EXPERIMENT 8a

ADITHIYA V

241501010

A PYTHON PROGRAM TO IMPLEMENT ADA BOOSTING

AIM:

TO IMPLEMENT A PYTHON PROGRAM TO IMPLEMENT ADA BOOSTING

CODE:

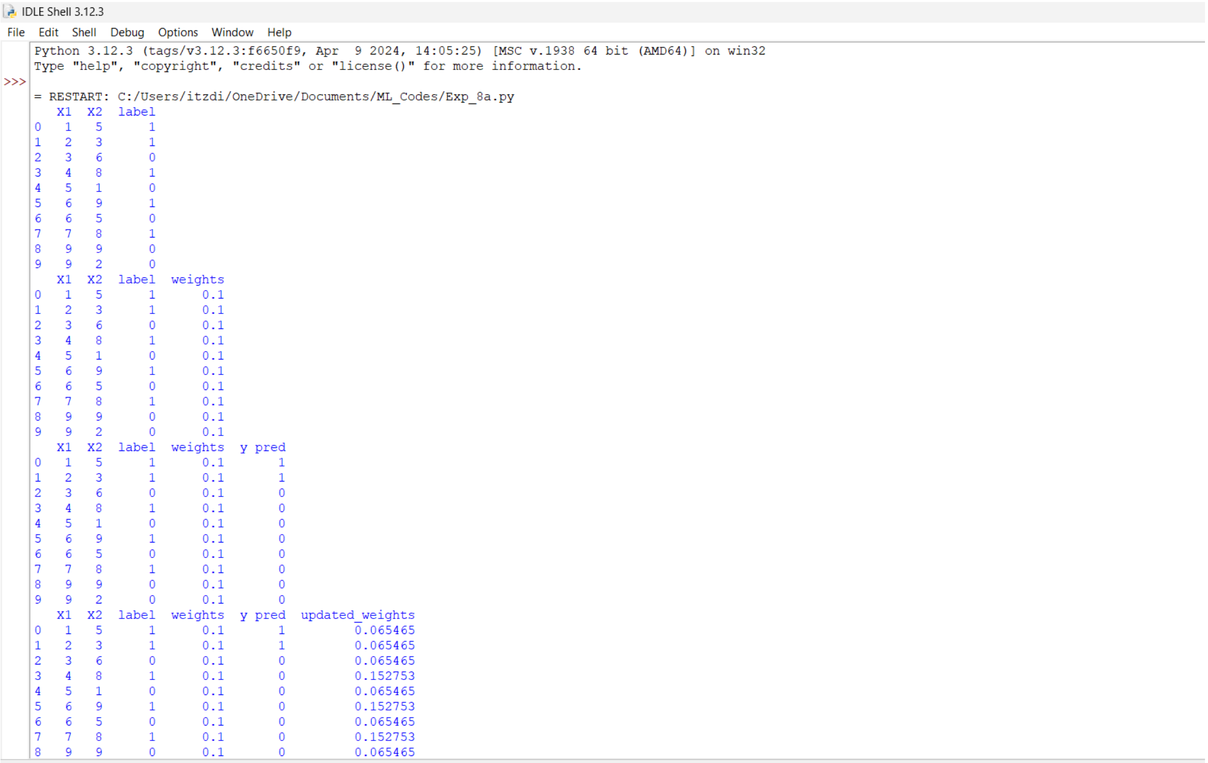
```
import pandas as pd
import numpy as np
from mlxtend.plotting import plot_decision_regions
df = pd.DataFrame()
df['X1']=[1,2,3,4,5,6,6,7,9,9]
df['X2']=[5,3,6,8,1,9,5,8,9,2]
df['label']=[1,1,0,1,0,1,0,1,0,0]
display (df)
import seaborn as sns
sns.scatterplot(x=df['X1'],y=df['X2'],hue=df['label'])

df['weights']=1/df.shape[0]
display (df)
from sklearn.tree import DecisionTreeClassifier
dt1 = DecisionTreeClassifier(max_depth=1)
x = df.iloc[:,0:2].values
y = df.iloc[:,2].values
# Step 2 - Train 1st Model
dt1.fit(x,y)
from sklearn.tree import plot_tree
plot_tree(dt1)

plot_decision_regions(x, y, clf=dt1, legend=2)
```

```
df['y pred'] = dt1.predict(x)
display (df)

def calculate_model_weight(error):
  return 0.5*np.log((1-error)/(error))
# Step - 3 Calculate model weight
alpha1 = calculate_model_weight(0.3)
# Step -4 Update weights
def update_row_weights(row,alpha):
  if row['label'] == row['y pred']:
    return row['weights']* np.exp(-alpha)
  else:
    return row['weights']* np.exp(alpha)
df['updated_weights'] = df.apply(lambda row: update_row_weights(row,
alpha1), axis=1)
display (df)

df['updated_weights'].sum()

df['normalized weights']=df['updated_weights']/df['updated_weights'].sum()
display(df)
df['normalized weights'].sum()

df['cumsum_upper'] = np.cumsum(df['normalized weights'])
df['cumsum_lower']=df['cumsum_upper'] - df['normalized weights']
display(df[['X1','X2','label','weights','y
pred','updated_weights','cumsum_lower','cumsum_upper']])

def create_new_dataset(df):
  indices= []
  for i in range(df.shape[0]):
    a = np.random.random()
    for index,row in df.iterrows():
      if row['cumsum_upper']>a and a>row['cumsum_lower']:
        indices.append(index)
  return indices
```

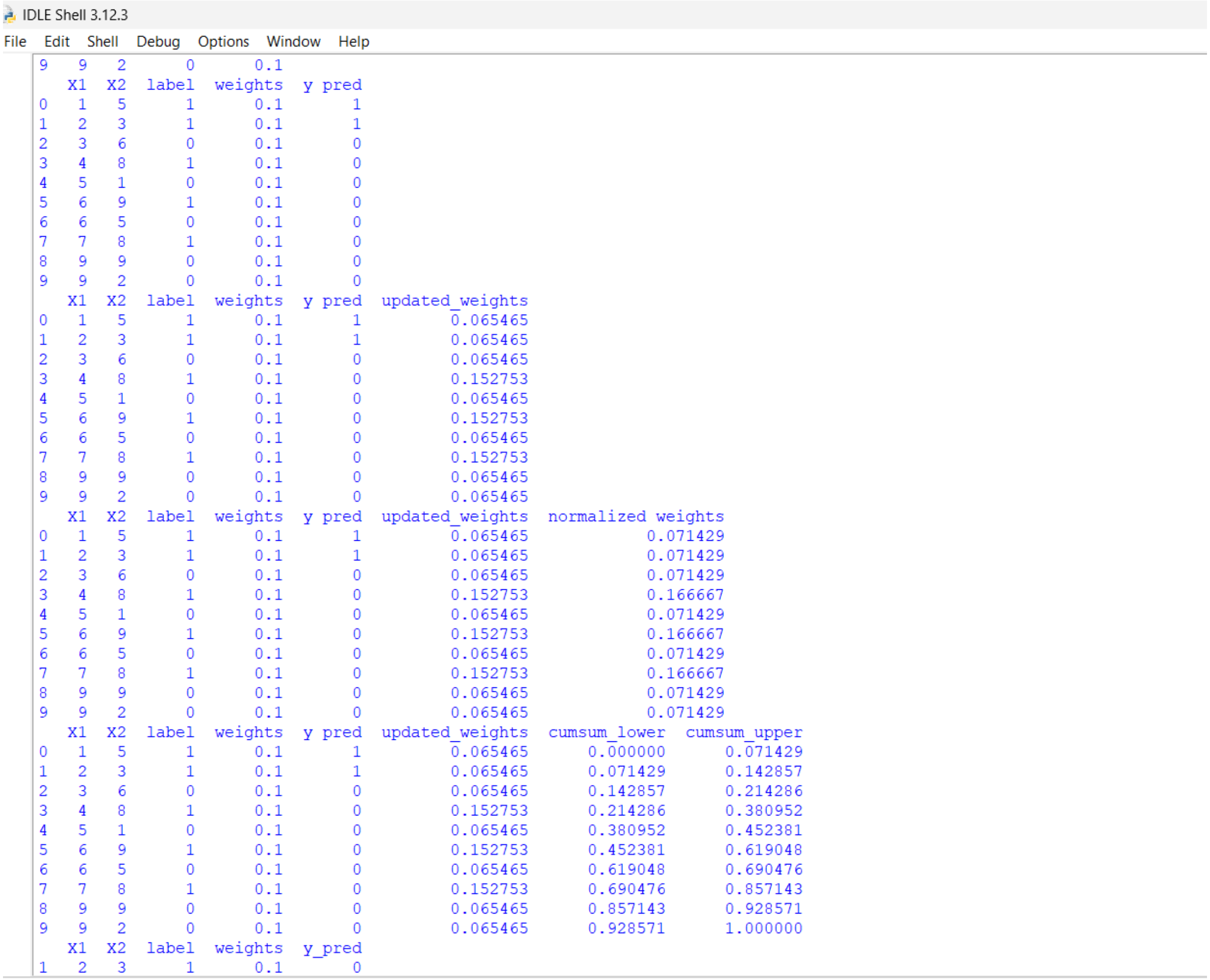
```
index_values = create_new_dataset(df)
index_values

second_df = df.iloc[index_values,[0,1,2,3]]
second_df

dt2 = DecisionTreeClassifier(max_depth=1)
x = second_df.iloc[:,0:2].values
y = second_df.iloc[:,2].values
dt2.fit(x,y)
plot_tree(dt2)

plot_decision_regions(x, y, clf=dt2, legend=2)

second_df['y_pred'] = dt2.predict(x)
second_df
alpha2 = calculate_model_weight(0.1)
display(second_df)

alpha2

# Step 4 - Update weights
def update_row_weights(row,alpha=1.09):
  if row['label'] == row['y_pred']:
    return row['weights'] * np.exp(-alpha)
  else:
    return row['weights'] * np.exp(alpha)
second_df['updated_weights'] =
second_df.apply(update_row_weights,axis=1)
second_df['normalized_weights'] = second_df['updated_weights'] /
second_df['updated_weights'].sum()
second_df
display(second_df)
second_df['normalized_weights'].sum()


second_df['cumsum_upper'] =
np.cumsum(second_df['normalized_weights'])
second_df['cumsum_lower'] = second_df['cumsum_upper'] - second_df['normalized_weights']
second_df[['X1','X2','label','weights','y_pred','normalized_weights','cumsum_lower','cumsum_upper']]

index_values=create_new_dataset(second_df)
third_df=second_df.iloc[index_values,[0,1,2,3]]
third_df

from sklearn.tree import DecisionTreeClassifier
dt3 = DecisionTreeClassifier(max_depth=1)
x = third_df.iloc[:,0:2].values
y = third_df.iloc[:,2].values
dt3.fit(x,y)

plot_decision_regions(x, y, clf=dt3, legend=2)



third_df['y_pred'] = dt3.predict(x)
third_df
alpha3 = calculate_model_weight(0.7)
alpha3

print(alpha1,alpha2,alpha3)

query = np.array([1,5]).reshape(1,2)
dt1.predict(query)

dt2.predict(query)

dt3.predict(query)

alpha1*1 + alpha2*(1) + alpha3*(1)

np.sign(1.09)
```

```
query = np.array([9,9]).reshape(1,2)
dt1.predict(query)

dt2.predict(query)

dt3.predict(query)

alpha1*(1) + alpha2*(-1) + alpha3*(-1)


np.sign(-0.25)
```

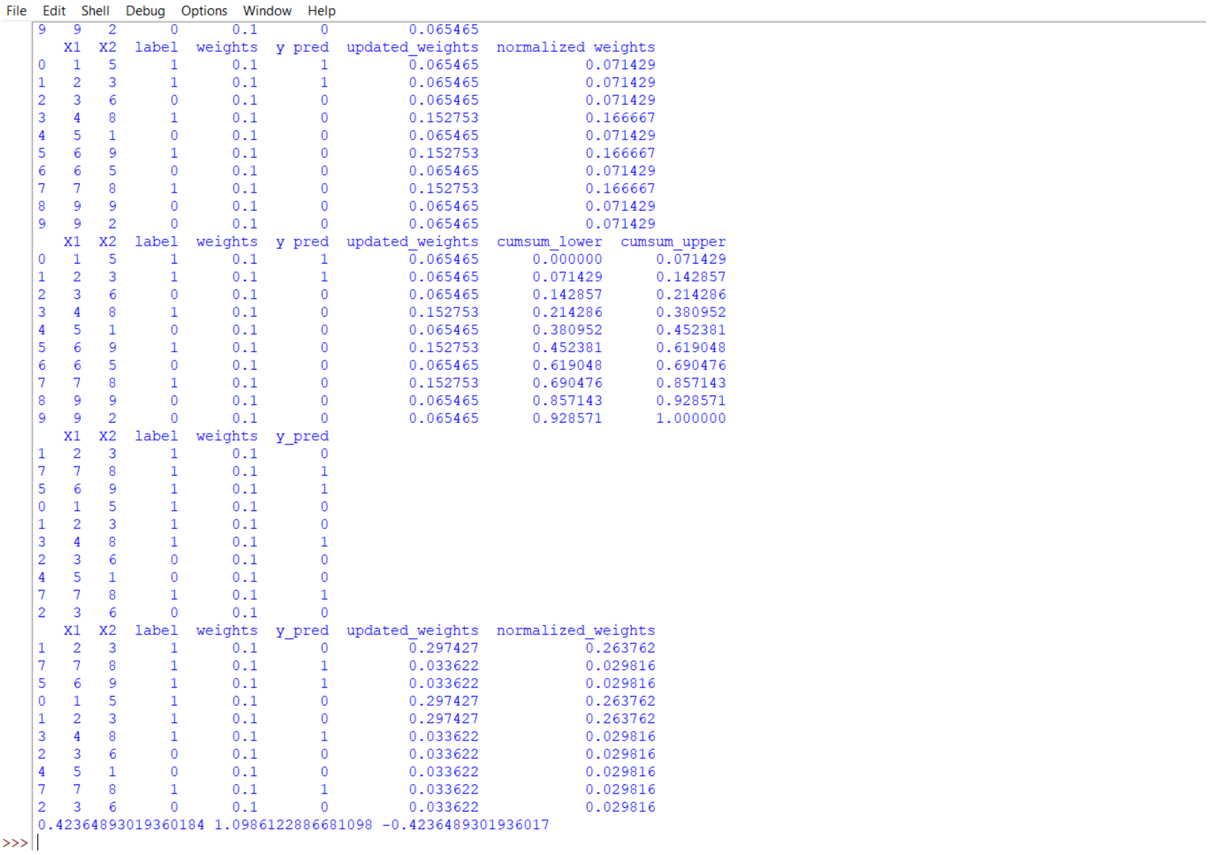
OUTPUT:



```
    Python 3.12.3 (tags/v3.12.3:f6650f9, Apr  9 2024, 14:05:25) [MSC v.1938 64 bit (AMD64)] on win32
    Type "help", "copyright", "credits" or "license()" for more information.
>>>
    = RESTART: C:/Users/itzdi/OneDrive/Documents/ML_Codes/Exp_8a.py
       X1  X2  label
    0   1   5      1
    1   2   3      1
    2   3   6      0
    3   4   8      1
    4   5   1      0
    5   6   9      1
    6   6   5      0
    7   7   8      1
    8   9   9      0
    9   9   2      0
       X1  X2  label  weights
    0   1   5      1      0.1
    1   2   3      1      0.1
    2   3   6      0      0.1
    3   4   8      1      0.1
    4   5   1      0      0.1
    5   6   9      1      0.1
    6   6   5      0      0.1
    7   7   8      1      0.1
    8   9   9      0      0.1
    9   9   2      0      0.1
       X1  X2  label  weights  y pred
    0   1   5      1      0.1       1
    1   2   3      1      0.1       1
    2   3   6      0      0.1       0
    3   4   8      1      0.1       0
    4   5   1      0      0.1       0
    5   6   9      1      0.1       0
    6   6   5      0      0.1       0
    7   7   8      1      0.1       0
    8   9   9      0      0.1       0
    9   9   2      0      0.1       0
       X1  X2  label  weights  y pred  updated_weights
    0   1   5      1      0.1       1         0.065465
    1   2   3      1      0.1       1         0.065465
    2   3   6      0      0.1       0         0.065465
    3   4   8      1      0.1       0         0.152753
    4   5   1      0      0.1       0         0.065465
    5   6   9      1      0.1       0         0.152753
    6   6   5      0      0.1       0         0.065465
    7   7   8      1      0.1       0         0.152753
    8   9   9      0      0.1       0         0.065465
```



```
9   9   2      0      0.1
   X1  X2  label  weights  y_pred
0   1   5      1      0.1       1
1   2   3      1      0.1       1
2   3   6      0      0.1       0
3   4   8      1      0.1       0
4   5   1      0      0.1       0
5   6   9      1      0.1       0
6   6   5      0      0.1       0
7   7   8      1      0.1       0
8   9   9      0      0.1       0
9   9   2      0      0.1       0
   X1  X2  label  weights  y_pred  updated_weights
0   1   5      1      0.1       1         0.065465
1   2   3      1      0.1       1         0.065465
2   3   6      0      0.1       0         0.065465
3   4   8      1      0.1       0         0.152753
4   5   1      0      0.1       0         0.065465
5   6   9      1      0.1       0         0.152753
6   6   5      0      0.1       0         0.065465
7   7   8      1      0.1       0         0.152753
8   9   9      0      0.1       0         0.065465
9   9   2      0      0.1       0         0.065465
   X1  X2  label  weights  y_pred  updated_weights  normalized_weights
0   1   5      1      0.1       1         0.065465            0.071429
1   2   3      1      0.1       1         0.065465            0.071429
2   3   6      0      0.1       0         0.065465            0.071429
3   4   8      1      0.1       0         0.152753            0.166667
4   5   1      0      0.1       0         0.065465            0.071429
5   6   9      1      0.1       0         0.152753            0.166667
6   6   5      0      0.1       0         0.065465            0.071429
7   7   8      1      0.1       0         0.152753            0.166667
8   9   9      0      0.1       0         0.065465            0.071429
9   9   2      0      0.1       0         0.065465            0.071429
   X1  X2  label  weights  y_pred  updated_weights  cumsum_lower  cumsum_upper
0   1   5      1      0.1       1         0.065465      0.000000      0.071429
1   2   3      1      0.1       1         0.065465      0.071429      0.142857
2   3   6      0      0.1       0         0.065465      0.142857      0.214286
3   4   8      1      0.1       0         0.152753      0.214286      0.380952
4   5   1      0      0.1       0         0.065465      0.380952      0.452381
5   6   9      1      0.1       0         0.152753      0.452381      0.619048
6   6   5      0      0.1       0         0.065465      0.619048      0.690476
7   7   8      1      0.1       0         0.152753      0.690476      0.857143
8   9   9      0      0.1       0         0.065465      0.857143      0.928571
9   9   2      0      0.1       0         0.065465      0.928571      1.000000
   X1  X2  label  weights  y_pred
1   2   3      1      0.1       0
```



```
9   9   2      0      0.1       0         0.065465
   X1  X2  label  weights  y_pred  updated_weights  normalized_weights
0   1   5      1      0.1       1         0.065465            0.071429
1   2   3      1      0.1       1         0.065465            0.071429
2   3   6      0      0.1       0         0.065465            0.071429
3   4   8      1      0.1       0         0.152753            0.166667
4   5   1      0      0.1       0         0.065465            0.071429
5   6   9      1      0.1       0         0.152753            0.166667
6   6   5      0      0.1       0         0.065465            0.071429
7   7   8      1      0.1       0         0.152753            0.166667
8   9   9      0      0.1       0         0.065465            0.071429
9   9   2      0      0.1       0         0.065465            0.071429
   X1  X2  label  weights  y_pred  updated_weights  cumsum_lower  cumsum_upper
0   1   5      1      0.1       1         0.065465      0.000000      0.071429
1   2   3      1      0.1       1         0.065465      0.071429      0.142857
2   3   6      0      0.1       0         0.065465      0.142857      0.214286
3   4   8      1      0.1       0         0.152753      0.214286      0.380952
4   5   1      0      0.1       0         0.065465      0.380952      0.452381
5   6   9      1      0.1       0         0.152753      0.452381      0.619048
6   6   5      0      0.1       0         0.065465      0.619048      0.690476
7   7   8      1      0.1       0         0.152753      0.690476      0.857143
8   9   9      0      0.1       0         0.065465      0.857143      0.928571
9   9   2      0      0.1       0         0.065465      0.928571      1.000000
   X1  X2  label  weights  y_pred
1   2   3      1      0.1       0
7   7   8      1      0.1       1
5   6   9      1      0.1       1
0   1   5      1      0.1       0
1   2   3      1      0.1       0
3   4   8      1      0.1       1
2   3   6      0      0.1       0
4   5   1      0      0.1       0
7   7   8      1      0.1       1
2   3   6      0      0.1       0
   X1  X2  label  weights  y_pred  updated_weights  normalized_weights
1   2   3      1      0.1       0         0.297427            0.263762
7   7   8      1      0.1       1         0.033622            0.029816
5   6   9      1      0.1       1         0.033622            0.029816
0   1   5      1      0.1       0         0.297427            0.263762
1   2   3      1      0.1       0         0.297427            0.263762
3   4   8      1      0.1       1         0.033622            0.029816
2   3   6      0      0.1       0         0.033622            0.029816
4   5   1      0      0.1       0         0.033622            0.029816
7   7   8      1      0.1       1         0.033622            0.029816
2   3   6      0      0.1       0         0.033622            0.029816
0.42364893019360184 1.0986122886681098 -0.42364893019360017
>>> 
```

RESULT:

A PYTHON PROGRAM TO IM[PLEMENT ADA BOOSTING AS BEEN ANALYSED AND VERIFEID