Early stage Diabetes Risk prediction

Importing necessary libraries

In [205…
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import accuracy_score,confusion_matrix
%matplotlib inline
```

** Dataset**

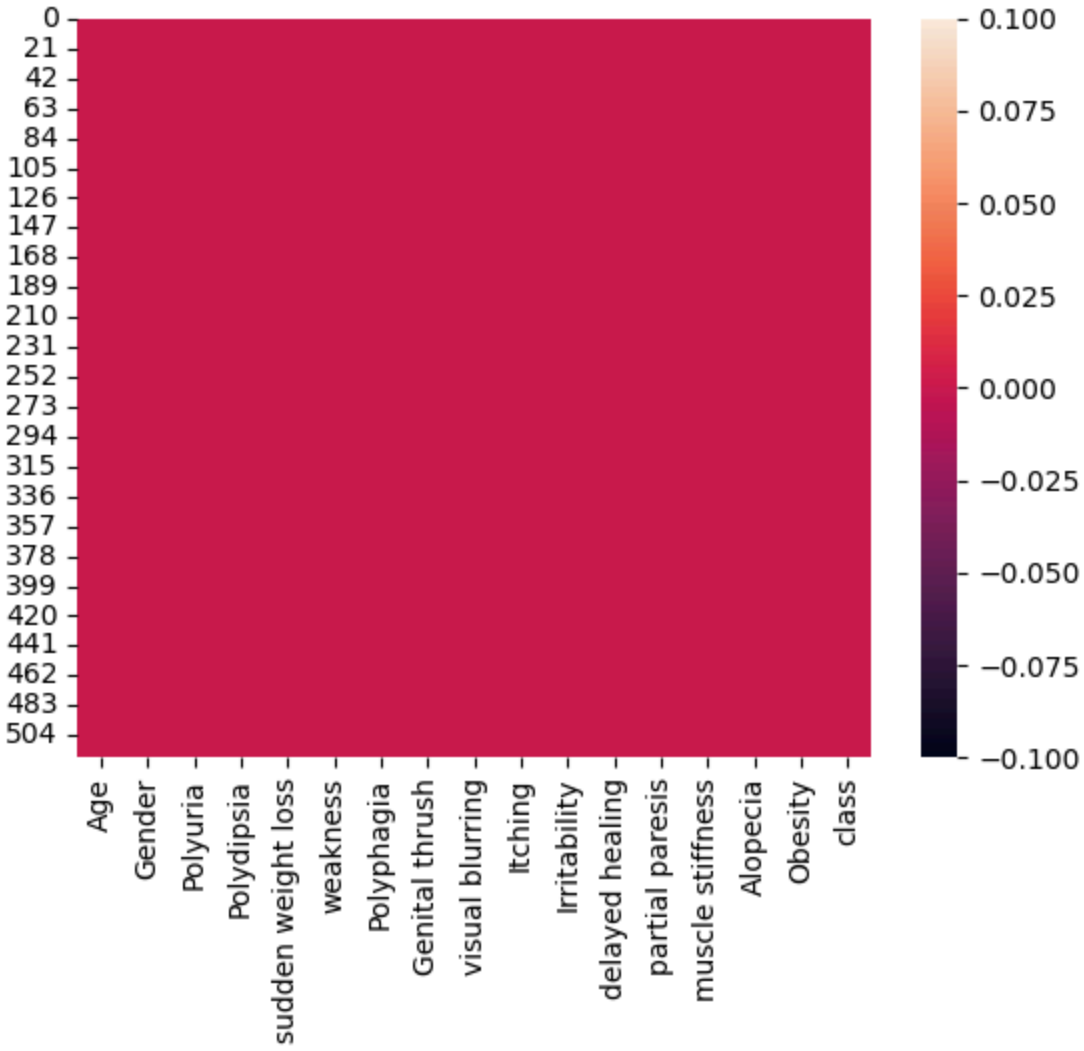
In [207…
```
dataset = pd.read_csv('Project4-diabetes_data.csv')
dataset.head()
```

Out[207…

	Age	Gender	Polyuria	Polydipsia	sudden weight loss	weakness	Polyphagia	Genital thrush	visual blurring	It
0	40	Male	No	Yes	No	Yes	No	No	No	
1	58	Male	No	No	No	Yes	No	No	Yes	
2	41	Male	Yes	No	No	Yes	Yes	No	No	
3	45	Male	No	No	Yes	Yes	Yes	Yes	No	
4	60	Male	Yes	Yes	Yes	Yes	Yes	No	Yes	

Checking whether dataset has null values

In [209…
```
sns.heatmap(dataset.isnull())
plt.show()
```



In [210…
```
dataset['class'].value_counts()
```

Out[210…
```
class
Positive    320
Negative    200
Name: count, dtype: int64
```

Mapping text into values

In [212…
```
dataset['Gender'] = dataset['Gender'].map({'Male':1,'Female':0})
dataset['class'] = dataset['class'].map({'Positive':1,'Negative':0})
dataset['Polyuria'] = dataset['Polyuria'].map({'Yes':1,'No':0})
dataset['Polydipsia'] = dataset['Polydipsia'].map({'Yes':1,'No':0})
dataset['sudden weight loss'] = dataset['sudden weight loss'].map({'Yes':1,'No':0})
dataset['weakness'] = dataset['weakness'].map({'Yes':1,'No':0})
dataset['Polyphagia'] = dataset['Polyphagia'].map({'Yes':1,'No':0})
dataset['Genital thrush'] = dataset['Genital thrush'].map({'Yes':1,'No':0})
dataset['visual blurring'] = dataset['visual blurring'].map({'Yes':1,'No':0})
dataset['Itching'] = dataset['Itching'].map({'Yes':1,'No':0})
dataset['Irritability'] = dataset['Irritability'].map({'Yes':1,'No':0})
dataset['delayed healing'] = dataset['delayed healing'].map({'Yes':1,'No':0})
dataset['partial paresis'] = dataset['partial paresis'].map({'Yes':1,'No':0})
dataset['muscle stiffness'] = dataset['muscle stiffness'].map({'Yes':1,'No':0})
```

```
dataset['Alopecia'] = dataset['Alopecia'].map({'Yes':1,'No':0})
dataset['Obesity'] = dataset['Obesity'].map({'Yes':1,'No':0})
```

Exploratory Data Analysis

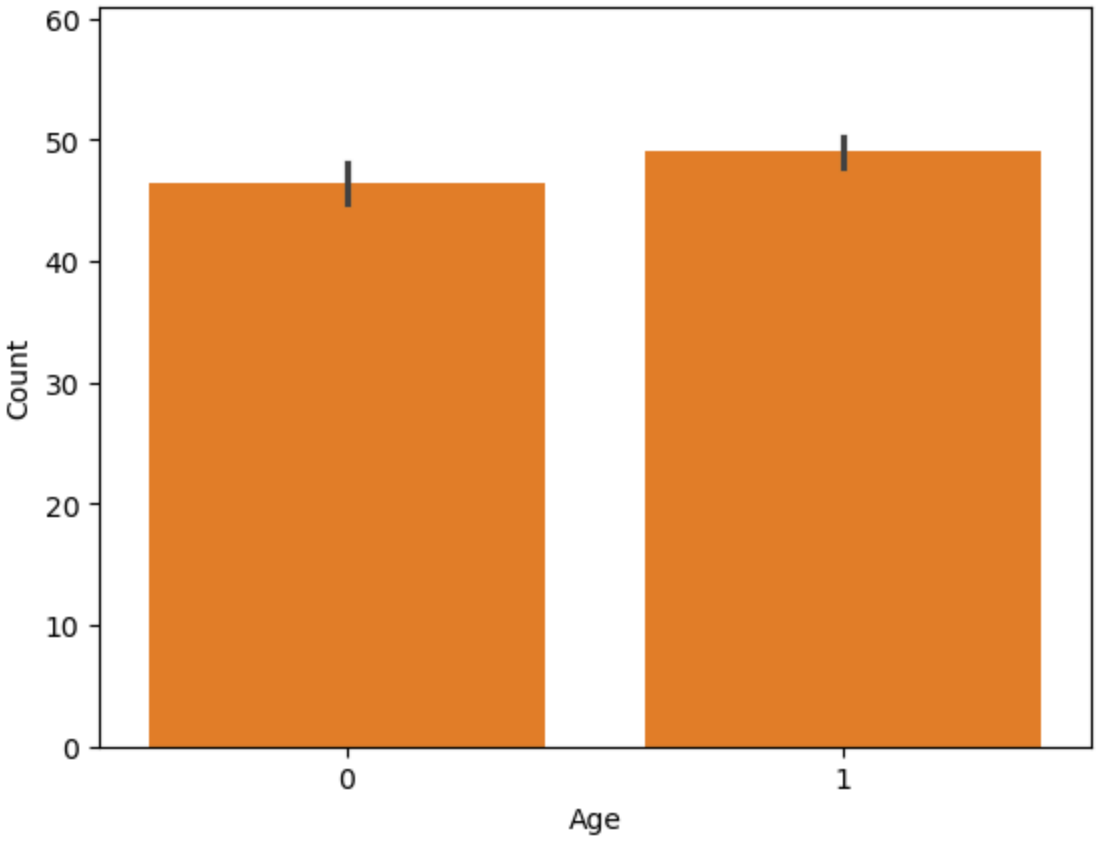
In [215…
```
corrdata = dataset.corr()
```

In [216…
```
sns.histplot(dataset['Age'],bins=30)
```

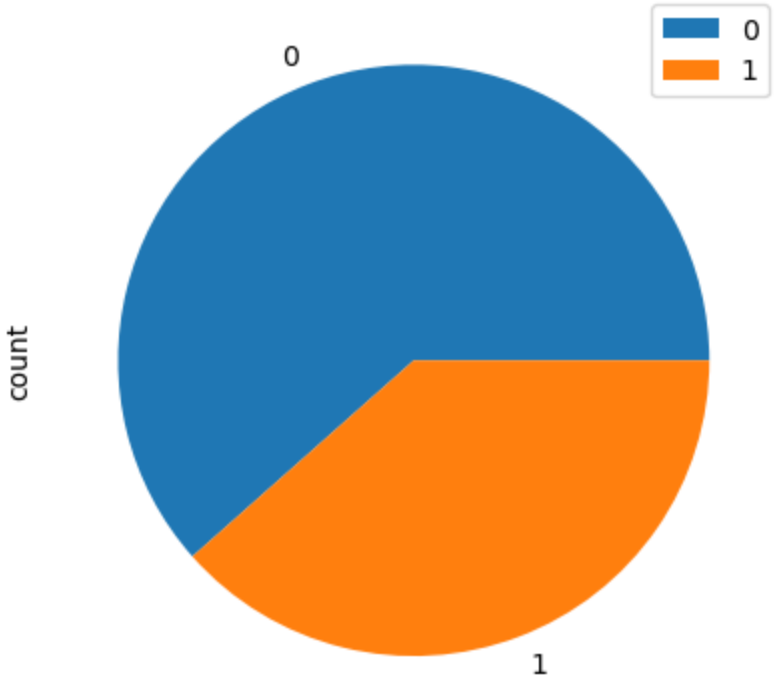
Out[216… `<Axes: xlabel='Age', ylabel='Count'>`

Age

In [218…
```
sns.barplot(x='class',y='Age',data=dataset)
plt.show()
```



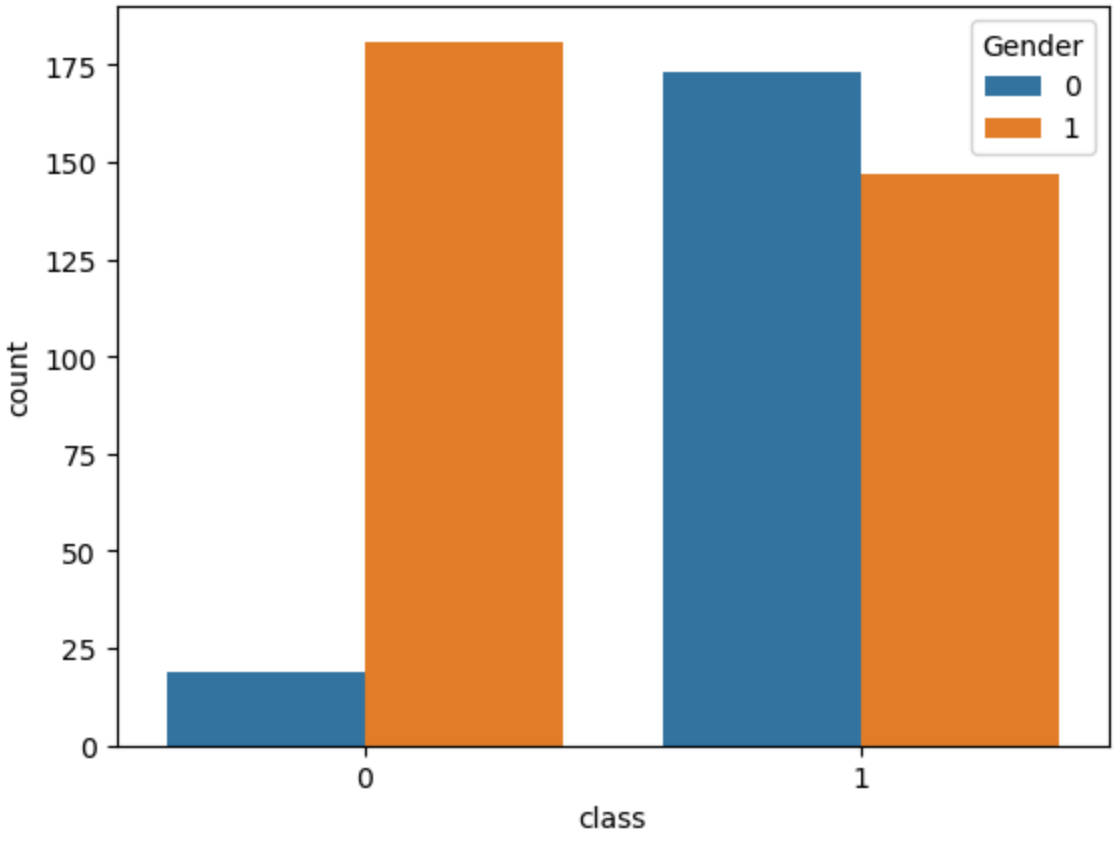
In [219…
```
ds = dataset['class'].value_counts().reset_index()
ds.columns = ['class', 'count']
plot=ds.plot.pie(y='count')
plt.show()
```



Gender

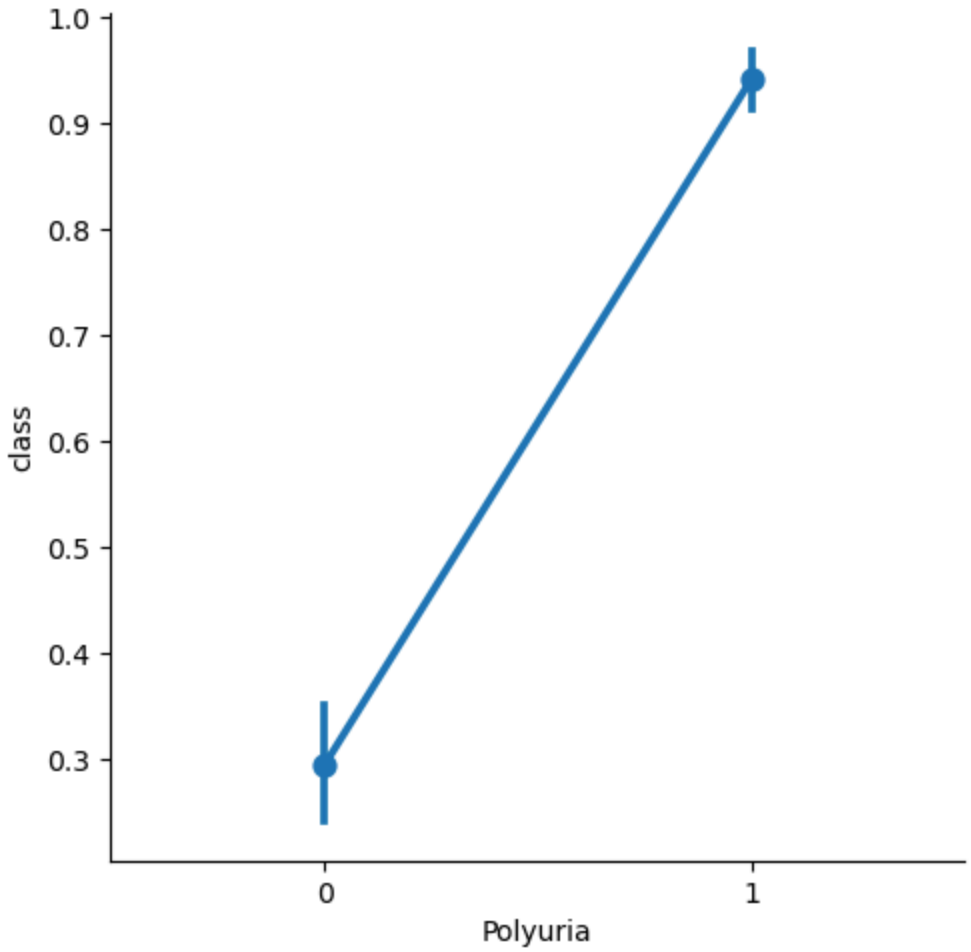
In [221…

```
sns.countplot(x='class',data=dataset,hue='Gender')
plt.show()
```



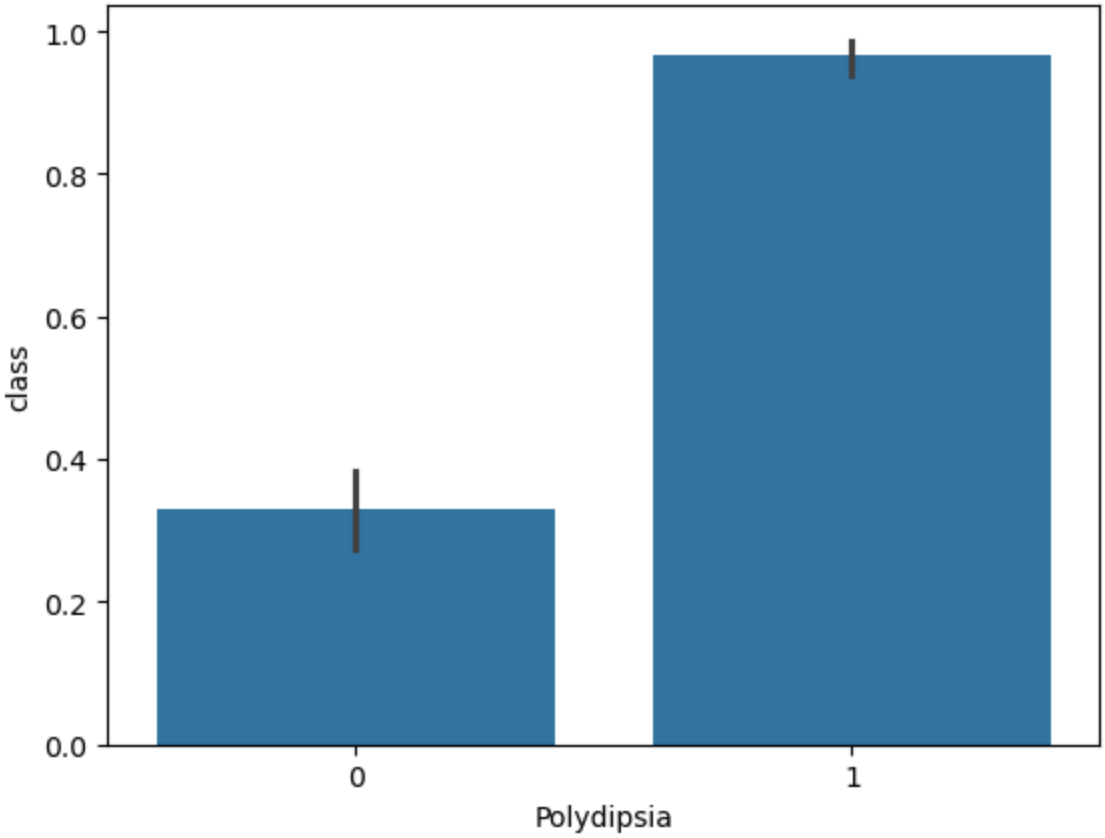
Polyuria

In [223…
```
sns.catplot(x="Polyuria", y="class", kind="point", data=dataset)
plt.show()
```



Polydipsia

In [225…
```
sns.barplot(x='Polydipsia',y='class',data=dataset)
plt.show()
```



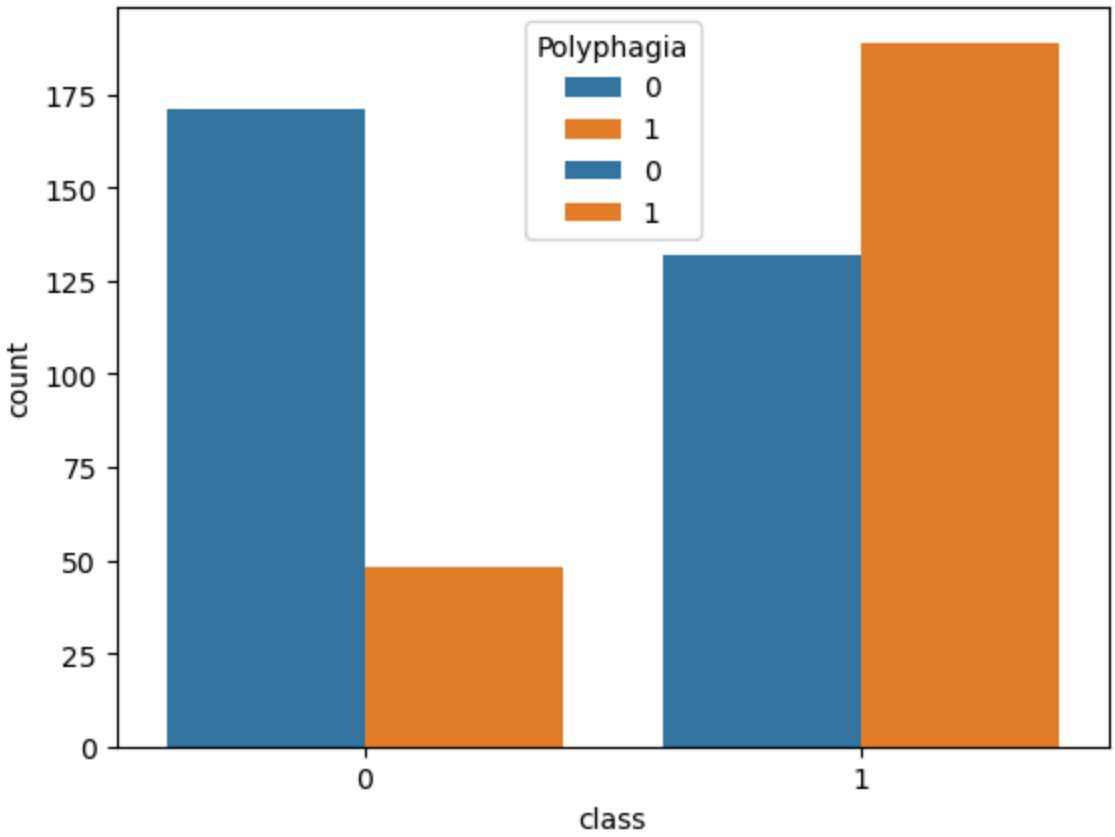
Sudden weight loss

In [227…
```
sns.countplot(x='class',data=dataset,hue='sudden weight loss')
```

Out[227…
```
<Axes: xlabel='class', ylabel='count'>
```

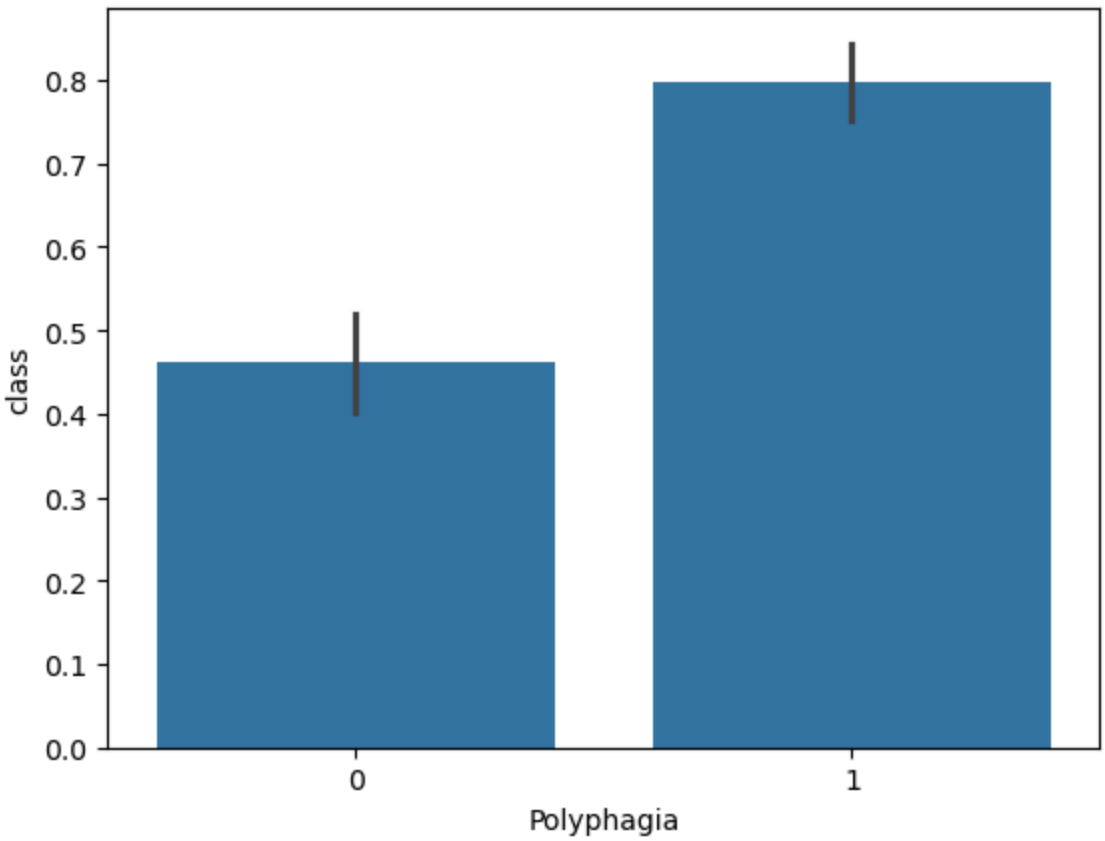
Polyphagia

In [229…
```
sns.countplot(x='class',data=dataset, hue='Polyphagia')
plt.show()
```



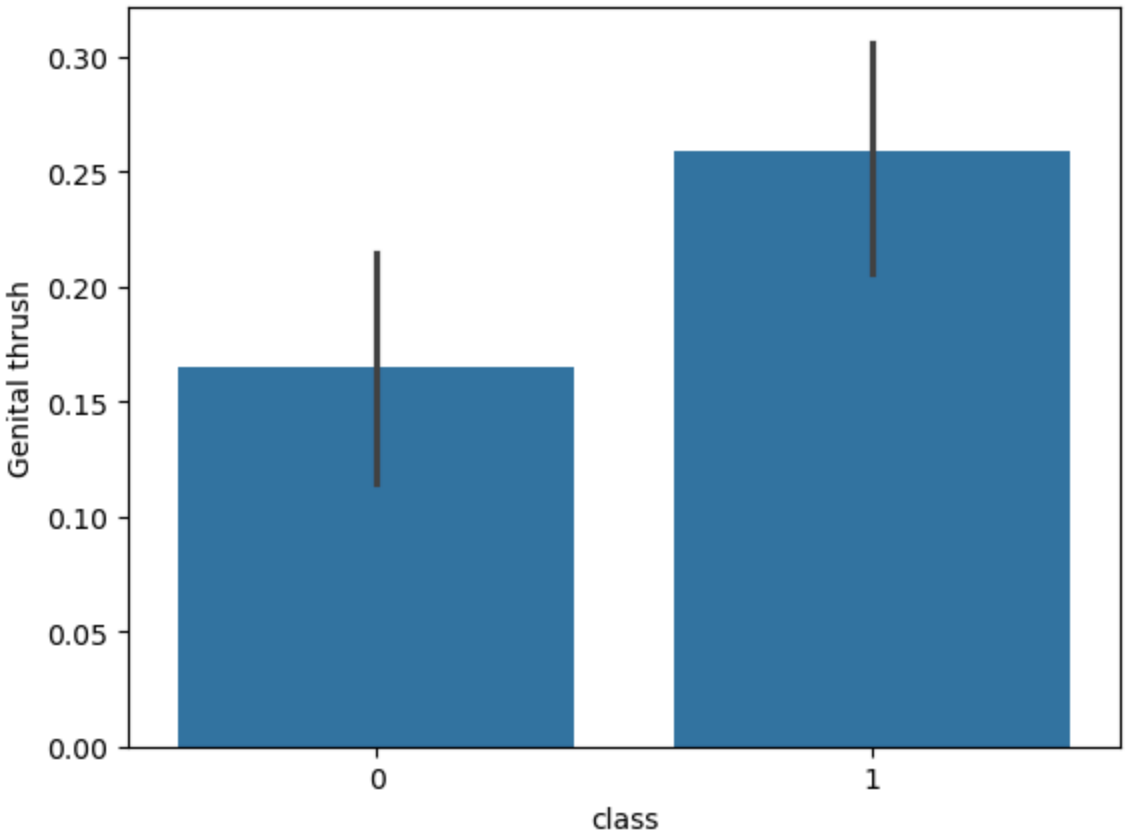
In [230…

```
sns.barplot(x='Polyphagia',y='class',data=dataset)
plt.show()
```



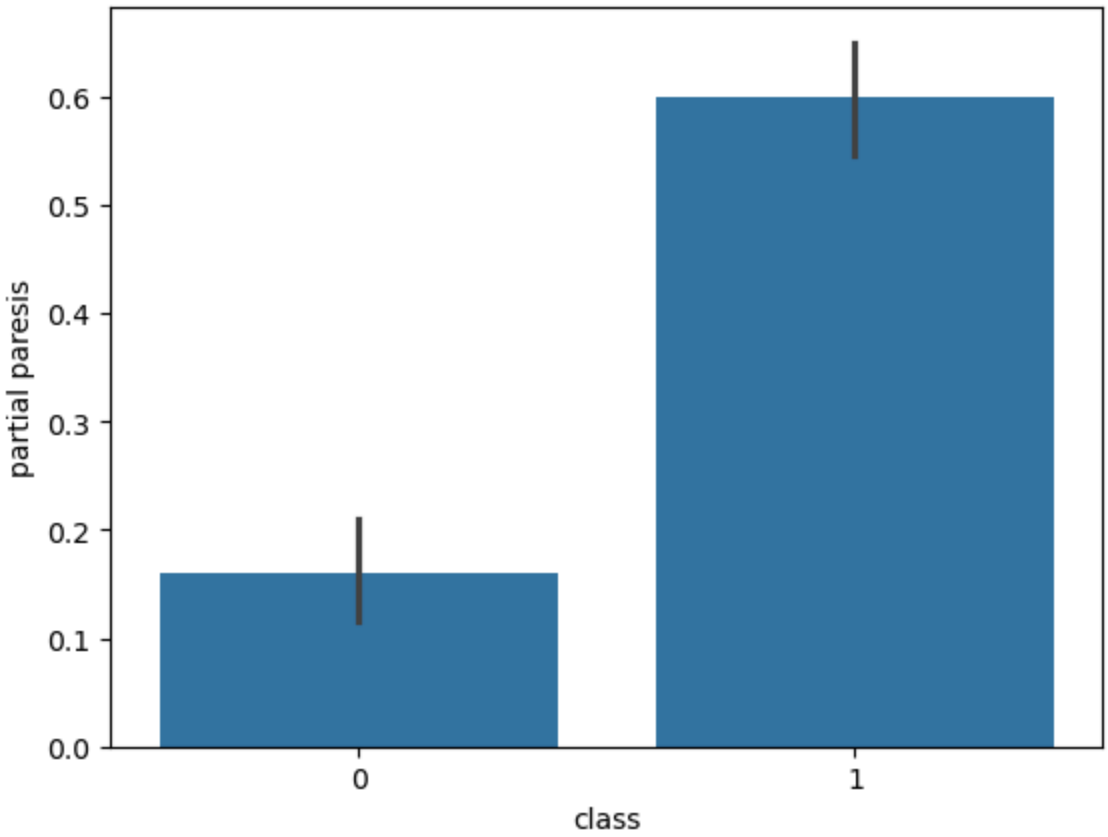
Genital Thrush

In [232…
```
sns.barplot(x='class',y='Genital thrush',data=dataset)
plt.show()
```



Partial paresis

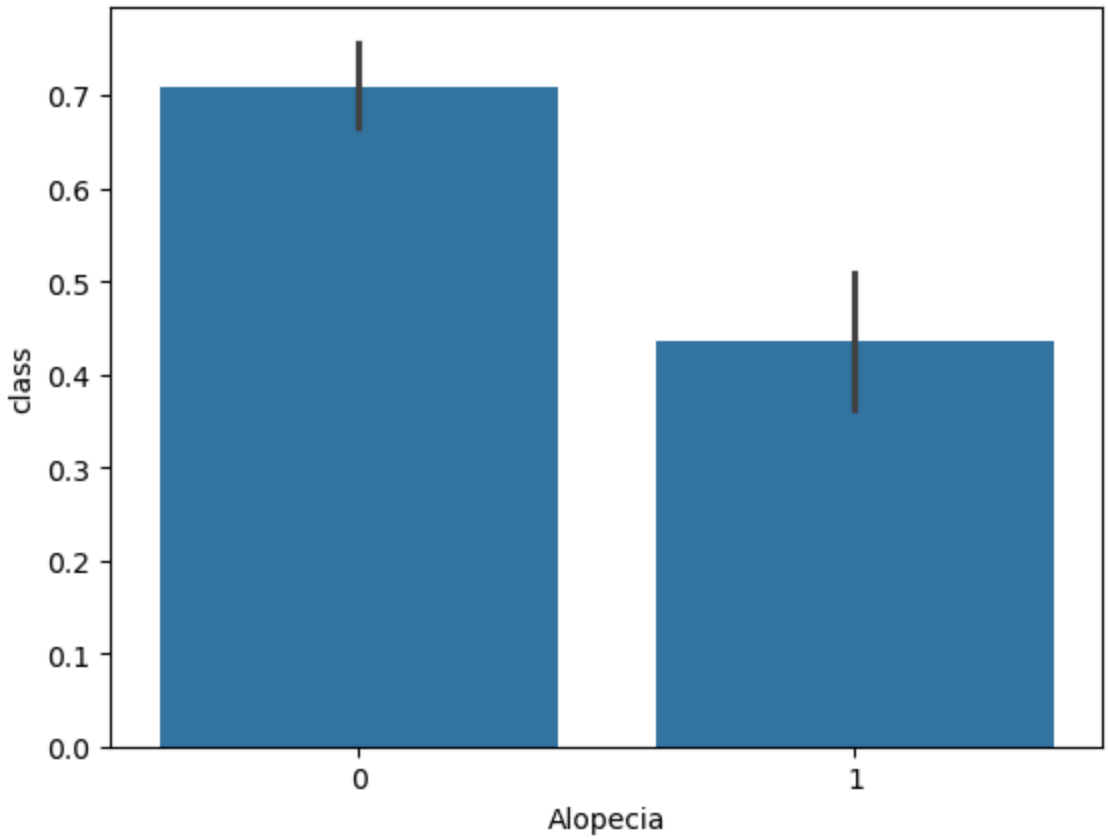
In [234…
```
sns.barplot(x='class',y='partial paresis',data=dataset)
plt.show()
```



Alopecia

In [236…

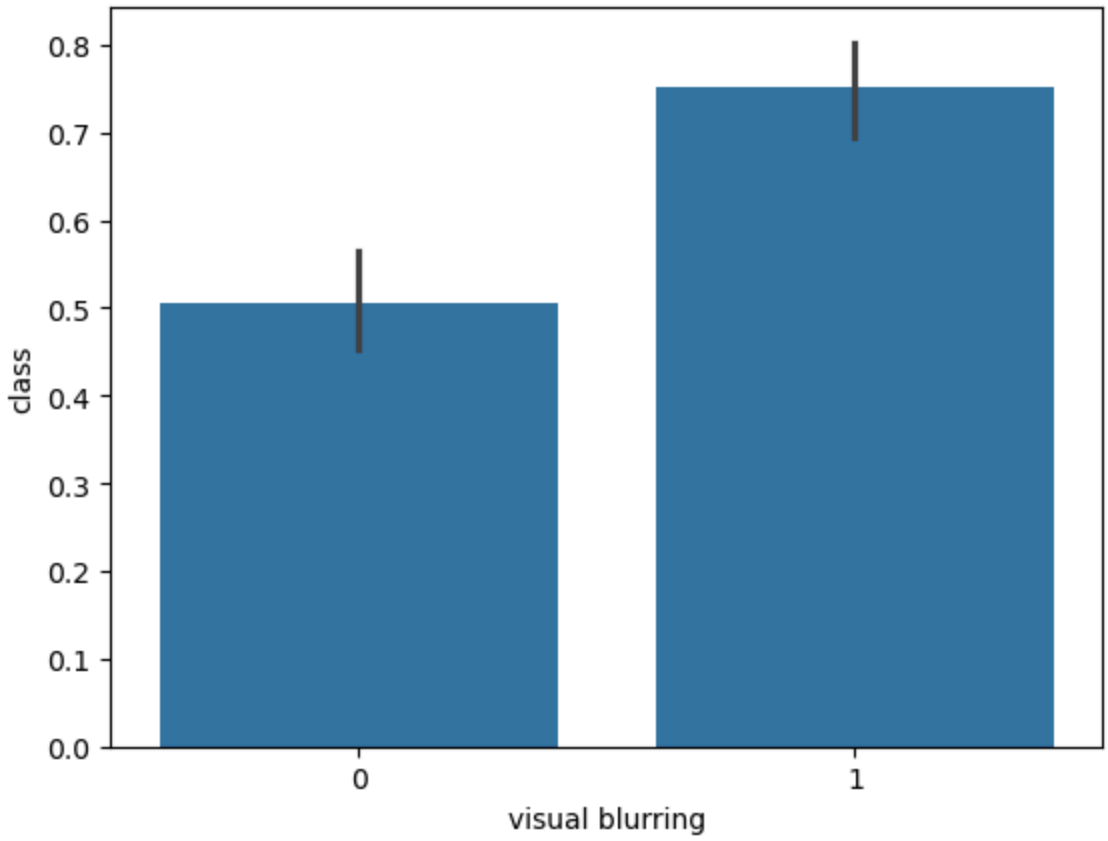
```
sns.barplot(x='Alopecia',y='class',data=dataset)
plt.show()
```



Visual blurring

In [238…

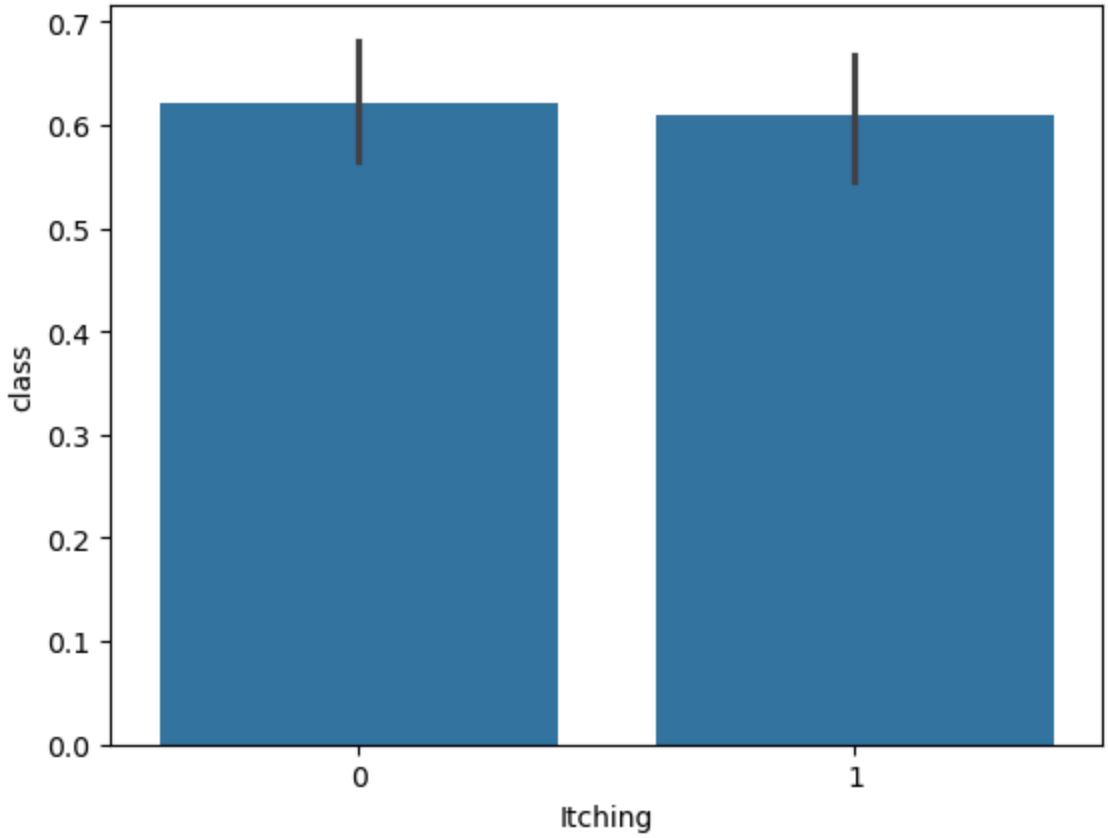
```
sns.barplot(x="visual blurring", y="class", data=dataset)
plt.show()
```



Itching

In [240…

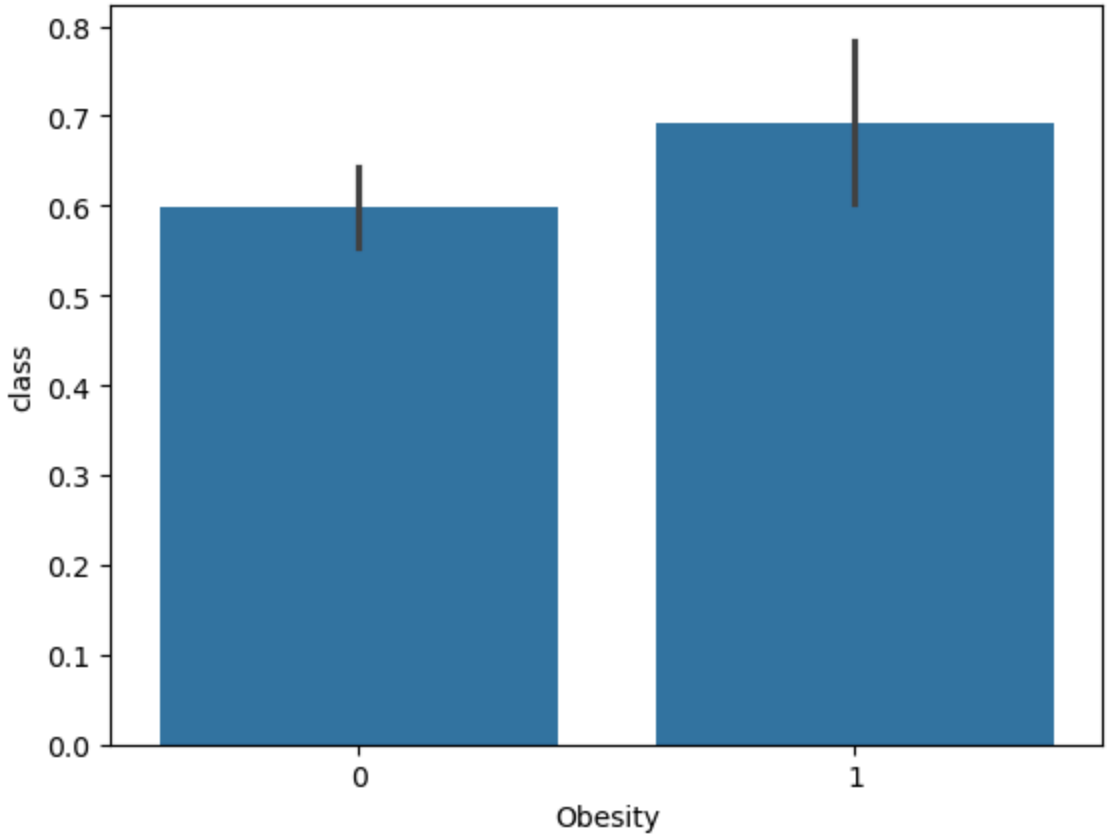
```
sns.barplot(x="Itching", y="class", data=dataset)
plt.show()
```



Obesity

In [242…

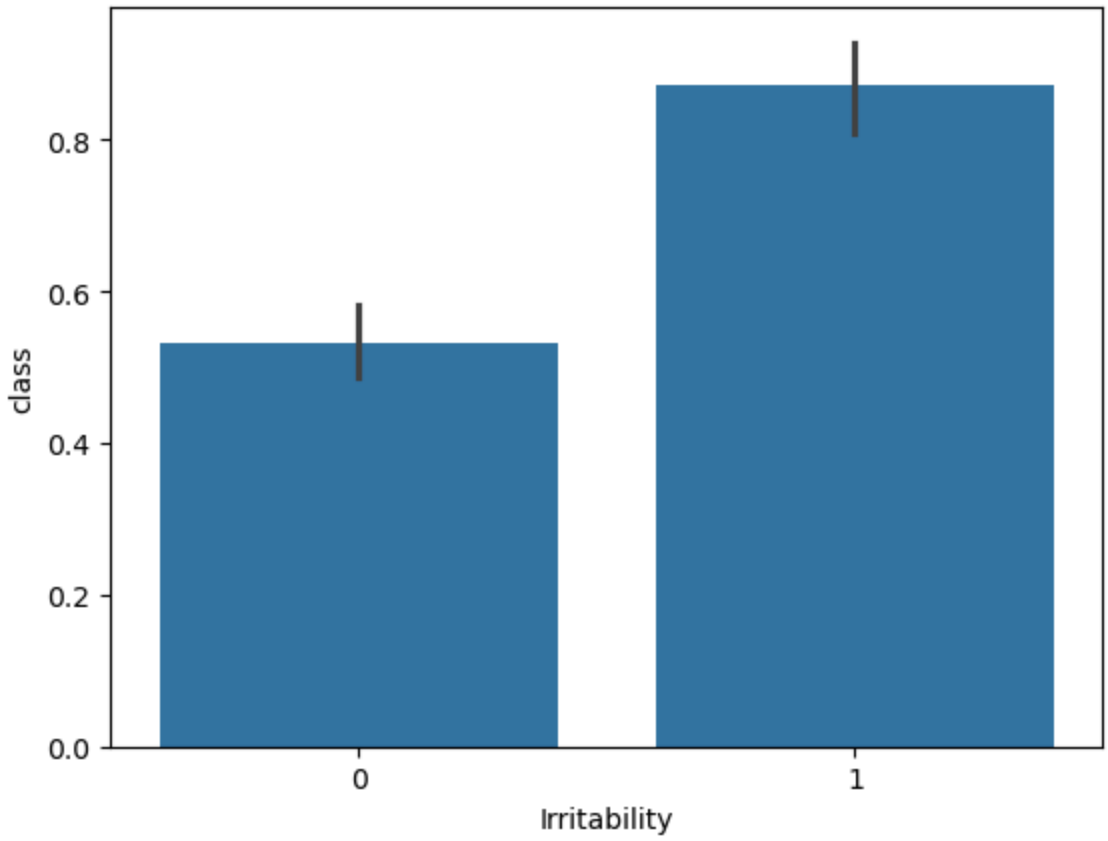
```
sns.barplot(x='Obesity',y='class',data=dataset)
plt.show()
```



Irritability

In [244…

```
sns.barplot(x='Irritability',y='class',data=dataset)
plt.show()
```



In [245…
```
X1 = dataset.iloc[:,0:-1]
y1 = dataset.iloc[:,-1]
```

In [246…
```
X1.columns
```

Out[246…
```
Index(['Age', 'Gender', 'Polyuria', 'Polydipsia', 'sudden weight loss',
       'weakness', 'Polyphagia', 'Genital thrush', 'visual blurring',
       'Itching', 'Irritability', 'delayed healing', 'partial paresis',
       'muscle stiffness', 'Alopecia', 'Obesity'],
      dtype='object')
```

Feature selection using selectkbest

In [248…
```
from sklearn.feature_selection import SelectKBest
from sklearn.feature_selection import chi2
best_feature = SelectKBest(score_func=chi2,k=10)
fit = best_feature.fit(X1,y1)
```

In [249…
```
dataset_scores = pd.DataFrame(fit.scores_)
dataset_cols = pd.DataFrame(X1.columns)
```

In [250…
```
featurescores = pd.concat([dataset_cols,dataset_scores],axis=1)
featurescores.columns=['column','scores']
```

These are the variables with their feature scores ,their importance/contribution towards class

In [252…
```
featurescores
```

Out[252…

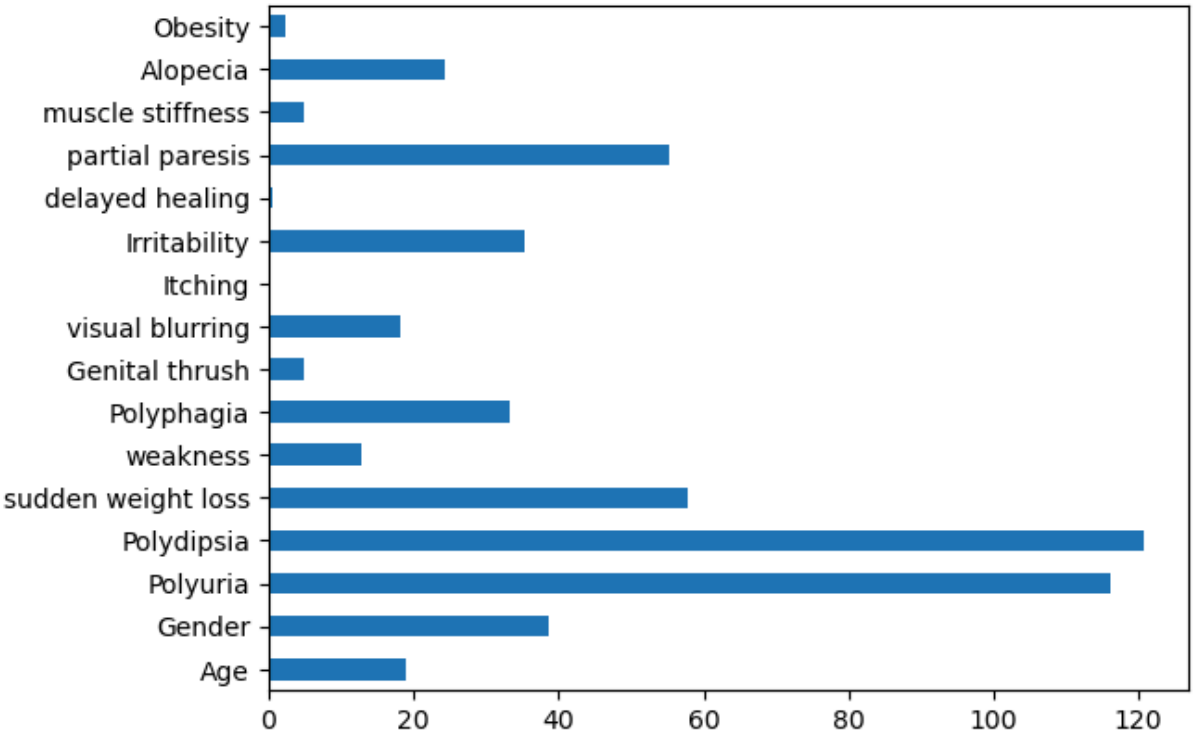
	column	scores
0	Age	18.845767
1	Gender	38.747637
2	Polyuria	116.184593
3	Polydipsia	120.785515
4	sudden weight loss	57.749309
5	weakness	12.724262
6	Polyphagia	33.198418
7	Genital thrush	4.914009
8	visual blurring	18.124571
9	Itching	0.047826
10	Irritability	35.334127
11	delayed healing	0.620188
12	partial paresis	55.314286
13	muscle stiffness	4.875000
14	Alopecia	24.402793
15	Obesity	2.250284

Top 10 features

In [254…
```
print(featurescores.nlargest(10,'scores'))
```

```
                column      scores
3           Polydipsia  120.785515
2             Polyuria  116.184593
4   sudden weight loss   57.749309
12     partial paresis   55.314286
1               Gender   38.747637
10        Irritability   35.334127
6           Polyphagia   33.198418
14            Alopecia   24.402793
0                   Age   18.845767
8       visual blurring   18.124571
```

In [255…
```
featureview=pd.Series(fit.scores_, index=X1.columns)
featureview.plot(kind='barh')
plt.show()
```



Checking the variance

In [257…
```
from sklearn.feature_selection import VarianceThreshold
feature_high_variance = VarianceThreshold(threshold=(0.5*(1-0.5)))
falls=feature_high_variance.fit(X1)
```

In [258…
```
dataset_scores1 = pd.DataFrame(falls.variances_)
dat1 = pd.DataFrame(X1.columns)
```

In [259…
```
high_variance = pd.concat([dataset_scores1,dat1],axis=1)
high_variance.columns=['variance','cols']
```

In [260…
```
high_variance[high_variance['variance']>0.2]
```

Out[260…

	variance	cols
0	147.374168	Age
1	0.232899	Gender
2	0.249985	Polyuria
3	0.247304	Polydipsia
4	0.243162	sudden weight loss
5	0.242511	weakness
6	0.248044	Polyphagia
8	0.247304	visual blurring
9	0.249819	Itching
11	0.248369	delayed healing
12	0.245207	partial paresis
13	0.234375	muscle stiffness
14	0.225736	Alopecia

In [261…

```
X = dataset[['Polydipsia','sudden weight loss','partial paresis','Irritability','Po
y = dataset['class']
```

Splitting the dataset into training and testing sets

In [263…

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size = 0.2,random_state=0
```

Standardization of independant variables

In [265…

```
from sklearn.preprocessing import StandardScaler
ss = StandardScaler()
X_train = ss.fit_transform(X_train)
X_test = ss.transform(X_test)
```

Logistic Regression

In [267…

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

Out[267…

▾ LogisticRegression

```
LogisticRegression()
```

Cross validation test for training data

In [269…
```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator=lg, X=X_train ,y=y_train,cv=10)
print("accuracy is {:.2f} %".format(accuracies.mean()*100))
print("standard deviation is {:.2f} %".format(accuracies.std()*100))
```

```
accuracy is 84.61 %
standard deviation is 5.32 %
```

Prediction

In [271…
```
pre=lg.predict(X_test)
```

** Confusion matrix**

In [273…
```
logistic_regression=accuracy_score(pre,y_test)
print("accuracy score:",)
print(accuracy_score(pre,y_test))
print("Confusion Matrix:",)
print(confusion_matrix(pre,y_test))
```

```
accuracy score:
0.8942307692307693
Confusion Matrix:
[[34  5]
 [ 6 59]]
```

In [274…
```
from sklearn.metrics import classification_report
print(classification_report(pre,y_test))
```

```
              precision    recall  f1-score   support

           0       0.85      0.87      0.86        39
           1       0.92      0.91      0.91        65

    accuracy                           0.89       104
   macro avg       0.89      0.89      0.89       104
weighted avg       0.89      0.89      0.89       104
```

SVM

In [276…
```
from sklearn.svm import SVC
sv=SVC(kernel='linear',random_state=0)
sv.fit(X_train,y_train)
```

Out[276…
```
SVC(kernel='linear', random_state=0)
```

In [277…
```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator=sv, X=X_train ,y=y_train,cv=10)
print(" mean accuracy is {:.2f} %".format(accuracies.mean()*100))
print("standrd deviation is {:.2f} %".format(accuracies.std()*100))
```

```
 mean accuracy is 83.18 %
standrd deviation is 4.94 %
```

In [278…
```
pre1=sv.predict(X_test)
```

In [279…
```
svm_linear=accuracy_score(pre1,y_test)
print("accuracy score:",)
print(accuracy_score(pre1,y_test))
print("Confusion Matrix:",)
print(confusion_matrix(pre1,y_test))
```

```
accuracy score:
0.9038461538461539
Confusion Matrix:
[[34  4]
 [ 6 60]]
```

In [280…
```
from sklearn.metrics import classification_report
print(classification_report(pre1,y_test))
```

```
              precision    recall  f1-score   support

           0       0.85      0.89      0.87        38
           1       0.94      0.91      0.92        66

    accuracy                           0.90       104
   macro avg       0.89      0.90      0.90       104
weighted avg       0.91      0.90      0.90       104
```

In [281…
```
from sklearn.svm import SVC
svrf=SVC(kernel='rbf',random_state=0)
svrf.fit(X_train,y_train)
```

Out[281…
```
SVC(random_state=0)
```

In [282…
```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator=svrf, X=X_train ,y=y_train,cv=10)
print("mean accuracy is {:.2f} %".format(accuracies.mean()*100))
print("standard deviation is {:.2f} %".format(accuracies.std()*100))
```

```
mean accuracy is 88.47 %
standard deviation is 3.69 %
```

In [283…
```
pre2=svrf.predict(X_test)
```

In [284…
```
svm_rbf=accuracy_score(pre2,y_test)
print(accuracy_score(pre2,y_test))
```

```
print(confusion_matrix(pre2,y_test))
```

```
0.9807692307692307
[[39  1]
 [ 1 63]]
```

In [285…

```
from sklearn.metrics import classification_report
print(classification_report(pre2,y_test))
```

```
              precision    recall  f1-score   support

           0       0.97      0.97      0.97        40
           1       0.98      0.98      0.98        64

    accuracy                           0.98       104
   macro avg       0.98      0.98      0.98       104
weighted avg       0.98      0.98      0.98       104
```

KNN

In [287…

```
from sklearn.neighbors import KNeighborsClassifier
score=[]

for i in range(1, 10):
    knn = KNeighborsClassifier(n_neighbors=i, metric='minkowski', p=2)
    knn.fit(X_train, y_train)
    pre3 = knn.predict(X_test)
    ans = accuracy_score(y_test, pre3)  # Ensure y_test is the true labels
    print("Accuracy score {}: {}".format(i, round(100 * ans, 2)))
    score.append(round(100 * ans, 2))


print("Top 5 accuracy scores:", sorted(score, reverse=True)[:5])


best_score = sorted(score, reverse=True)[:1]
print("Best accuracy score:", best_score)
```

```
Accuracy score 1: 98.08
Accuracy score 2: 98.08
Accuracy score 3: 98.08
Accuracy score 4: 98.08
Accuracy score 5: 96.15
Accuracy score 6: 95.19
Accuracy score 7: 97.12
Accuracy score 8: 95.19
Accuracy score 9: 96.15
Top 5 accuracy scores: [98.08, 98.08, 98.08, 98.08, 97.12]
Best accuracy score: [98.08]
```

Naive bayes-Gaussian NB

In [289…
```
from sklearn.naive_bayes import GaussianNB
gb=GaussianNB()
gb.fit(X_train,y_train)
```

Out[289…
GaussianNB

GaussianNB()

In [290…
```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator=gb, X=X_train ,y=y_train,cv=10)
print("Mean accuracy is {:.2f} %".format(accuracies.mean()*100))
print("standard Deviation is {:.2f} %".format(accuracies.std()*100))
```

```
Mean accuracy is 82.94 %
standard Deviation is 8.03 %
```

In [291…
```
pre4=gb.predict(X_test)
```

In [292…
```
Naive_bayes_Gaussian_nb=accuracy_score(pre4,y_test)
print("accuracy score:",)
print(accuracy_score(pre4,y_test))
print("Confusion Matrix:",)
print(confusion_matrix(pre4,y_test))
```

```
accuracy score:
0.8557692307692307
Confusion Matrix:
[[32  7]
 [ 8 57]]
```

In [293…
```
from sklearn.metrics import classification_report
print(classification_report(pre4,y_test))
```

```
              precision    recall  f1-score   support

           0       0.80      0.82      0.81        39
           1       0.89      0.88      0.88        65

    accuracy                           0.86       104
   macro avg       0.85      0.85      0.85       104
weighted avg       0.86      0.86      0.86       104
```

Decision Tress Classifier

In [295…
```
from sklearn.tree import DecisionTreeClassifier
dc=DecisionTreeClassifier(criterion='gini')
dc.fit(X_train,y_train)
```

Out[295…

DecisionTreeClassifier

DecisionTreeClassifier()

In [296…
```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator=dc, X=X_train ,y=y_train,cv=10)
print("accuracy is {:.2f} %".format(accuracies.mean()*100))
print("std is {:.2f} %".format(accuracies.std()*100))
```

```
accuracy is 91.11 %
std is 4.02 %
```

In [297…
```
pre5=dc.predict(X_test)
```

In [298…
```
Decisiontress_classifier=accuracy_score(pre5,y_test)
print("accuracy score:",)
print(accuracy_score(pre5,y_test))
print("Confusion Matrix:",)
print(confusion_matrix(pre5,y_test))
```

```
accuracy score:
0.9615384615384616
Confusion Matrix:
[[38  2]
 [ 2 62]]
```

In [299…
```
from sklearn.metrics import classification_report
print(classification_report(pre5,y_test))
```

```
              precision    recall  f1-score   support

           0       0.95      0.95      0.95        40
           1       0.97      0.97      0.97        64

    accuracy                           0.96       104
   macro avg       0.96      0.96      0.96       104
weighted avg       0.96      0.96      0.96       104
```

Random Forest Classifier

In [301…
```
from sklearn.ensemble import RandomForestClassifier
estime=[]
for i in range(1,100):
    rc=RandomForestClassifier(n_estimators=i,criterion='entropy',random_state=0)
    rc.fit(X_train,y_train)
```

In [302…
```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator=rc, X=X_train ,y=y_train,cv=10)
print("accuracy is {:.2f} %".format(accuracies.mean()*100))
print("std is {:.2f} %".format(accuracies.std()*100))
```

```
accuracy is 89.90 %
std is 5.60 %
```

In [303…
```
pre6 = rc.predict(X_test)
```

In [304…
```
Random_forest=accuracy_score(pre6,y_test)
print("accuracy score:",)
print(accuracy_score(pre6,y_test))
print("Confusion Matrix:",)
print(confusion_matrix(pre6,y_test))
```

```
accuracy score:
0.9807692307692307
Confusion Matrix:
[[39  1]
 [ 1 63]]
```

In [305…
```
from sklearn.metrics import classification_report
print(classification_report(pre6,y_test))
```

```
              precision    recall  f1-score   support

           0       0.97      0.97      0.97        40
           1       0.98      0.98      0.98        64

    accuracy                           0.98       104
   macro avg       0.98      0.98      0.98       104
weighted avg       0.98      0.98      0.98       104
```

Accuracies of all classification model overview

In [307…
```
print('Logistic regression:',logistic_regression)
print('svmlinear:',svm_linear)
print('svmrbf:',svm_rbf)
print('knn:',knn)
print('naive bayes:',Naive_bayes_Gaussian_nb)
print('Decision tress:',Decisiontress_classifier)
print('Random forest:',Random_forest)
```

```
Logistic regression: 0.8942307692307693
svmlinear: 0.9038461538461539
svmrbf: 0.9807692307692307
knn: KNeighborsClassifier(n_neighbors=9)
naive bayes: 0.8557692307692307
Decision tress: 0.9615384615384616
Random forest: 0.9807692307692307
```

The best model is SVM , KNN and Random forest with 98% Accuracy