Classification

In [1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import AdaBoostClassifier
from sklearn.preprocessing import StandardScaler
from warnings import filterwarnings
filterwarnings("ignore")
```

In [2]:
```
df_train=pd.read_csv("C:\\Users\\USER\\Desktop\\Data Science\\SEM 5\\ML\\train.csv")
df_test=pd.read_csv("C:\\Users\\USER\\Desktop\\Data Science\\SEM 5\\ML\\test.csv")
```

In [3]:
```
df_train.head(1)
```

Out[3]:

	id	Mean of the integrated profile	Standard deviation of the integrated profile	Excess kurtosis of the integrated profile	Skewness of the integrated profile	Mean of the DM-SNR curve	Standard deviation of the DM-SNR curve	Excess kurtosis of the DM-SNR curve	Skewness of the DM-SNR curve	target_class
0	16330	136.828938	45.453922	-0.060961	0.086916	3.062776	18.529046	7.737922	60.660346	0

In [4]:
```
df_test.head(1)
```

Out[4]:

	id	Mean of the integrated profile	Standard deviation of the integrated profile	Excess kurtosis of the integrated profile	Skewness of the integrated profile	Mean of the DM-SNR curve	Standard deviation of the DM-SNR curve	Excess kurtosis of the DM-SNR curve	Skewness of the DM-SNR curve
0	15	130.960938	51.285872	0.072242	-0.564055	1.940635	13.092225	10.481509	147.756658

In [5]:
```
X=df_train[["id","Mean of the integrated profile","Standard deviation of the integrated profile","Excess kurtosis of the integrated profile","Skewness of the integrated profile","Mean of the DM-SNR curve","Standard deviation of the DM-SNR curve","Excess kurtosis of the DM-SNR curve","Skewness of the DM-SNR curve"]]
Y=df_train["target_class"]
```

In [6]:
```
from sklearn.preprocessing import StandardScaler
X = StandardScaler().fit_transform(X)
```

In [7]:
```
X_TEST=StandardScaler().fit_transform(df_test)
```

In [8]:
```
from sklearn.svm import SVC
svc = SVC(kernel='rbf',C=30,gamma='auto')
svc.fit(X,Y)
print("Accuracy:", clf_svc.score(X,Y) )
```

```
Accuracy:  0.9540061461807919
```

In [9]:
```
predictions_test=svc.predict(X_TEST)
```

In [10]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.20, random_state=0)
```

In [11]:
```
from sklearn.svm import SVC
clf_svc = SVC(kernel='rbf',C=50,gamma='auto')
clf_svc.fit(X_train, Y_train)
print ("Accuracy: ", clf_svc.score(X_test, Y_test) )
```

```
Accuracy:  0.9811452513966481
```

In [12]:
```
print(X_train.shape, Y_train.shape,Y_test.shape,X_test.shape)
```

```
(11454, 9) (11454, 1) (2864, 1) (2864, 9)
```

In [13]:
```
predictions_train=svc.predict(X_test)
```

In [14]:
```
from sklearn import metrics
print("accuracy:{:0.4f}".format(metrics.accuracy_score(Y_test,predictions_train)))
```

```
accuracy:0.9811451
```

In [15]:
```
from sklearn.model_selection import GridSearchCV

# defining parameter range
param_grid = {'C': [0.1, 1, 10, 100, 1000],
              'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
              'kernel': ['rbf']}

grid = GridSearchCV(SVC(), param_grid, refit = True, verbose = 3)

# fitting the model for grid search
grid.fit(X, Y)
```

```
Fitting 5 folds for each of 25 candidates, totalling 125 fits
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:   1.1s remaining:    0.0s
[CV] ....... C=0.1, gamma=1, kernel=rbf, score=0.956, total=  1.2s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ....... C=0.1, gamma=1, kernel=rbf, score=0.960, total=  1.5s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[Parallel(n_jobs=1)]: Done   2 out of   2 | elapsed:   2.6s remaining:    0.0s
[CV] ....... C=0.1, gamma=1, kernel=rbf, score=0.958, total=  1.1s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ....... C=0.1, gamma=1, kernel=rbf, score=0.954, total=  1.1s
[CV] C=0.1, gamma=1, kernel=rbf .....................................
[CV] ....... C=0.1, gamma=1, kernel=rbf, score=0.959, total=  1.2s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=0.1, gamma=0.1, kernel=rbf, score=0.974, total=  0.4s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=0.1, gamma=0.1, kernel=rbf, score=0.977, total=  0.4s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=0.1, gamma=0.1, kernel=rbf, score=0.980, total=  0.6s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=0.1, gamma=0.1, kernel=rbf, score=0.973, total=  0.4s
[CV] C=0.1, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=0.1, gamma=0.1, kernel=rbf, score=0.977, total=  0.4s
[CV] C=0.1, gamma=0.01, kernel=rbf ..................................
[CV] .... C=0.1, gamma=0.01, kernel=rbf, score=0.970, total=  0.4s
[CV] C=0.1, gamma=0.01, kernel=rbf ..................................
[CV] .... C=0.1, gamma=0.01, kernel=rbf, score=0.974, total=  0.5s
[CV] C=0.1, gamma=0.01, kernel=rbf ..................................
[CV] .... C=0.1, gamma=0.01, kernel=rbf, score=0.973, total=  0.5s
[CV] C=0.1, gamma=0.01, kernel=rbf ..................................
[CV] .... C=0.1, gamma=0.01, kernel=rbf, score=0.967, total=  0.4s
[CV] C=0.1, gamma=0.01, kernel=rbf ..................................
[CV] .... C=0.1, gamma=0.01, kernel=rbf, score=0.973, total=  0.4s
[CV] C=0.1, gamma=0.001, kernel=rbf .................................
[CV] ... C=0.1, gamma=0.001, kernel=rbf, score=0.957, total=  0.7s
[CV] C=0.1, gamma=0.001, kernel=rbf .................................
[CV] ... C=0.1, gamma=0.001, kernel=rbf, score=0.962, total=  0.7s
[CV] C=0.1, gamma=0.001, kernel=rbf .................................
[CV] ... C=0.1, gamma=0.001, kernel=rbf, score=0.959, total=  0.8s
[CV] C=0.1, gamma=0.001, kernel=rbf .................................
[CV] ... C=0.1, gamma=0.001, kernel=rbf, score=0.954, total=  0.7s
[CV] C=0.1, gamma=0.001, kernel=rbf .................................
[CV] ... C=0.1, gamma=0.001, kernel=rbf, score=0.959, total=  0.7s
[CV] C=0.1, gamma=0.0001, kernel=rbf ................................
[CV] .. C=0.1, gamma=0.0001, kernel=rbf, score=0.909, total=  0.9s
[CV] C=0.1, gamma=0.0001, kernel=rbf ................................
[CV] .. C=0.1, gamma=0.0001, kernel=rbf, score=0.909, total=  0.9s
[CV] C=0.1, gamma=0.0001, kernel=rbf ................................
[CV] .. C=0.1, gamma=0.0001, kernel=rbf, score=0.908, total=  0.9s
[CV] C=0.1, gamma=0.0001, kernel=rbf ................................
[CV] .. C=0.1, gamma=0.0001, kernel=rbf, score=0.908, total=  1.0s
[CV] C=0.1, gamma=0.0001, kernel=rbf ................................
[CV] .. C=0.1, gamma=0.0001, kernel=rbf, score=0.908, total=  1.0s
[CV] C=1, gamma=1, kernel=rbf .......................................
[CV] ......... C=1, gamma=1, kernel=rbf, score=0.977, total=  1.1s
[CV] C=1, gamma=1, kernel=rbf .......................................
[CV] ......... C=1, gamma=1, kernel=rbf, score=0.976, total=  1.2s
[CV] C=1, gamma=1, kernel=rbf .......................................
[CV] ......... C=1, gamma=1, kernel=rbf, score=0.981, total=  1.1s
[CV] C=1, gamma=1, kernel=rbf .......................................
[CV] ......... C=1, gamma=1, kernel=rbf, score=0.975, total=  1.2s
[CV] C=1, gamma=1, kernel=rbf .......................................
[CV] ......... C=1, gamma=1, kernel=rbf, score=0.978, total=  1.1s
[CV] C=1, gamma=0.1, kernel=rbf .....................................
[CV] ....... C=1, gamma=0.1, kernel=rbf, score=0.979, total=  0.4s
[CV] C=1, gamma=0.1, kernel=rbf .....................................
[CV] ....... C=1, gamma=0.1, kernel=rbf, score=0.981, total=  0.4s
[CV] C=1, gamma=0.1, kernel=rbf .....................................
[CV] ....... C=1, gamma=0.1, kernel=rbf, score=0.982, total=  0.4s
[CV] C=1, gamma=0.1, kernel=rbf .....................................
[CV] ....... C=1, gamma=0.1, kernel=rbf, score=0.976, total=  0.4s
[CV] C=1, gamma=0.1, kernel=rbf .....................................
[CV] ....... C=1, gamma=0.1, kernel=rbf, score=0.980, total=  0.4s
[CV] C=1, gamma=0.01, kernel=rbf ....................................
[CV] ..... C=1, gamma=0.01, kernel=rbf, score=0.976, total=  0.3s
[CV] C=1, gamma=0.01, kernel=rbf ....................................
[CV] ..... C=1, gamma=0.01, kernel=rbf, score=0.978, total=  0.3s
[CV] C=1, gamma=0.01, kernel=rbf ....................................
[CV] ..... C=1, gamma=0.01, kernel=rbf, score=0.980, total=  0.3s
[CV] C=1, gamma=0.01, kernel=rbf ....................................
[CV] ..... C=1, gamma=0.01, kernel=rbf, score=0.973, total=  0.3s
[CV] C=1, gamma=0.01, kernel=rbf ....................................
[CV] ..... C=1, gamma=0.01, kernel=rbf, score=0.977, total=  0.3s
[CV] C=1, gamma=0.001, kernel=rbf ...................................
[CV] ..... C=1, gamma=0.001, kernel=rbf, score=0.972, total=  0.6s
[CV] C=1, gamma=0.001, kernel=rbf ...................................
[CV] ..... C=1, gamma=0.001, kernel=rbf, score=0.975, total=  0.4s
[CV] C=1, gamma=0.001, kernel=rbf ...................................
[CV] ..... C=1, gamma=0.001, kernel=rbf, score=0.974, total=  0.4s
[CV] C=1, gamma=0.001, kernel=rbf ...................................
[CV] ..... C=1, gamma=0.001, kernel=rbf, score=0.968, total=  0.4s
[CV] C=1, gamma=0.001, kernel=rbf ...................................
[CV] ..... C=1, gamma=0.001, kernel=rbf, score=0.973, total=  0.4s
[CV] C=1, gamma=0.0001, kernel=rbf ..................................
[CV] ... C=1, gamma=0.0001, kernel=rbf, score=0.957, total=  0.7s
[CV] C=1, gamma=0.0001, kernel=rbf ..................................
[CV] ... C=1, gamma=0.0001, kernel=rbf, score=0.962, total=  0.7s
[CV] C=1, gamma=0.0001, kernel=rbf ..................................
[CV] ... C=1, gamma=0.0001, kernel=rbf, score=0.959, total=  0.7s
[CV] C=1, gamma=0.0001, kernel=rbf ..................................
[CV] ... C=1, gamma=0.0001, kernel=rbf, score=0.954, total=  0.6s
[CV] C=1, gamma=0.0001, kernel=rbf ..................................
[CV] ... C=1, gamma=0.0001, kernel=rbf, score=0.959, total=  0.7s
[CV] C=10, gamma=1, kernel=rbf ......................................
[CV] ........ C=10, gamma=1, kernel=rbf, score=0.974, total=  1.1s
[CV] C=10, gamma=1, kernel=rbf ......................................
[CV] ........ C=10, gamma=1, kernel=rbf, score=0.979, total=  1.1s
[CV] C=10, gamma=1, kernel=rbf ......................................
[CV] ........ C=10, gamma=1, kernel=rbf, score=0.971, total=  1.1s
[CV] C=10, gamma=1, kernel=rbf ......................................
[CV] ........ C=10, gamma=1, kernel=rbf, score=0.976, total=  1.5s
[CV] C=10, gamma=0.1, kernel=rbf ....................................
[CV] ...... C=10, gamma=0.1, kernel=rbf, score=0.977, total=  0.5s
[CV] C=10, gamma=0.1, kernel=rbf ....................................
[CV] ...... C=10, gamma=0.1, kernel=rbf, score=0.980, total=  0.5s
[CV] C=10, gamma=0.1, kernel=rbf ....................................
[CV] ...... C=10, gamma=0.1, kernel=rbf, score=0.982, total=  0.5s
[CV] C=10, gamma=0.1, kernel=rbf ....................................
[CV] ...... C=10, gamma=0.1, kernel=rbf, score=0.976, total=  0.6s
[CV] C=10, gamma=0.1, kernel=rbf ....................................
[CV] ...... C=10, gamma=0.1, kernel=rbf, score=0.980, total=  0.5s
[CV] C=10, gamma=0.01, kernel=rbf ...................................
[CV] ..... C=10, gamma=0.01, kernel=rbf, score=0.978, total=  0.3s
[CV] C=10, gamma=0.01, kernel=rbf ...................................
[CV] ..... C=10, gamma=0.01, kernel=rbf, score=0.980, total=  0.5s
[CV] C=10, gamma=0.01, kernel=rbf ...................................
[CV] ..... C=10, gamma=0.01, kernel=rbf, score=0.983, total=  0.4s
[CV] C=10, gamma=0.01, kernel=rbf ...................................
[CV] ..... C=10, gamma=0.01, kernel=rbf, score=0.975, total=  0.4s
[CV] C=10, gamma=0.01, kernel=rbf ...................................
[CV] ..... C=10, gamma=0.01, kernel=rbf, score=0.980, total=  0.3s
[CV] C=10, gamma=0.001, kernel=rbf ..................................
[CV] .... C=10, gamma=0.001, kernel=rbf, score=0.976, total=  0.4s
[CV] C=10, gamma=0.001, kernel=rbf ..................................
[CV] .... C=10, gamma=0.001, kernel=rbf, score=0.977, total=  0.4s
[CV] C=10, gamma=0.001, kernel=rbf ..................................
[CV] .... C=10, gamma=0.001, kernel=rbf, score=0.979, total=  0.4s
[CV] C=10, gamma=0.001, kernel=rbf ..................................
[CV] .... C=10, gamma=0.001, kernel=rbf, score=0.973, total=  0.4s
[CV] C=10, gamma=0.001, kernel=rbf ..................................
[CV] .... C=10, gamma=0.001, kernel=rbf, score=0.976, total=  0.4s
[CV] C=10, gamma=0.0001, kernel=rbf .................................
[CV] ... C=10, gamma=0.0001, kernel=rbf, score=0.972, total=  0.5s
[CV] C=10, gamma=0.0001, kernel=rbf .................................
[CV] ... C=10, gamma=0.0001, kernel=rbf, score=0.975, total=  0.5s
[CV] C=10, gamma=0.0001, kernel=rbf .................................
[CV] ... C=10, gamma=0.0001, kernel=rbf, score=0.973, total=  0.5s
[CV] C=10, gamma=0.0001, kernel=rbf .................................
[CV] ... C=10, gamma=0.0001, kernel=rbf, score=0.966, total=  0.5s
[CV] C=10, gamma=0.0001, kernel=rbf .................................
[CV] ... C=10, gamma=0.0001, kernel=rbf, score=0.971, total=  1.5s
[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] ....... C=100, gamma=1, kernel=rbf, score=0.970, total=  1.4s
[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] ....... C=100, gamma=1, kernel=rbf, score=0.968, total=  1.2s
[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] ....... C=100, gamma=1, kernel=rbf, score=0.967, total=  1.5s
[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] ....... C=100, gamma=1, kernel=rbf, score=0.976, total=  1.0s
[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] ....... C=100, gamma=1, kernel=rbf, score=0.986, total=  1.2s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=100, gamma=0.1, kernel=rbf, score=0.981, total=  1.1s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=100, gamma=0.1, kernel=rbf, score=0.976, total=  1.3s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ..... C=100, gamma=0.1, kernel=rbf, score=0.979, total=  1.2s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] .... C=100, gamma=0.01, kernel=rbf, score=0.978, total=  0.4s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] .... C=100, gamma=0.01, kernel=rbf, score=0.983, total=  0.5s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] .... C=100, gamma=0.01, kernel=rbf, score=0.976, total=  0.4s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] .... C=100, gamma=0.01, kernel=rbf, score=0.981, total=  0.5s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ... C=100, gamma=0.001, kernel=rbf, score=0.979, total=  0.3s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ... C=100, gamma=0.001, kernel=rbf, score=0.981, total=  0.3s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ... C=100, gamma=0.001, kernel=rbf, score=0.975, total=  0.3s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ... C=100, gamma=0.001, kernel=rbf, score=0.979, total=  0.5s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] .. C=100, gamma=0.0001, kernel=rbf, score=0.976, total=  0.3s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] .. C=100, gamma=0.0001, kernel=rbf, score=0.973, total=  0.5s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] .. C=100, gamma=0.0001, kernel=rbf, score=0.966, total=  1.3s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] .. C=100, gamma=0.0001, kernel=rbf, score=0.965, total=  1.6s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ..... C=1000, gamma=1, kernel=rbf, score=0.963, total=  1.6s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ..... C=1000, gamma=1, kernel=rbf, score=0.963, total=  1.3s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ..... C=1000, gamma=1, kernel=rbf, score=0.962, total=  1.6s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] .... C=1000, gamma=0.1, kernel=rbf, score=0.976, total=  4.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] .... C=1000, gamma=0.1, kernel=rbf, score=0.980, total=  4.5s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] .... C=1000, gamma=0.1, kernel=rbf, score=0.979, total=  4.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] .... C=1000, gamma=0.1, kernel=rbf, score=0.979, total=  3.8s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] .... C=1000, gamma=0.1, kernel=rbf, score=0.979, total=  5.1s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ... C=1000, gamma=0.01, kernel=rbf, score=0.976, total=  1.4s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ... C=1000, gamma=0.01, kernel=rbf, score=0.982, total=  1.3s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ... C=1000, gamma=0.01, kernel=rbf, score=0.983, total=  1.4s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ... C=1000, gamma=0.01, kernel=rbf, score=0.975, total=  1.3s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ... C=1000, gamma=0.01, kernel=rbf, score=0.980, total=  1.5s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] .. C=1000, gamma=0.001, kernel=rbf, score=0.978, total=  0.4s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] .. C=1000, gamma=0.001, kernel=rbf, score=0.980, total=  0.5s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] .. C=1000, gamma=0.001, kernel=rbf, score=0.983, total=  0.5s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] .. C=1000, gamma=0.001, kernel=rbf, score=0.976, total=  0.5s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] .. C=1000, gamma=0.001, kernel=rbf, score=0.981, total=  0.5s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] . C=1000, gamma=0.0001, kernel=rbf, score=0.983, total=  0.3s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] . C=1000, gamma=0.0001, kernel=rbf, score=0.975, total=  0.3s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] . C=1000, gamma=0.0001, kernel=rbf, score=0.976, total=  0.3s
[Parallel(n_jobs=1)]: Done 125 out of 125 | elapsed:  1.9min finished
```

Out[15]:
```
GridSearchCV(estimator=SVC(),
             param_grid={'C': [0.1, 1, 10, 100, 1000],
                         'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
                         'kernel': ['rbf']},
             verbose=3)
```

In [16]:
```
# print best parameter after tuning
print(grid.best_params_)

# print how our model looks after hyper-parameter tuning
print(grid.best_estimator_)
```

```
{'C': 100, 'gamma': 0.01, 'kernel': 'rbf'}
SVC(C=100, gamma=0.01)
```

In [17]:
```
from sklearn.metrics import classification_report, confusion_matrix
grid_predictions = grid.predict(X_test)

# print classification report
print(classification_report(Y_test, grid_predictions))
```

```
              precision    recall  f1-score   support

           0       0.98      1.00      0.99      2604
           1       0.95      0.82      0.88       260

    accuracy                           0.98      2864
   macro avg       0.96      0.91      0.93      2864
weighted avg       0.98      0.98      0.98      2864
```

In [18]:
```
grid_predictions_test = grid.predict(X_TEST)
```

In [19]:
```
test_id=df_test['id']
```

In [20]:
```
predictions_test.shape,test_id.shape
```

Out[20]:
```
((3580,), (3580,))
```

In [21]:
```
prediction=pd.DataFrame(grid_predictions_test,columns=['target_class'])
```

In [22]:
```
test_id=pd.DataFrame(test_id,columns=['id'])
```

In [23]:
```
submission=[test_id,prediction]

final=pd.concat(submission,axis=1)
```

In [24]:
```
from IPython.display import HTML
import pandas as pd
import numpy as np
import base64
def create_download_link(df, title = "Download CSV file", filename = "data.csv"):
    csv = df.to_csv()
    b64 = base64.b64encode(csv.encode())
    payload = b64.decode()
    html = '<a download="{filename}" href="data:text/csv;base64,{payload}" target="_blank">{title}</a>'
    html = html.format(payload=payload,title=title,filename=filename)
    return HTML(html)

# create a link to download the dataframe
create_download_link(final)
```

Out[24]:
Download CSV file

In [ ]:
```

```