In [68]:

```
#Installation of required libraries
#pip install pandas
#!pip install scikit-learn
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.simplefilter(action = "ignore")
```

In [2]:

```
#Read the dataset
df = pd.read_csv(r'D:\Download\diabetes.csv')
```

In [3]:

```
#First 5 observation units of dataset accessed
df.head()
```

Out[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

EXPLORATORY DATA ANALYSIS

In [4]:

```
#Size of the dataset were examined
df.shape
```

Out[4]:

```
(768, 9)
```

In [5]:

```
#feature Information
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
```

In [6]:

```
# Missing value were filled.
df.isnull().sum()
```

Out[6]:

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

In [7]:

```
df.pivot_table(index=['Outcome'] )
```

Out[7]:

	Age	BMI	BloodPressure	DiabetesPedigreeFunction	Glucose	Insulin	Pregnancies	SkinThickness
Outcome								
0	31.190000	30.304200	68.184000	0.429734	109.980000	68.792000	3.298000	19.664000
1	37.067164	35.142537	70.824627	0.550500	141.257463	100.335821	4.865672	22.164179

In [8]:

```
#Descriptive statistics of the data set accessed.
df.describe()
```

Out[8]:

	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

In [9]:

```
# The distribution of the Outcome variable was examined.
df['Outcome'].value_counts()*100/len(df)
```

Out[9]:

```
Outcome
0    65.104167
1    34.895833
Name: count, dtype: float64
```

In [10]:

```
# The classes of the outcome variable were examined.
df['Outcome'].value_counts()
```

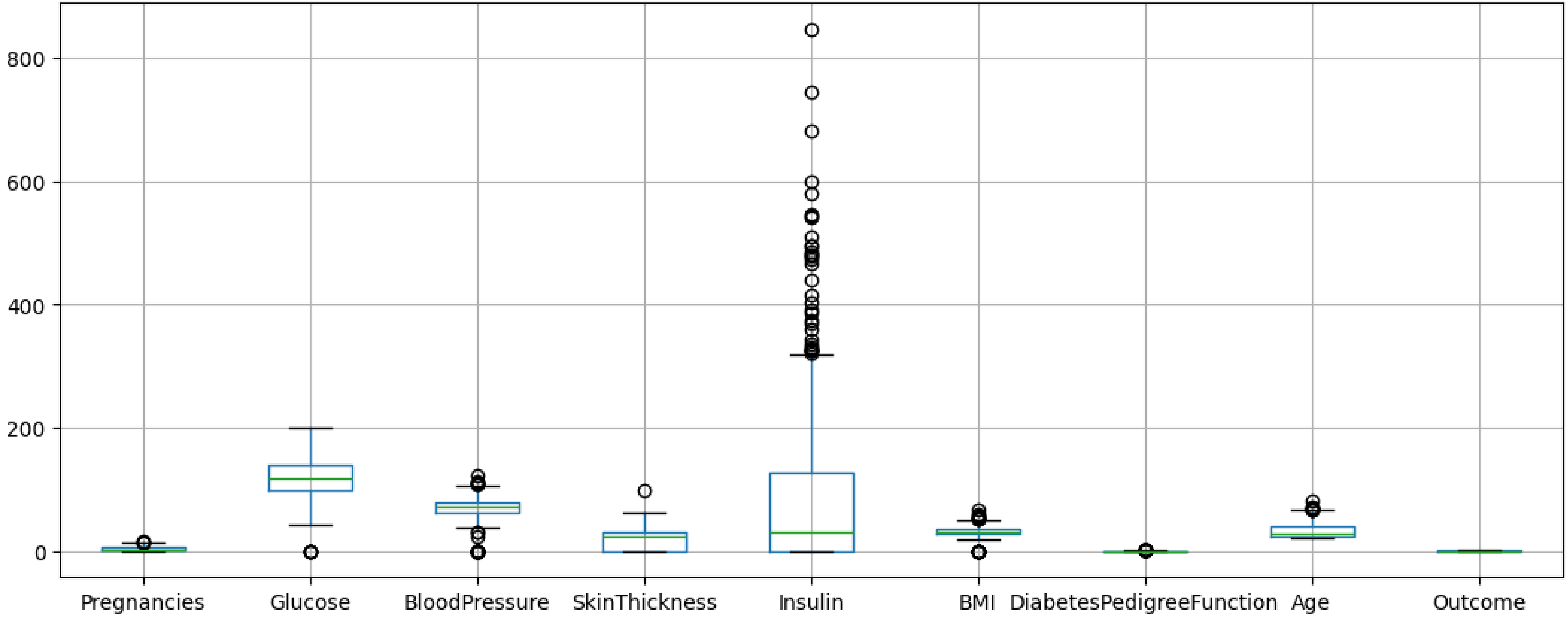
Out[10]:

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

In [ ]:

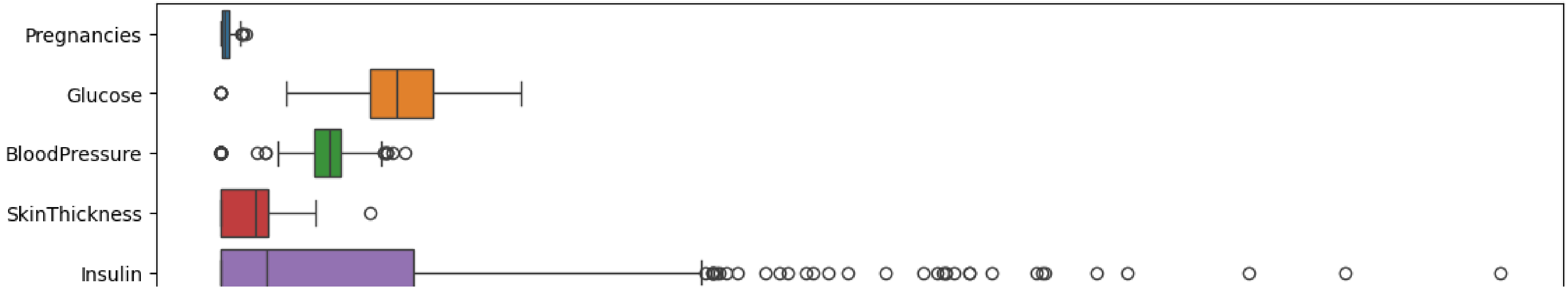
In [11]:

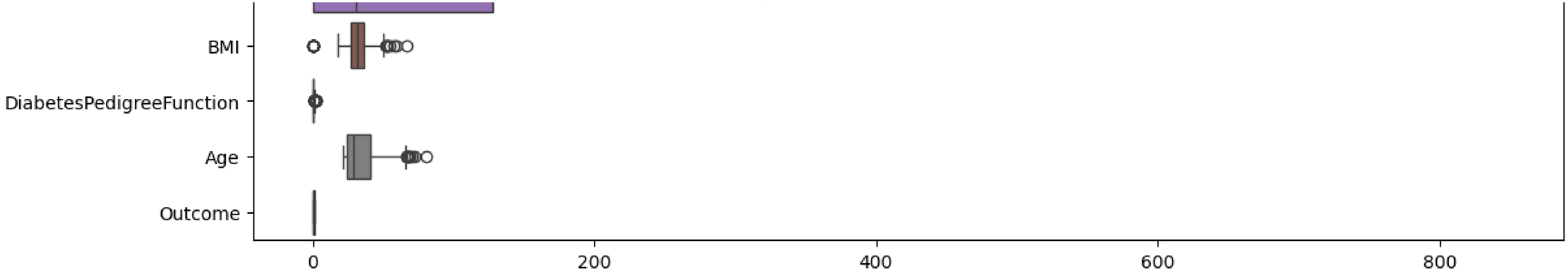
```
# Outlier observation analysis
df.boxplot(figsize=(13,5))
plt.show()
```



In [12]:

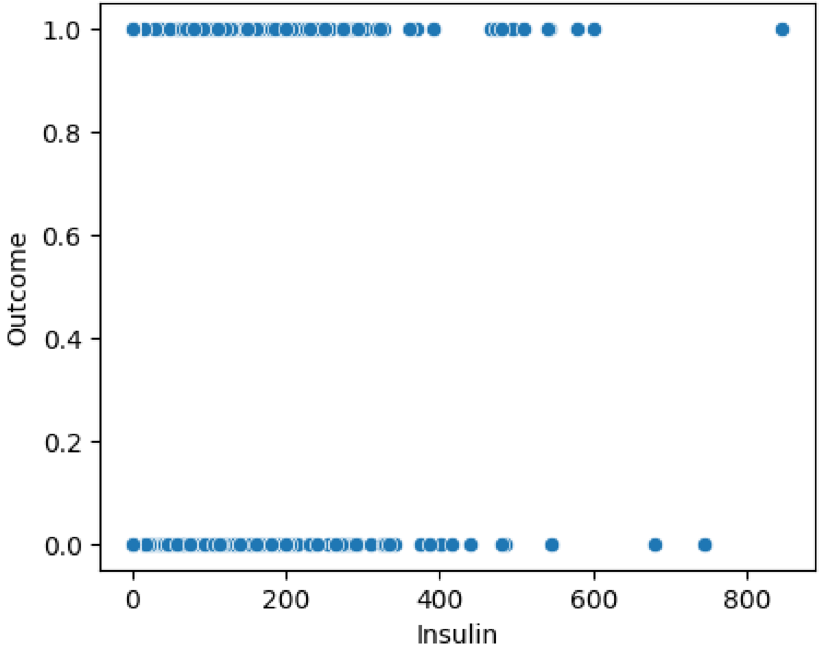
```
plt.figure(figsize=(13,5))
sns.boxplot(data=df,orient='h')
plt.show()
```





In [67]:

```
plt.figure(figsize=(5,4))
sns.scatterplot(x=df['Insulin'],y=df['Outcome'])
plt.show()
```



REPLACING 0 WITH MEAN WITH RESPECTIVE COLUMNS

In [14]:

```
X=df.drop('Outcome',axis=1)
```

In [15]:

```
X
```

Out[15]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
0	6	148	72	35	0	33.6	0.627	50
1	1	85	66	29	0	26.6	0.351	31
2	8	183	64	0	0	23.3	0.672	32
3	1	89	66	23	94	28.1	0.167	21
4	0	137	40	35	168	43.1	2.288	33
...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63
764	2	122	70	27	0	36.8	0.340	27
765	5	121	72	23	112	26.2	0.245	30
766	1	126	60	0	0	30.1	0.349	47
767	1	93	70	31	0	30.4	0.315	23

768 rows × 8 columns

In [16]:

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

In [17]:

```
Y
```

Out[17]:

```
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
```

In [18]:

In [18]:

```
X.describe()
```

Out[18]:

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

In [ ]:

```

```

In [19]:

```
X.replace(to_replace=0,value=X.mean(),inplace=True)
```

In [20]:

```
X.describe()
```

Out[20]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000
mean	4.400782	121.681605	72.254807	26.606479	118.660163	32.450805	0.471876	33.240885
std	2.984162	30.436016	12.115932	9.631241	93.080358	6.875374	0.331329	11.760232
min	1.000000	44.000000	24.000000	7.000000	14.000000	18.200000	0.078000	21.000000
25%	2.000000	99.750000	64.000000	20.536458	79.799479	27.500000	0.243750	24.000000
50%	3.845052	117.000000	72.000000	23.000000	79.799479	32.000000	0.372500	29.000000
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	0.626250	41.000000
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	2.420000	81.000000

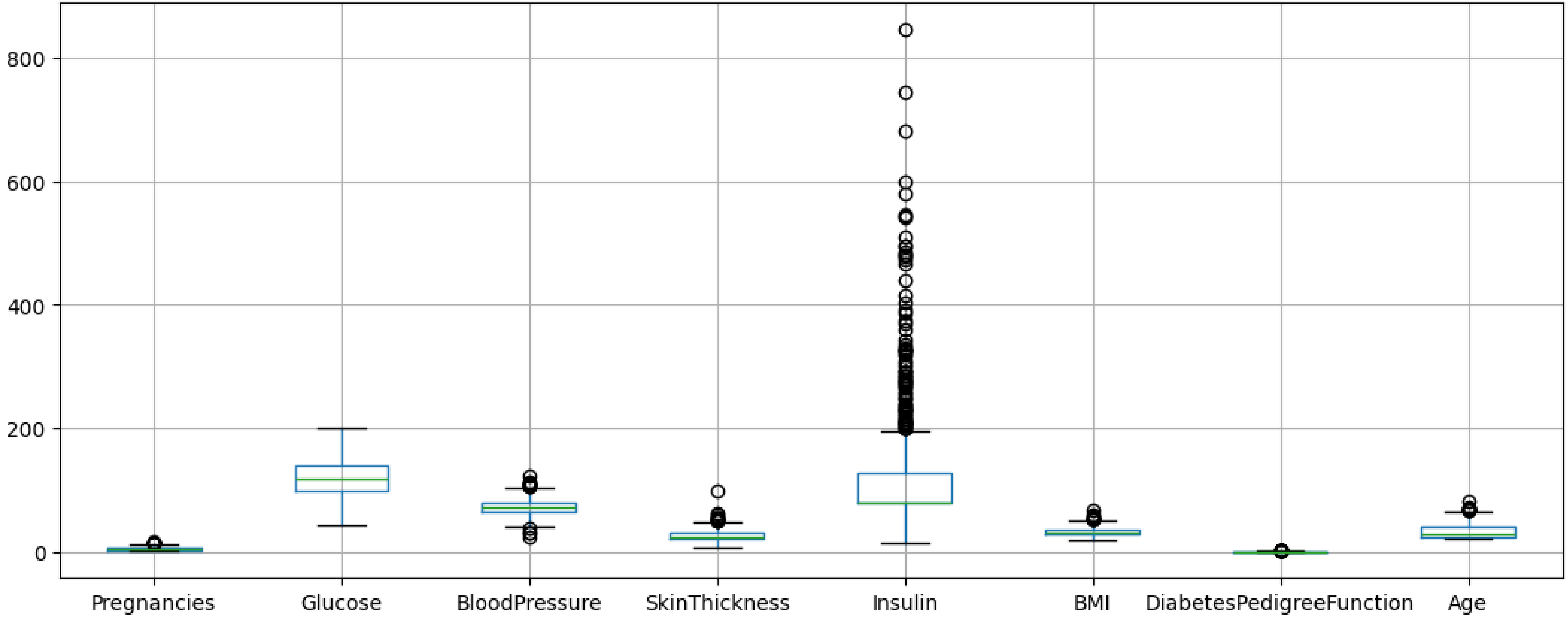
In [ ]:

```

```

In [21]:

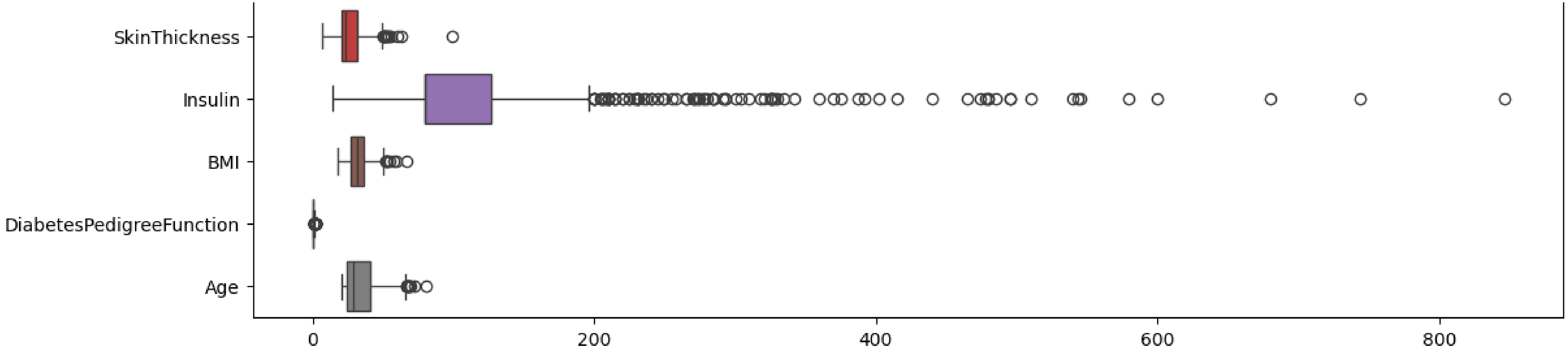
```
X.boxplot(figsize=(13,5))
plt.show()
```



In [22]:

```
plt.figure(figsize=(13,5))
sns.boxplot(data=X,orient='h')
plt.show()
```

Pregnancies
Glucose
BloodPressure



SPLITTING OF DATA FOR TRAINING AND TESTING IN THE RATIO OF 75:25

In [23]:

```
X
```

Out[23]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
0	6.000000	148.0	72.0	35.000000	79.799479	33.6	0.627	50
1	1.000000	85.0	66.0	29.000000	79.799479	26.6	0.351	31
2	8.000000	183.0	64.0	20.536458	79.799479	23.3	0.672	32
3	1.000000	89.0	66.0	23.000000	94.000000	28.1	0.167	21
4	3.845052	137.0	40.0	35.000000	168.000000	43.1	2.288	33
...	...	...	...	...	...	...	...	...
763	10.000000	101.0	76.0	48.000000	180.000000	32.9	0.171	63
764	2.000000	122.0	70.0	27.000000	79.799479	36.8	0.340	27
765	5.000000	121.0	72.0	23.000000	112.000000	26.2	0.245	30
766	1.000000	126.0	60.0	20.536458	79.799479	30.1	0.349	47
767	1.000000	93.0	70.0	31.000000	79.799479	30.4	0.315	23

768 rows × 8 columns

In [24]:

```
Y
```

Out[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
```

In [25]:

```
from sklearn.model_selection import train_test_split
```

In [26]:

```
X_train , X_test , Y_train , Y_test = train_test_split(X,Y,test_size=0.25,random_state=101)
```

In [27]:

```
X_train
```

Out[27]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
341	1.000000	95.000000	74.0	21.000000	73.000000	25.9	0.673	36
146	9.000000	57.000000	80.0	37.000000	79.799479	32.8	0.096	41
372	3.845052	84.000000	64.0	22.000000	66.000000	35.8	0.545	21
204	6.000000	103.000000	72.0	32.000000	190.000000	37.7	0.324	55
450	1.000000	82.000000	64.0	13.000000	95.000000	21.2	0.415	23
...	...	...	...	...	...	...	...	...
75	1.000000	120.894531	48.0	20.000000	79.799479	24.7	0.140	22
599	1.000000	109.000000	38.0	18.000000	120.000000	23.1	0.407	26
575	1.000000	119.000000	44.0	47.000000	63.000000	35.5	0.280	25
337	5.000000	115.000000	76.0	20.536458	79.799479	31.2	0.343	44
523	9.000000	130.000000	70.0	20.536458	79.799479	34.2	0.652	45

576 rows × 8 columns

In [28]:

```
Y_train
```

Out[28]:

```
341    0
146    0
372    0
204    0
450    0
      ..
75     0
599    0
575    0
337    1
523    1
Name: Outcome, Length: 576, dtype: int64
```

In [29]:

```
X_test
```

Out[29]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
766	1.000000	126.0	60.0	20.536458	79.799479	30.1	0.349	47
748	3.000000	187.0	70.0	22.000000	200.000000	36.4	0.408	36
42	7.000000	106.0	92.0	18.000000	79.799479	22.7	0.235	48
485	3.845052	135.0	68.0	42.000000	250.000000	42.3	0.365	24
543	4.000000	84.0	90.0	23.000000	56.000000	39.5	0.159	25
...	...	...	...	...	...	...	...	...
593	2.000000	82.0	52.0	22.000000	115.000000	28.5	1.699	25
335	3.845052	165.0	76.0	43.000000	255.000000	47.9	0.259	26
473	7.000000	136.0	90.0	20.536458	79.799479	29.9	0.210	50
130	4.000000	173.0	70.0	14.000000	168.000000	29.7	0.361	33
48	7.000000	103.0	66.0	32.000000	79.799479	39.1	0.344	31

192 rows × 8 columns

In [30]:

```
Y_test
```

Out[30]:

```
766    1
748    1
42     0
485    1
543    0
      ..
593    0
335    0
473    0
130    1
48     1
Name: Outcome, Length: 192, dtype: int64
```

In [ ]:

```

```

STANDARD SCALER

In [31]:

```
from sklearn.preprocessing import StandardScaler
std=StandardScaler()
```

In [32]:

```
X_train_std=std.fit_transform(X_train)
X_test_std=std.transform(X_test)
```

In [33]:

```
X_train_std
```

Out[33]:

```
array([[-1.15569536, -0.87560446,  0.14113892, ..., -0.94687861,
         0.63088494,  0.22975102],
       [ 1.58691234, -2.13618689,  0.64283313, ...,  0.04373097,
        -1.20512382,  0.64880292],
       [-0.18033764, -1.2405099 , -0.69501809, ...,  0.47443079,
         0.22359011, -1.02740468],
       ...,
       [-1.15569536, -0.07944714, -2.36733211, ...,  0.43136081,
        -0.61963749, -0.69216316],
       [ 0.21560849, -0.21214003,  0.30837032, ..., -0.18597559,
         0.41917206,  0.90023407],
        -0.41917206,   0.90023407],
       [ 1.58691234,   0.2854583 , -0.19332388, ...,   0.24472422,
         0.56406313,   0.98404445]])
```

In [ ]:

```

```

TRAIN OUR MODEL LOGISTIC REGRESSION

In [34]:

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

In [35]:

```
lr.fit(X_train_std,Y_train)
```

Out[35]:

```
▼  LogisticRegression i ?

LogisticRegression()
```

In [36]:

```
Y_pred=lr.predict(X_test_std)
```

In [37]:

```
Y_pred
```

Out[37]:

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

In [38]:

```
Y_test
```

Out[38]:

```
766    1
748    1
42     0
485    1
543    0
      ..
593    0
335    0
473    0
130    1
48     1
Name: Outcome, Length: 192, dtype: int64
```

In [39]:

```
X_test
```

Out[39]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age
766	1.000000	126.0	60.0	20.536458	79.799479	30.1	0.349	47
748	3.000000	187.0	70.0	22.000000	200.000000	36.4	0.408	36
42	7.000000	106.0	92.0	18.000000	79.799479	22.7	0.235	48
485	3.845052	135.0	68.0	42.000000	250.000000	42.3	0.365	24
543	4.000000	84.0	90.0	23.000000	56.000000	39.5	0.159	25
...	...	...	...	...	...	...	...	...
593	2.000000	82.0	52.0	22.000000	115.000000	28.5	1.699	25
335	3.845052	165.0	76.0	43.000000	255.000000	47.9	0.259	26
473	7.000000	136.0	90.0	20.536458	79.799479	29.9	0.210	50
130	4.000000	173.0	70.0	14.000000	168.000000	29.7	0.361	33
48	7.000000	103.0	66.0	32.000000	79.799479	39.1	0.344	31

192 rows × 8 columns

In [40]:

```
from sklearn.metrics import accuracy_score
```

In [41]:

```
accuracy_score(Y_test,Y_pred) * 100
```

Out[41]:

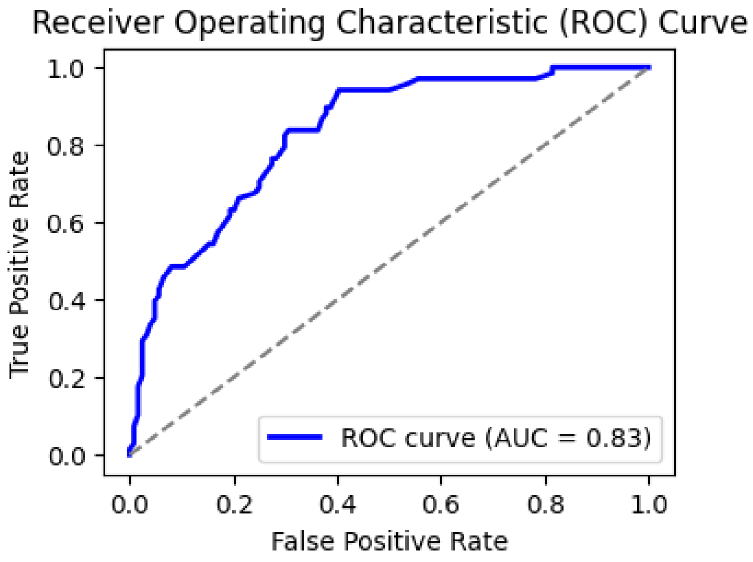
```
79.16666666666666
```

In [42]:

```
#ROC Curve
from sklearn.metrics import roc_curve, auc
fpr, tpr, thresholds = roc_curve(Y_test, lr.predict_proba(X_test)[:, 1])
roc_auc = auc(fpr, tpr)
```

In [64]:

```
plt.figure(figsize=(4, 3))
plt.plot(fpr, tpr, color='blue', lw=2, label='ROC curve (AUC = %0.2f)' % roc_auc)
plt.plot([0, 1], [0, 1], color='gray', linestyle='--')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic (ROC) Curve')
plt.legend(loc='lower right')
plt.show()
```



In [ ]:

```

```

DECISION TREE

In [44]:

```
from sklearn.tree import DecisionTreeClassifier
dt=DecisionTreeClassifier()
```

In [45]:

```
dt.fit(X_train_std,Y_train)
```

Out[45]:

```
▼ DecisionTreeClassifier i ?

DecisionTreeClassifier()
```

In [46]:

```
Y_pred=dt.predict(X_test_std)
```

In [47]:

```
Y_pred
```

Out[47]:

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

In [48]:

```
Y_test
```

Out[48]:

```
766    1
748    1
42     0
485    1
543    0
      ..
593    0
335    0
473    0
130    1
48     1
```

```
Name: Outcome, Length: 192, dtype: int64
```

In [49]:

```
accuracy_score(Y_test,Y_pred)*100
```

Out[49]:

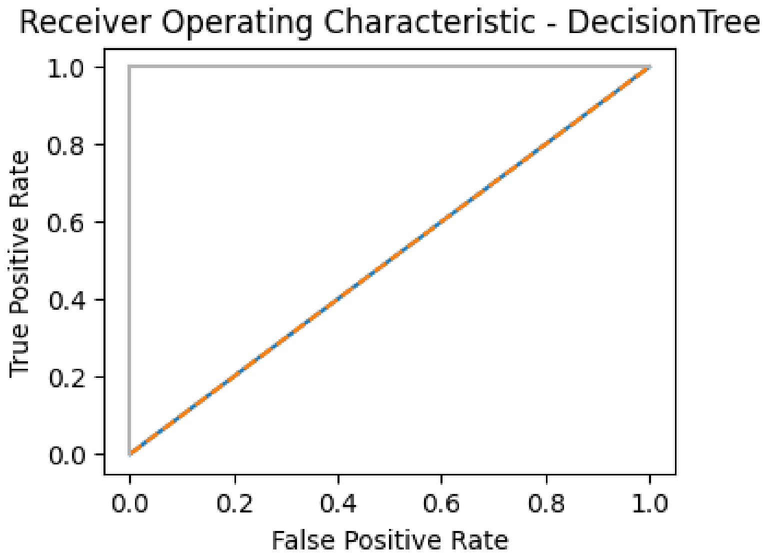
```
71.875
```

In [50]:

```
#ROC Curve
from sklearn.metrics import roc_curve, roc_auc_score
Y_pred = dt.predict_proba(X_test)[:,1]
false_positive_rate, true_positive_rate, threshold = roc_curve(Y_test, Y_pred)
```

In [63]:

```
plt.subplots(1, figsize=(4,3))
plt.title('Receiver Operating Characteristic - DecisionTree')
plt.plot(false_positive_rate, true_positive_rate)
plt.plot([0, 1], ls="--")
plt.plot([0, 0], [1, 0] , c=".7"), plt.plot([1, 1] , c=".7")
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



In [ ]:

Random Forest

In [52]:

```
from sklearn.ensemble import RandomForestClassifier
rf = RandomForestClassifier()
```

In [53]:

```
rf.fit(X_train, Y_train)
```

Out[53]:

```
▼ RandomForestClassifier i ?

RandomForestClassifier()
```

In [54]:

```
Y_pred = rf.predict(X_test_std)
```

In [55]:

```
Y_pred
```

Out[55]:

```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0], dtype=int64)
```

In [56]:

```
Y_test
```

Out[56]:

```
766    1
748    1
42     0
485    1
543    0
```

```
        ..
593     0
335     0
473     0
130     1
48      1
Name: Outcome, Length: 192, dtype: int64
```

In [57]:

```
from sklearn.metrics import accuracy_score
accuracy_score(Y_pred,Y_test)*100
```

Out[57]:

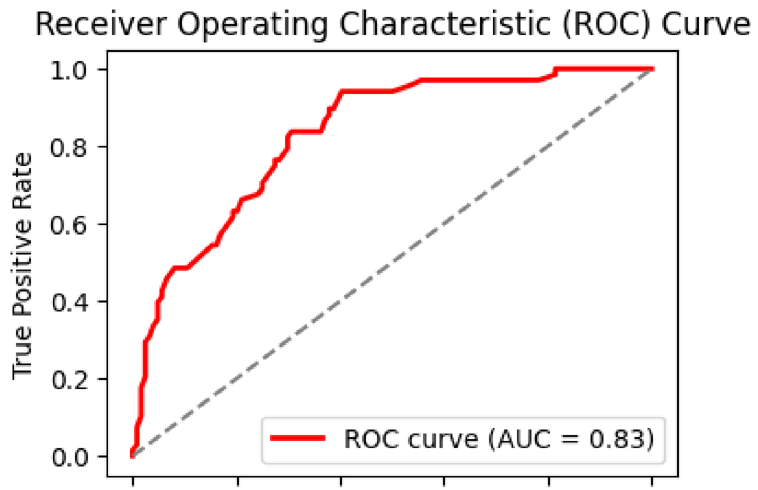
```
64.58333333333334
```

In [58]:

```
#ROC Curve
from sklearn.metrics import roc_curve, auc
fpr, tpr, thresholds = roc_curve(Y_test, rf.predict_proba(X_test)[:, 1])
roc_auc = auc(fpr, tpr)
```

In [65]:

```
plt.figure(figsize=(4, 3))
plt.plot(fpr, tpr, color='red', lw=2, label='ROC curve (AUC = %0.2f)' % roc_auc)
plt.plot([0, 1], [0, 1], color='gray', linestyle='--')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic (ROC) Curve')
plt.legend(loc='lower right')
plt.show()
```



```
In [ ]:
```