In [1]:
```
from mlxtend.plotting import plot_decision_regions
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()
import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

In [2]:
```
diabetes_data = pd.read_csv('diabetes.csv')
diabetes_data.head()
```

Out[2]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Pedigree	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

In [3]:
```
diabetes_data.info(verbose=True)
```

```
<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   Pedigree       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 [4]:
```
diabetes_data.info(verbose=False)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Columns: 9 entries, Pregnancies to Outcome
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

In [5]:
```
diabetes_data.describe()
```

Out[5]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Pedigr
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000(
mean	3.845052	120.894531	69.105469	20.536458	79.799479	31.992578	0.4718
std	3.369578	31.972618	19.355807	15.952218	115.244002	7.884160	0.3313
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.078(
25%	1.000000	99.000000	62.000000	0.000000	0.000000	27.300000	0.2437
50%	3.000000	117.000000	72.000000	23.000000	30.500000	32.000000	0.3725
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	0.6262
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	2.420(

In [6]:
```
diabetes_data.describe().T
```

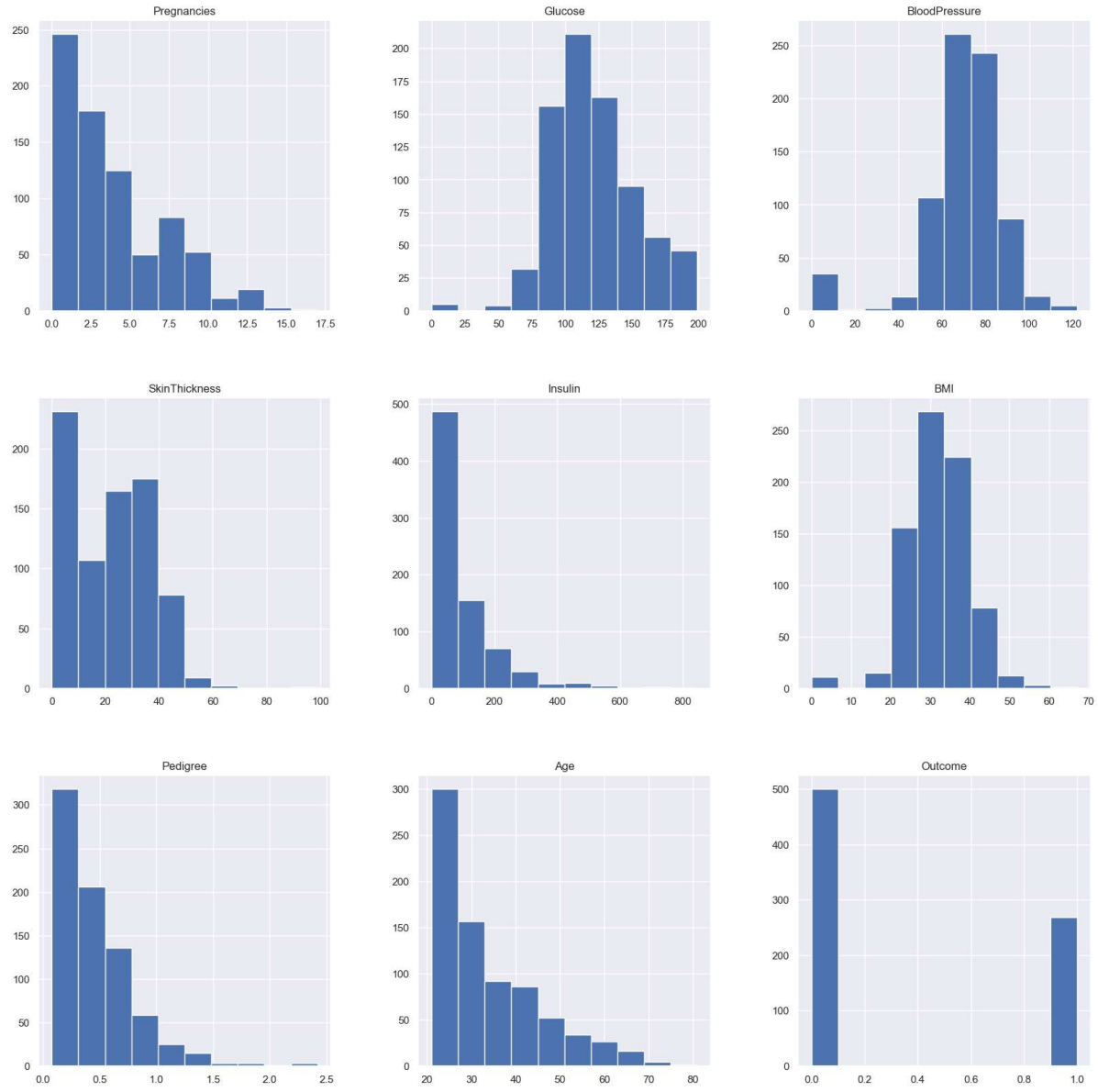
Out[6]:

	count	mean	std	min	25%	50%	75%	max
Pregnancies	768.0	3.845052	3.369578	0.000	1.00000	3.0000	6.00000	17.00
Glucose	768.0	120.894531	31.972618	0.000	99.00000	117.0000	140.25000	199.00
BloodPressure	768.0	69.105469	19.355807	0.000	62.00000	72.0000	80.00000	122.00
SkinThickness	768.0	20.536458	15.952218	0.000	0.00000	23.0000	32.00000	99.00
Insulin	768.0	79.799479	115.244002	0.000	0.00000	30.5000	127.25000	846.00
BMI	768.0	31.992578	7.884160	0.000	27.30000	32.0000	36.60000	67.10
Pedigree	768.0	0.471876	0.331329	0.078	0.24375	0.3725	0.62625	2.42
Age	768.0	33.240885	11.760232	21.000	24.00000	29.0000	41.00000	81.00
Outcome	768.0	0.348958	0.476951	0.000	0.00000	0.0000	1.00000	1.00

In [7]:
```
diabetes_data_copy = diabetes_data.copy(deep = True)
diabetes_data_copy[['Glucose','BloodPressure','SkinThickness','Insulin','BMI']

print(diabetes_data_copy.isnull().sum())
```

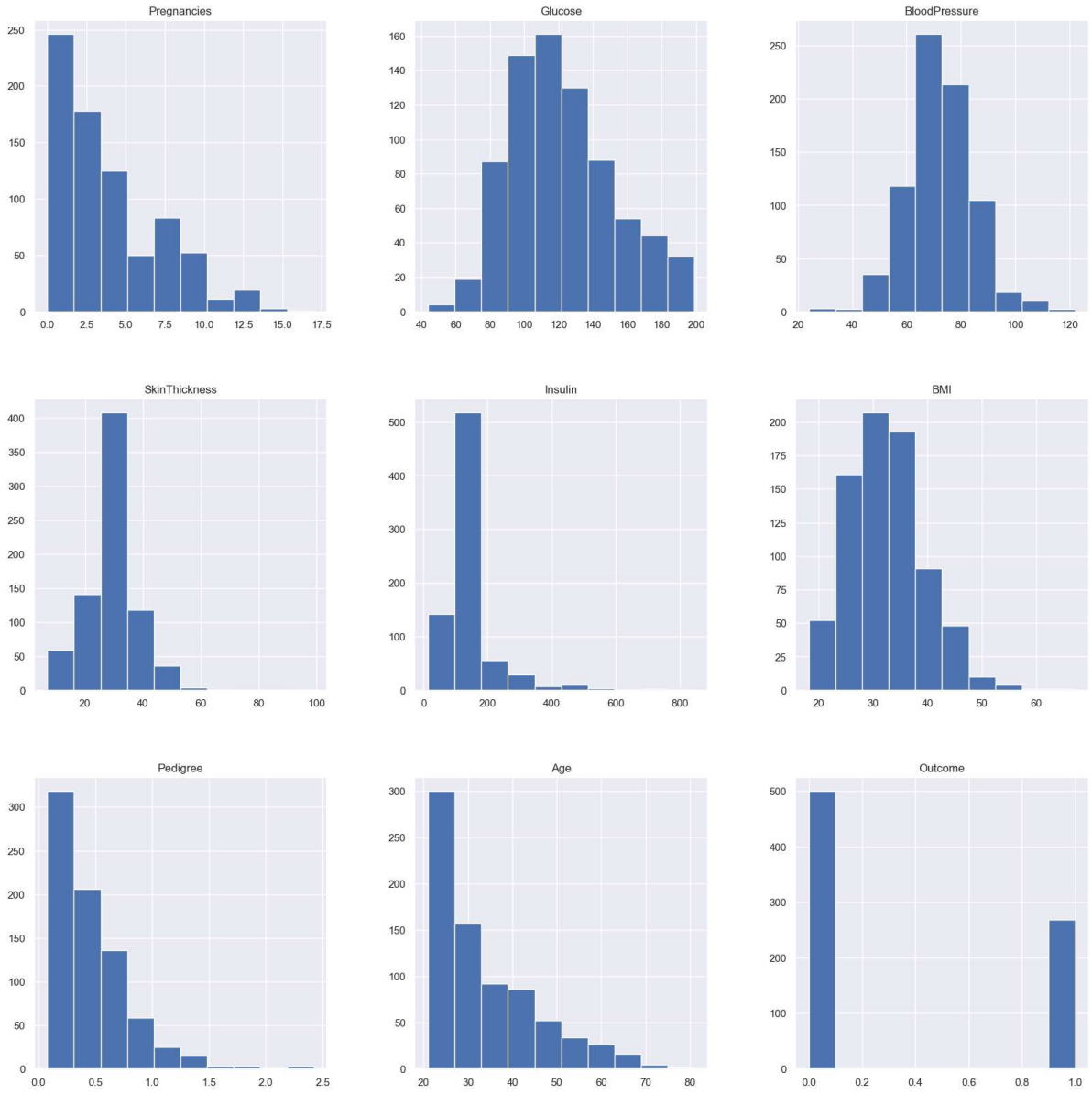
```
Pregnancies         0
Glucose             5
BloodPressure      35
SkinThickness     227
Insulin           374
BMI                11
Pedigree            0
Age                 0
Outcome             0
dtype: int64
```

In [8]:
```
p = diabetes_data.hist(figsize = (20,20))
```



In [9]:
```
diabetes_data_copy['Glucose'].fillna(diabetes_data_copy['Glucose'].mean(), inp
diabetes_data_copy['BloodPressure'].fillna(diabetes_data_copy['BloodPressure']
diabetes_data_copy['SkinThickness'].fillna(diabetes_data_copy['SkinThickness']
diabetes_data_copy['Insulin'].fillna(diabetes_data_copy['Insulin'].median(), i
diabetes_data_copy['BMI'].fillna(diabetes_data_copy['BMI'].median(), inplace =
```

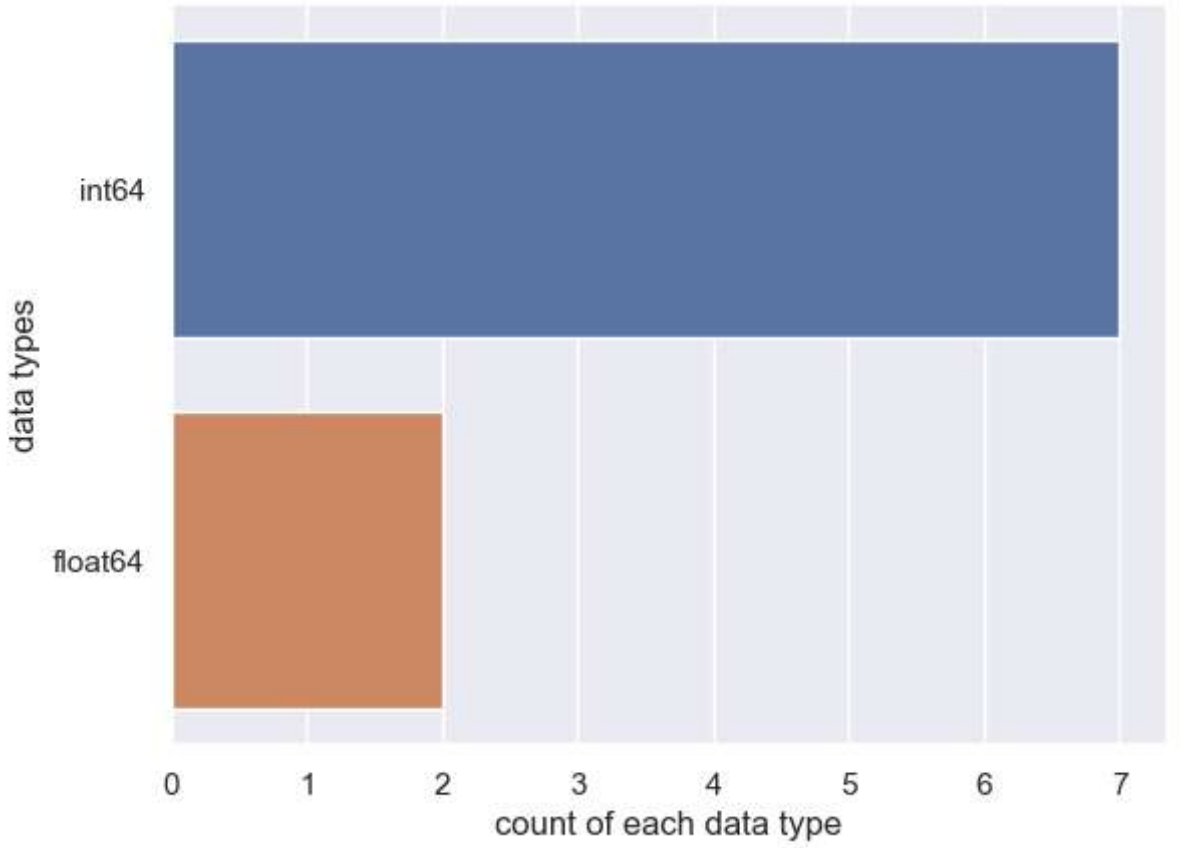
In [10]:
```
p = diabetes_data_copy.hist(figsize = (20,20))
```



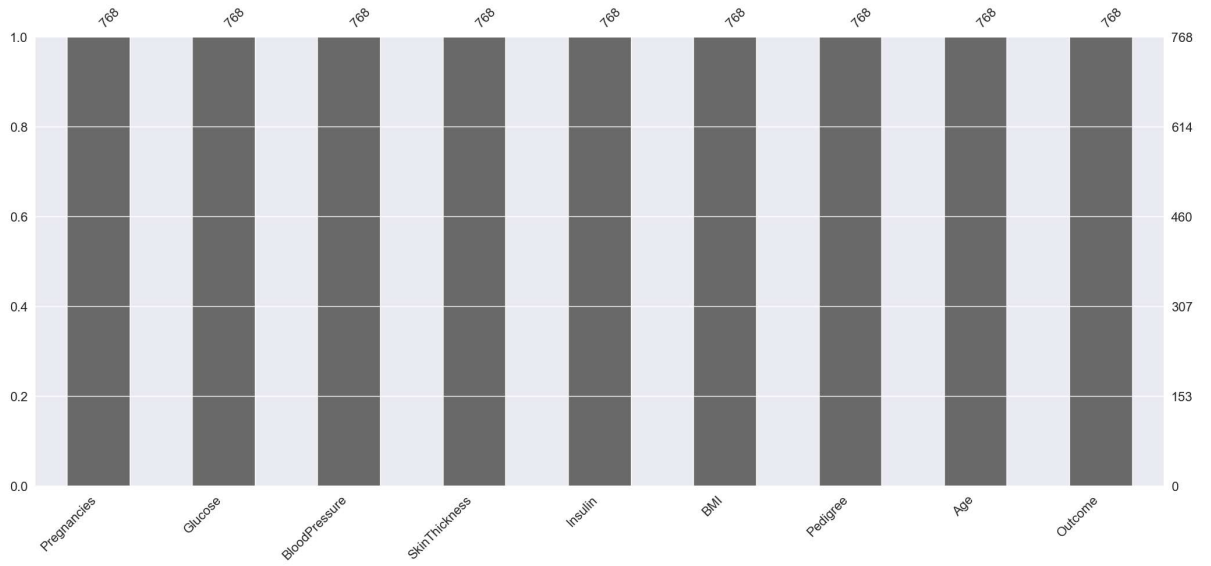
In [11]:
```
diabetes_data.shape
```

Out[11]:
```
(768, 9)
```

In [12]:
```
sns.countplot(y=diabetes_data.dtypes ,data=diabetes_data)
plt.xlabel("count of each data type")
plt.ylabel("data types")
plt.show()
```

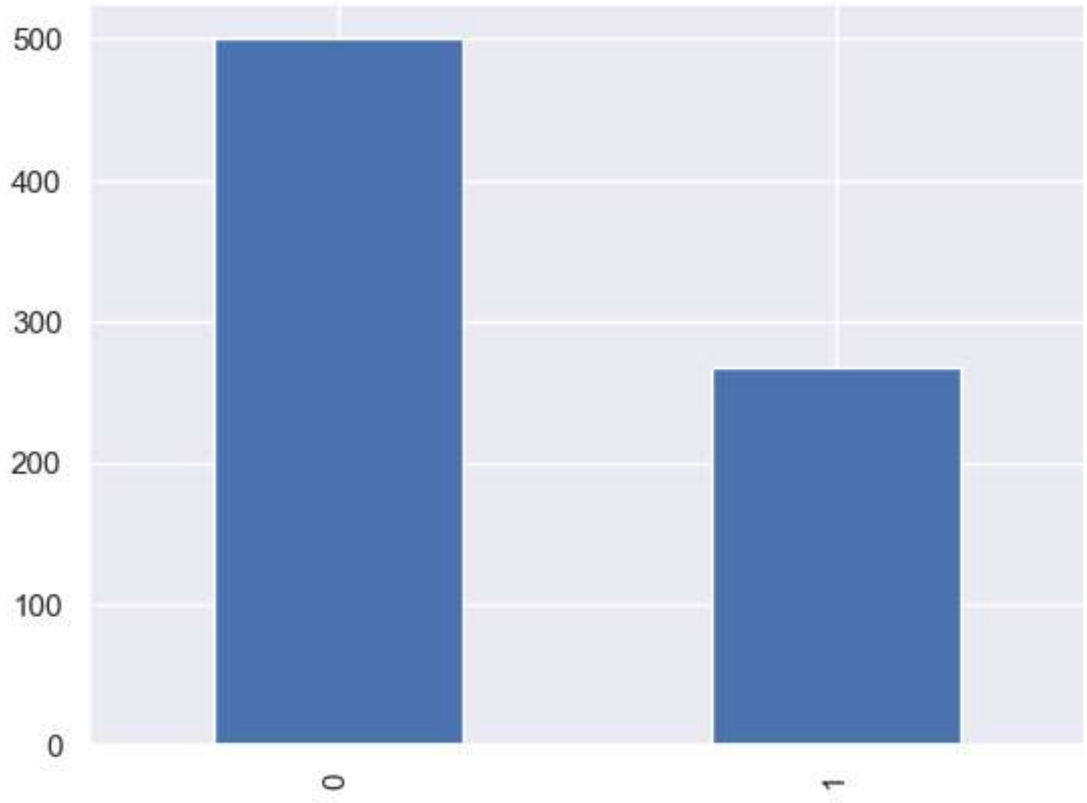


In [15]:
```
import missingno as msno
p=msno.bar(diabetes_data)
```



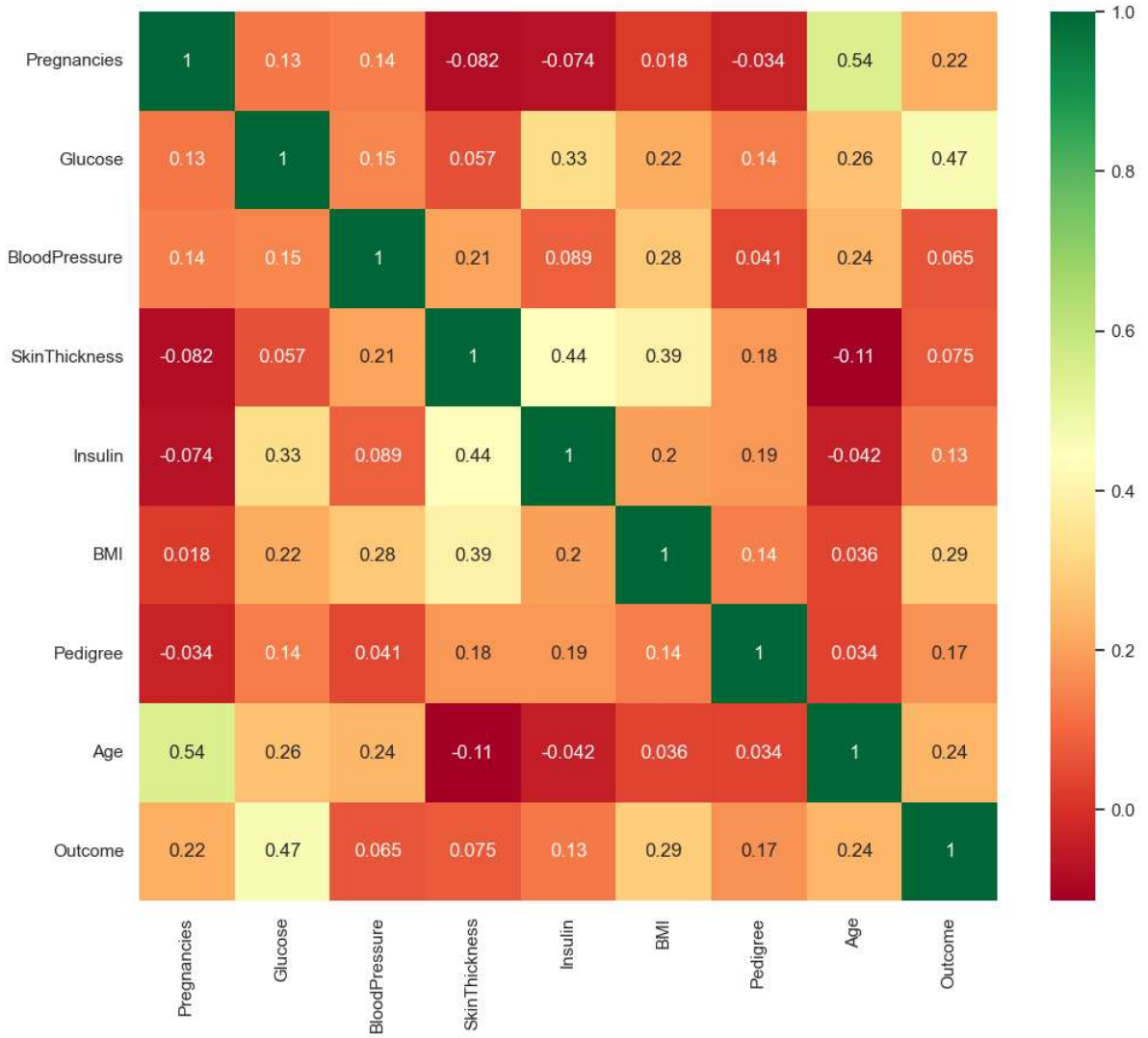
In [16]:
```
color_wheel = {1: "#0392cf",
               2: "#7bc043"}
colors = diabetes_data["Outcome"].map(lambda x: color_wheel.get(x + 1))
print(diabetes_data.Outcome.value_counts())
p=diabetes_data.Outcome.value_counts().plot(kind="bar")
```

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

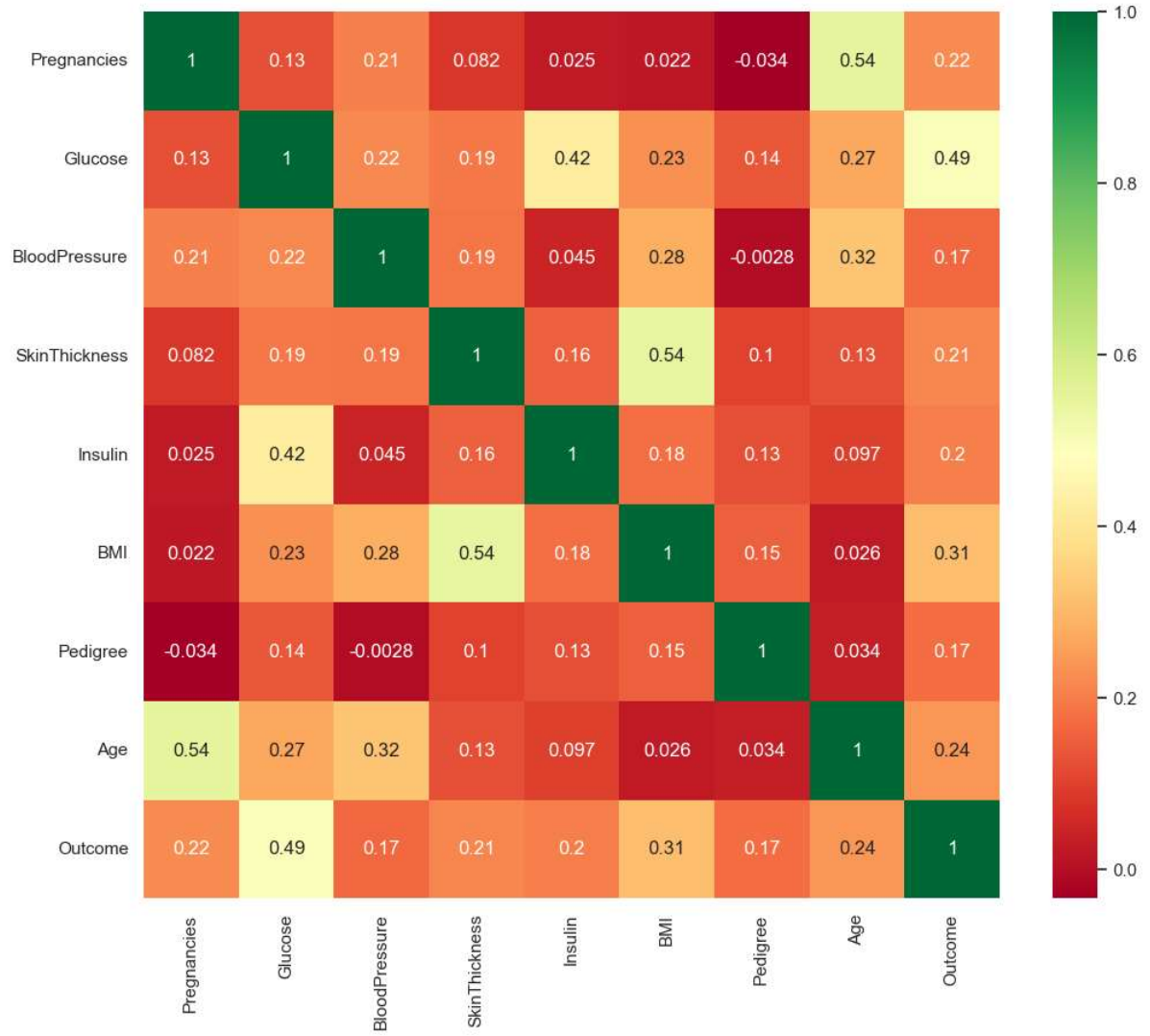


In [31]:
```
p=sns.pairplot(diabetes_data_copy, hue = 'Outcome')
```

In [32]:
```
plt.figure(figsize=(12,10))
p=sns.heatmap(diabetes_data.corr(), annot=True,cmap ='RdYlGn')
```



In [33]:
```
plt.figure(figsize=(12,10))
p=sns.heatmap(diabetes_data_copy.corr(), annot=True,cmap ='RdYlGn')
```



In [34]:
```
from sklearn.preprocessing import StandardScaler
sc_X = StandardScaler()
X =  pd.DataFrame(sc_X.fit_transform(diabetes_data_copy.drop(["Outcome"],axis
       columns=['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', '
      'BMI', 'DiabetesPedigreeFunction', 'Age'])
```

In [35]:
```
X.head()
```

Out[35]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeI
0	0.639947	0.865108	-0.033518	0.670643	-0.181541	0.166619	
1	-0.844885	-1.206162	-0.529859	-0.012301	-0.181541	-0.852200	
2	1.233880	2.015813	-0.695306	-0.012301	-0.181541	-1.332500	
3	-0.844885	-1.074652	-0.529859	-0.695245	-0.540642	-0.633881	
4	-1.141852	0.503458	-2.680669	0.670643	0.316566	1.549303	

In [36]:
```
y = diabetes_data_copy.Outcome
```

In [37]:
```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=1/3,random_stat
```

In [38]:
```
from sklearn.neighbors import KNeighborsClassifier


test_scores = []
train_scores = []

for i in range(1,15):

    knn = KNeighborsClassifier(i)
    knn.fit(X_train,y_train)

    train_scores.append(knn.score(X_train,y_train))
    test_scores.append(knn.score(X_test,y_test))
```

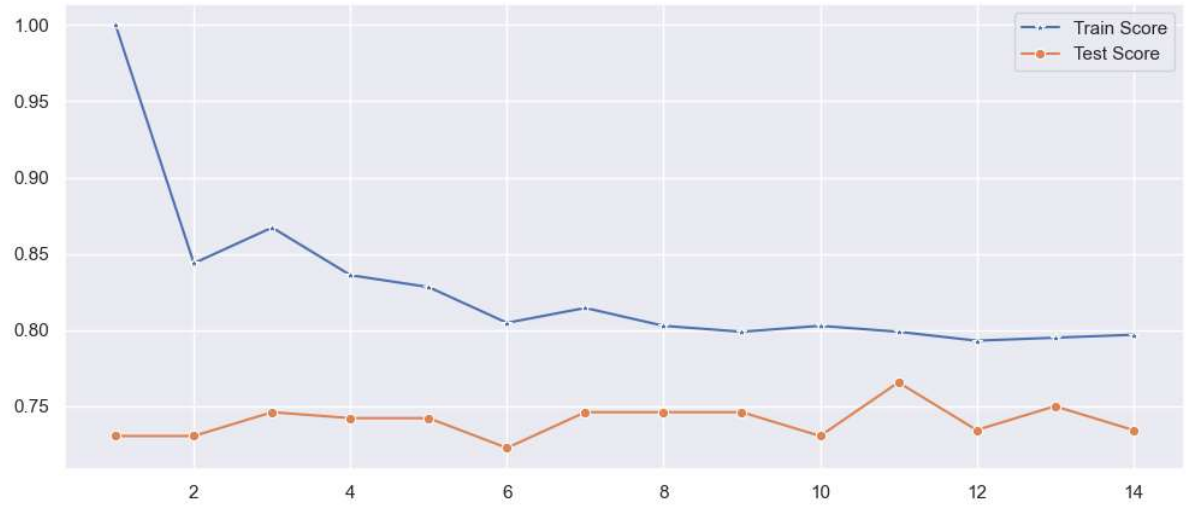
In [39]:
```
max_train_score = max(train_scores)
train_scores_ind = [i for i, v in enumerate(train_scores) if v == max_train_sc
print('Max train score {} % and k = {}'.format(max_train_score*100,list(map(la
```

```
Max train score 100.0 % and k = [1]
```

In [40]:
```
max_test_score = max(test_scores)
test_scores_ind = [i for i, v in enumerate(test_scores) if v == max_test_score
print('Max test score {} % and k = {}'.format(max_test_score*100,list(map(lamb
```

```
Max test score 76.5625 % and k = [11]
```

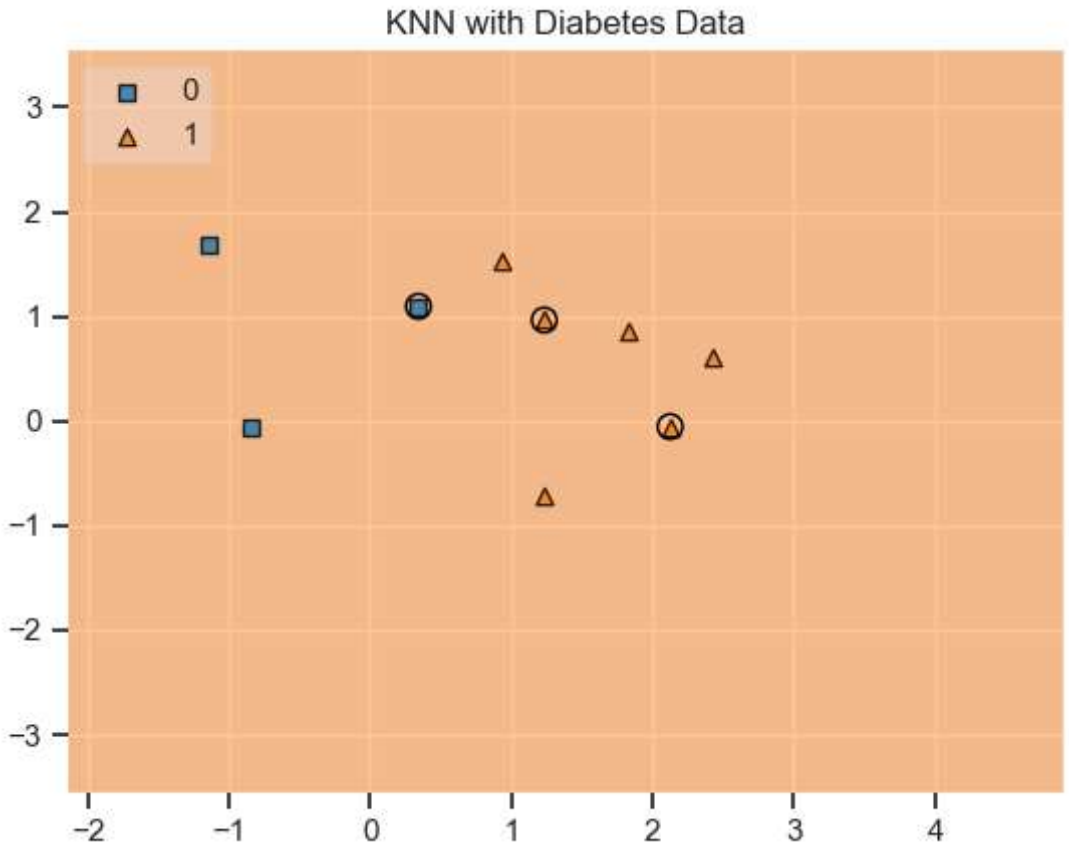
In [41]:
```
plt.figure(figsize=(12,5))
p = sns.lineplot(range(1,15),train_scores,marker='*',label='Train Score')
p = sns.lineplot(range(1,15),test_scores,marker='o',label='Test Score')
```



In [42]:
```
knn = KNeighborsClassifier(11)

knn.fit(X_train,y_train)
knn.score(X_test,y_test)
```

Out[42]: 0.765625

In [43]:
```
value = 20000
width = 20000
plot_decision_regions(X.values, y.values, clf=knn, legend=2,
                      filler_feature_values={2: value, 3: value, 4: value, 5:
                      filler_feature_ranges={2: width, 3: width, 4: width, 5:
                      X_highlight=X_test.values)

plt.title('KNN with Diabetes Data')
plt.show()
```



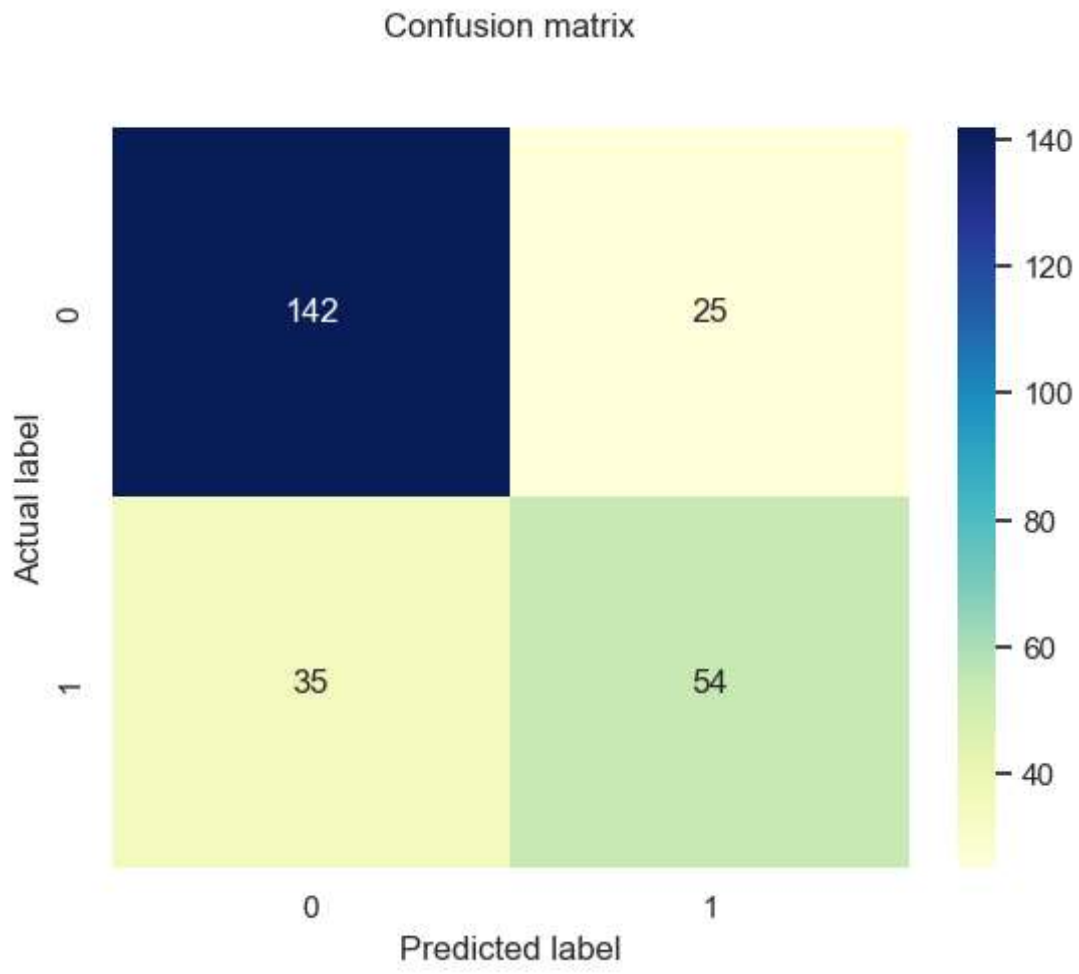
In [44]:
```
from sklearn.metrics import confusion_matrix

y_pred = knn.predict(X_test)
confusion_matrix(y_test,y_pred)
pd.crosstab(y_test, y_pred, rownames=['True'], colnames=['Predicted'], margins
```

Out[44]:

Predicted	0	1	All
True			
0	142	25	167
1	35	54	89
All	177	79	256

In [45]:
```
y_pred = knn.predict(X_test)
from sklearn import metrics
cnf_matrix = metrics.confusion_matrix(y_test, y_pred)
p = sns.heatmap(pd.DataFrame(cnf_matrix), annot=True, cmap="YlGnBu" ,fmt='g')
plt.title('Confusion matrix', y=1.1)
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
```

Out[45]:
```
Text(0.5, 20.049999999999997, 'Predicted label')
```

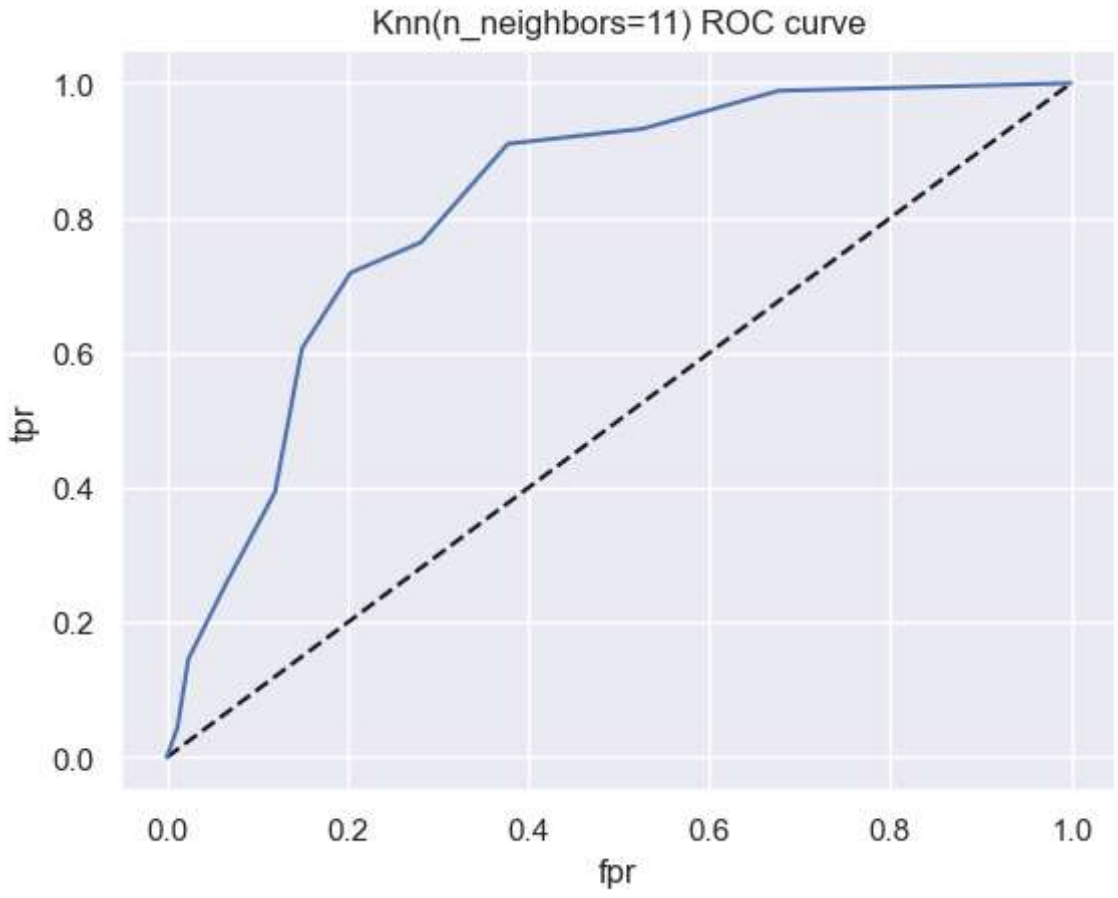


In [46]:
```
from sklearn.metrics import classification_report
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.80      0.85      0.83       167
           1       0.68      0.61      0.64        89

    accuracy                           0.77       256
   macro avg       0.74      0.73      0.73       256
weighted avg       0.76      0.77      0.76       256
```

In [47]:
```
from sklearn.metrics import roc_curve
y_pred_proba = knn.predict_proba(X_test)[:,1]
fpr, tpr, thresholds = roc_curve(y_test, y_pred_proba)
```

In [48]:
```
plt.plot([0,1],[0,1],'k--')
plt.plot(fpr,tpr, label='Knn')
plt.xlabel('fpr')
plt.ylabel('tpr')
plt.title('Knn(n_neighbors=11) ROC curve')
plt.show()
```



In [49]:
```
from sklearn.metrics import roc_auc_score
roc_auc_score(y_test,y_pred_proba)
```

Out[49]:
```
0.8193500639171096
```

In [50]:
```
from sklearn.model_selection import GridSearchCV

param_grid = {'n_neighbors':np.arange(1,50)}
knn = KNeighborsClassifier()
knn_cv= GridSearchCV(knn,param_grid,cv=5)
knn_cv.fit(X,y)

print("Best Score:" + str(knn_cv.best_score_))
print("Best Parameters: " + str(knn_cv.best_params_))
```

```
Best Score:0.7721840251252015
Best Parameters: {'n_neighbors': 25}
```

In [ ]: