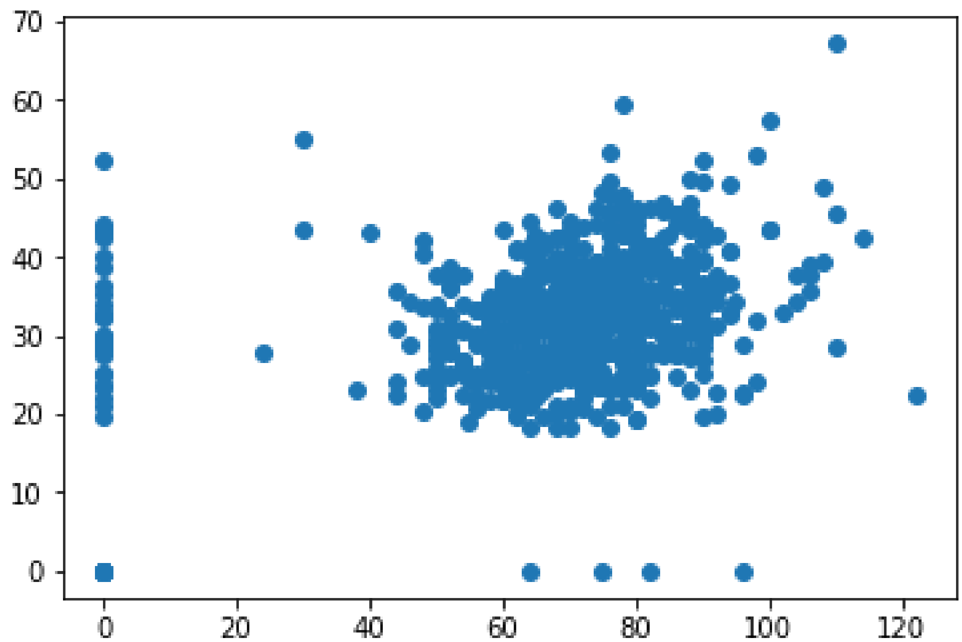

```
plt.scatter(data['Insulin'],data['Glucose'])
```

```
<matplotlib.collections.PathCollection at 0x7fc5b8215b20>
```



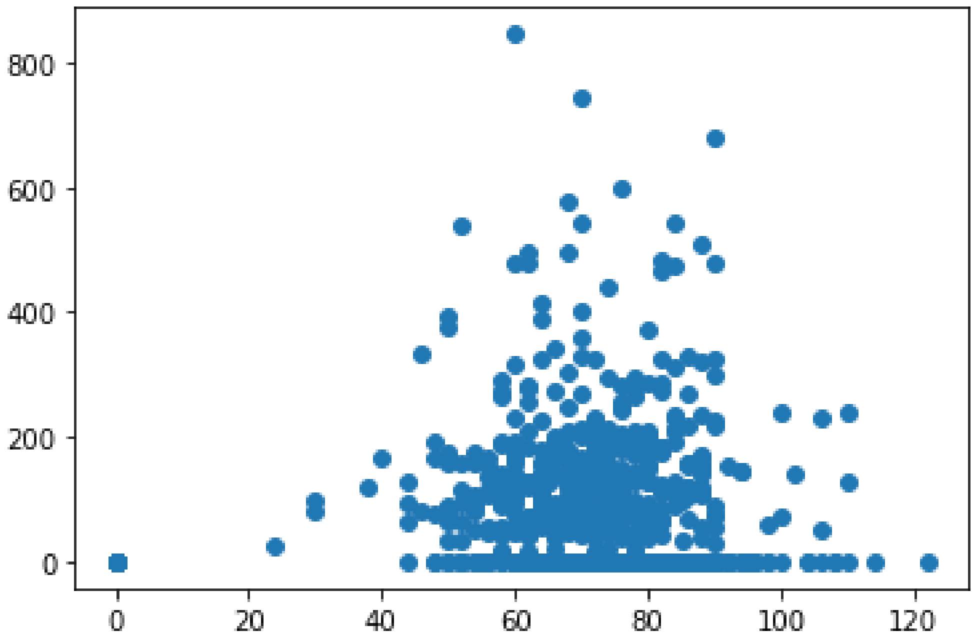

```
plt.scatter(data['BloodPressure'],data['BMI'])
```

<matplotlib.collections.PathCollection at 0x7fc5c9f4faf0>




```
plt.scatter(data['BloodPressure'],data['Insulin'])
```

<matplotlib.collections.PathCollection at 0x7fc5880b3e80>




```
#heatmap
data.corr()
```

```
                          Pregnancies   Glucose  BloodPressure
SkinThickness  \
Pregnancies                  1.000000  0.129459       0.141282      -
0.081672
Glucose                      0.129459  1.000000       0.152590
0.057328
BloodPressure                0.141282  0.152590       1.000000
0.207371
SkinThickness               -0.081672  0.057328       0.207371
1.000000
Insulin                     -0.073535  0.331357       0.088933
0.436783
BMI                          0.017683  0.221071       0.281805
0.392573
DiabetesPedigreeFunction    -0.033523  0.137337       0.041265
0.183928
Age                          0.544341  0.263514       0.239528      -
0.113970
Outcome                      0.221898  0.466581       0.065068
0.074752

                           Insulin       BMI  DiabetesPedigreeFunction
\
Pregnancies              -0.073535  0.017683                 -0.033523

Glucose                   0.331357  0.221071                  0.137337
```

```
BloodPressure               0.088933  0.281805                    0.041265

SkinThickness               0.436783  0.392573                    0.183928

Insulin                     1.000000  0.197859                    0.185071

BMI                         0.197859  1.000000                    0.140647

DiabetesPedigreeFunction    0.185071  0.140647                    1.000000

Age                        -0.042163  0.036242                    0.033561

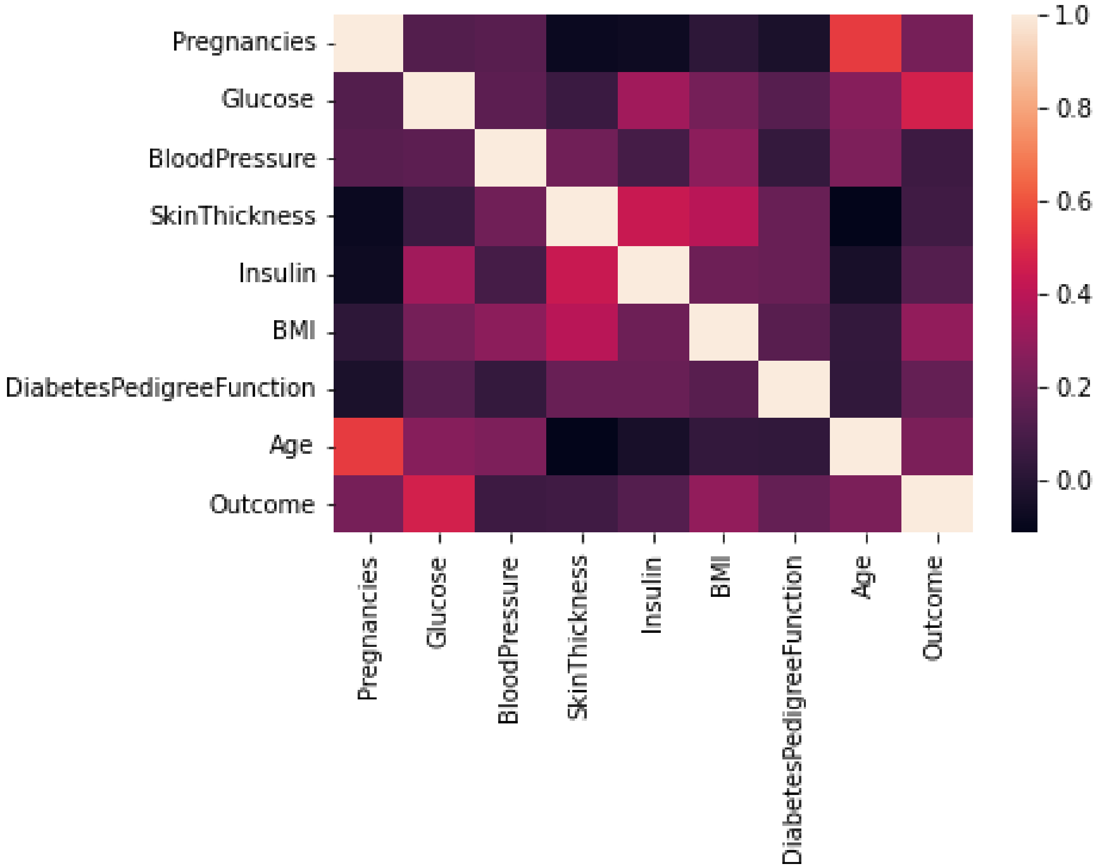
Outcome                     0.130548  0.292695                    0.173844


                                 Age   Outcome
Pregnancies                 0.544341  0.221898
Glucose                     0.263514  0.466581
BloodPressure               0.239528  0.065068
SkinThickness              -0.113970  0.074752
Insulin                    -0.042163  0.130548
BMI                         0.036242  0.292695
DiabetesPedigreeFunction    0.033561  0.173844
Age                         1.000000  0.238356
Outcome                     0.238356  1.000000
```

```
import seaborn as sns

sns.heatmap(data.corr())
```

```
<AxesSubplot:>
```




```
data.head()

   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin
BMI  \
0            6      148             72             35        0  33.6

1            1       85             66             29        0  26.6

2            8      183             64              0        0  23.3

3            1       89             66             23       94  28.1

4            0      137             40             35      168  43.1


   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
```

```
#model building
# Extract the features
features=data.iloc[:,0:8].values
label=data.iloc[:,8].values

features

array([[  6.   , 148.   ,  72.   , ...,  33.6  ,   0.627,  50.   ],
       [  1.   ,  85.   ,  66.   , ...,  26.6  ,   0.351,  31.   ],
       [  8.   , 183.   ,  64.   , ...,  23.3  ,   0.672,  32.   ],
       ...,
       [  5.   , 121.   ,  72.   , ...,  26.2  ,   0.245,  30.   ],
       [  1.   , 126.   ,  60.   , ...,  30.1  ,   0.349,  47.   ],
       [  1.   ,  93.   ,  70.   , ...,  30.4  ,   0.315,  23.   ]])

label

array([1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 0, 1, 0,
0,
       1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0,
1,
       0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1,
0,
       1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0,
0,
       1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0,
1,
       1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1,
1,
       1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1,
0,
       1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0,
1,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0,
1,
       1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 1,
1,
       1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0,
0,
       1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0,
0,
       1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1,
0,
       0, 1, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1,
0,
       1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1,
0,
       0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
0,
       0, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0,
0,
```

```
       0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1,
0,
       0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0,
1,
       0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0,
0,
       1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0,
0,
       0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0,
0,
       1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0,
0,
       1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,
0,
       0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0,
0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0,
0,
       0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1,
0,
       0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1,
0,
       0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0,
0,
       1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,
1,
       0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0,
1,
       0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1,
0,
       0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0,
0,
       0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1,
0,
       1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0])
```

```
from sklearn.model_selection import train_test_split

X_train,X_test,y_train,y_test = train_test_split(features,
                                                 label,
                                                 test_size=0.2,
                                                 random_state =10)

from sklearn.linear_model import LogisticRegression
classifier = LogisticRegression()
classifier.fit(X_train,y_train)
```

```
LogisticRegression()
```

```
print(classifier.score(X_train,y_train))
print(classifier.score(X_test,y_test))
```

```
0.7719869706840391
0.7662337662337663
```

```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(label,classifier.predict(features))
cm
```

```
array([[446,  54],
       [122, 146]])
```

```
from sklearn.metrics import classification_report
print(classification_report(label,classifier.predict(features)))
```

```
              precision    recall  f1-score   support

           0       0.79      0.89      0.84       500
           1       0.73      0.54      0.62       268

    accuracy                           0.77       768
   macro avg       0.76      0.72      0.73       768
weighted avg       0.77      0.77      0.76       768
```

```
from sklearn.metrics import roc_curve
from sklearn.metrics import roc_auc_score     #ROC Curve

probability = classifier.predict_proba(features) # predict
probabilities

probability = probability[:, 1] # probabilty for positive outcomes

auc = roc_auc_score(label, probability) # calculating  AUC

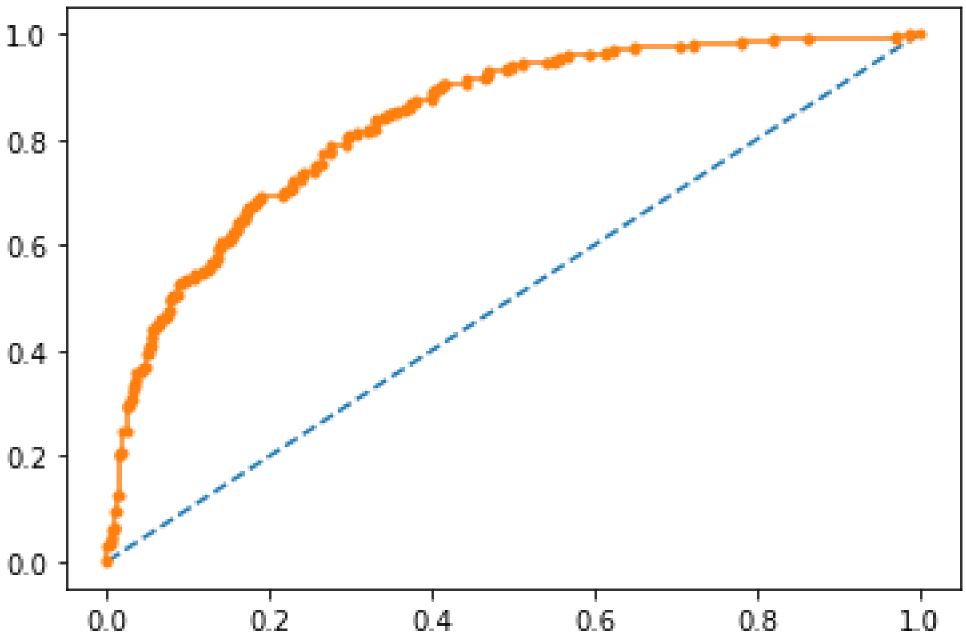
print('AUC: %.3f' % auc)
```

```
AUC: 0.837
```

```
fpr, tpr, thresholds = roc_curve(label, probability)    # ROC curve
calculation

plt.plot([0, 1], [0, 1], linestyle='--')
plt.plot(fpr, tpr, marker='.')
```

```
[<matplotlib.lines.Line2D at 0x7fc5dc5f20a0>]
```




```
from sklearn.metrics import classification_report
print(classification_report)
```

```
<function classification_report at 0x7fc5dc29f940>
```

```
print(classifier.score(X_train,y_train))
print(classifier.score(X_test,y_test))
```

```
0.7719869706840391
0.7662337662337663
```

```
classification_report
```

```
<function
sklearn.metrics._classification.classification_report(y_true, y_pred,
*, labels=None, target_names=None, sample_weight=None, digits=2,
output_dict=False, zero_division='warn')>
```

```
classifier.predict(X_test)
```

```
array([1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0,
0,
       0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
0,
       0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0,
       1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0,
0,
       1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0,
1,
       0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1,
0,
```

```
       1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1,
0])
```

```
from sklearn.metrics import classification_report
print(classification_report)
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```
<function classification_report at 0x7fc5dc29f940>
```