# ELEC 390 – Lab 06

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Composed By

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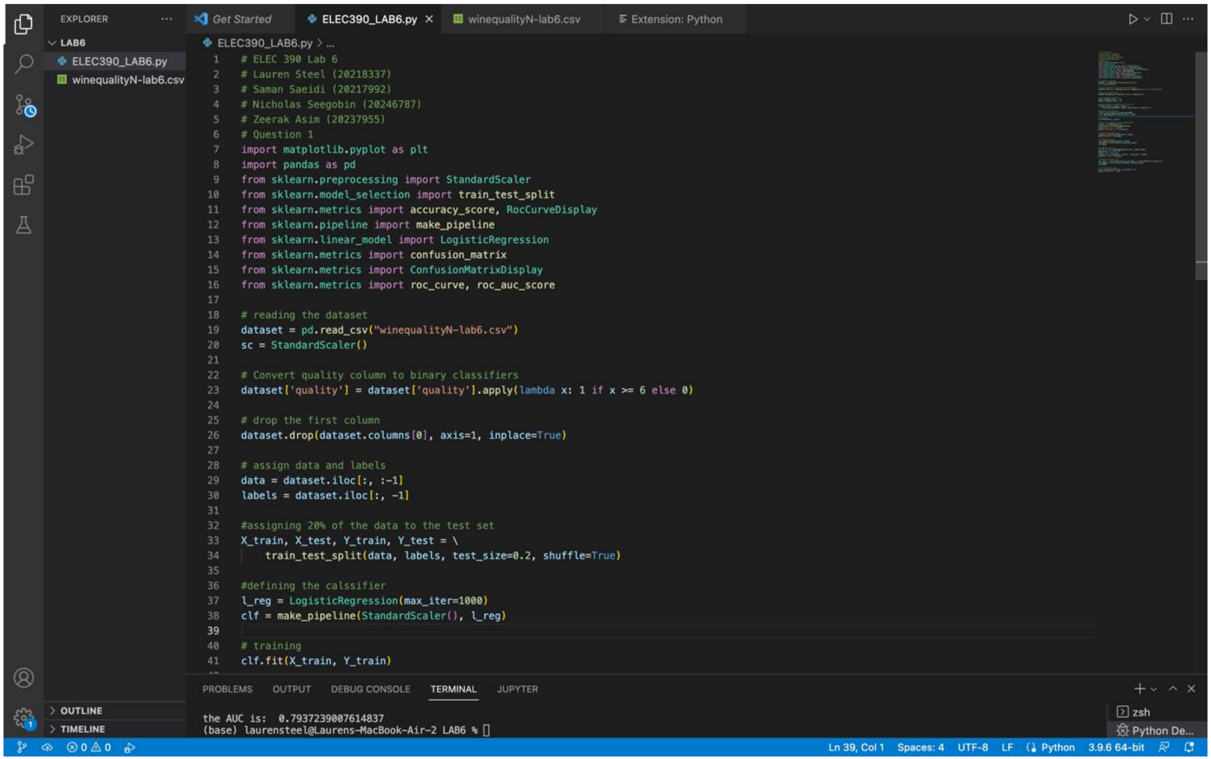
Section 03

Date of Submission

2023 March 30th

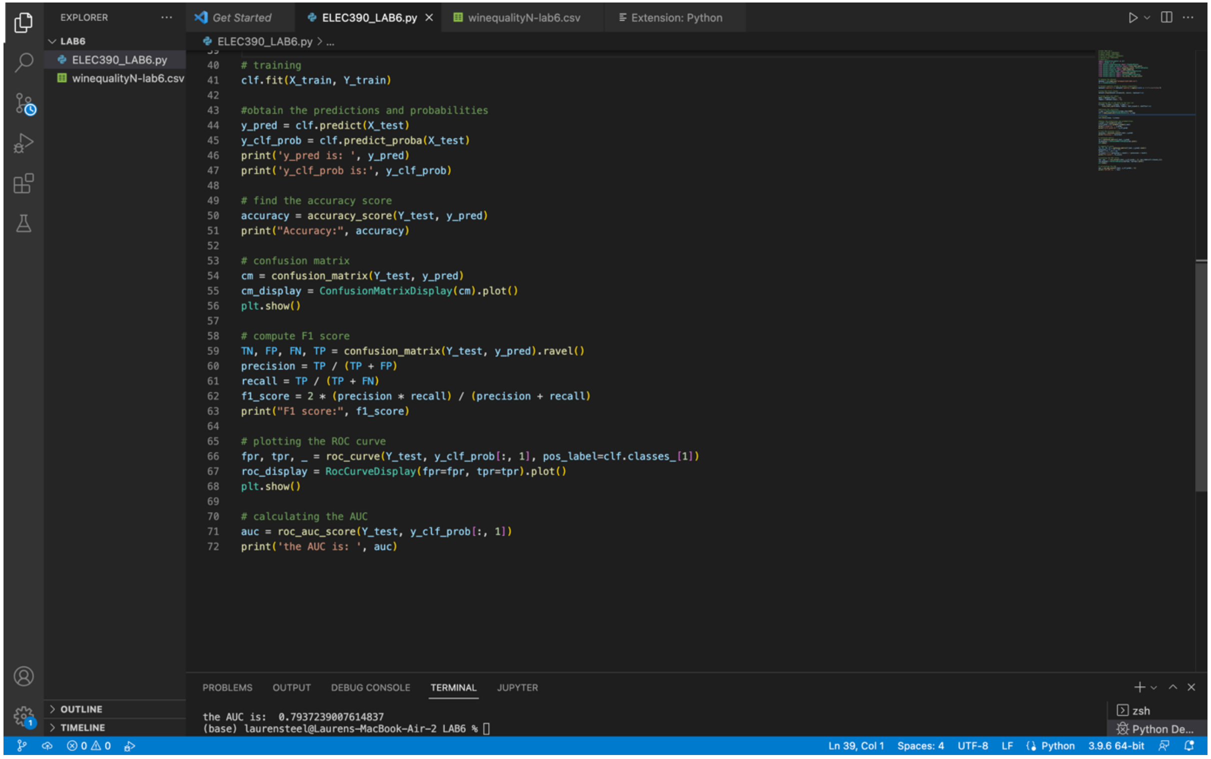
# Part 1

## Python Code



```python
# ELEC 390 Lab 6
# Lauren Steel (20218337)
# Saman Saeidi (20217992)
# Nicholas Seegobin (20246787)
# Zeerak Asim (20237955)
# Question 1
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, RocCurveDisplay
from sklearn.pipeline import make_pipeline
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix
from sklearn.metrics import ConfusionMatrixDisplay
from sklearn.metrics import roc_curve, roc_auc_score

# reading the dataset
dataset = pd.read_csv("winequalityN-lab6.csv")
sc = StandardScaler()

# Convert quality column to binary classifiers
dataset['quality'] = dataset['quality'].apply(lambda x: 1 if x >= 6 else 0)

# drop the first column
dataset.drop(dataset.columns[0], axis=1, inplace=True)

# assign data and labels
data = dataset.iloc[:, :-1]
labels = dataset.iloc[:, -1]

#assigning 20% of the data to the test set
X_train, X_test, Y_train, Y_test = \
    train_test_split(data, labels, test_size=0.2, shuffle=True)

#defining the calssifier
l_reg = LogisticRegression(max_iter=1000)
clf = make_pipeline(StandardScaler(), l_reg)

# training
clf.fit(X_train, Y_train)
```

```
the AUC is:  0.7937239007614837
(base) laurensteel@Laurens-MacBook-Air-2 LAB6 % 
```

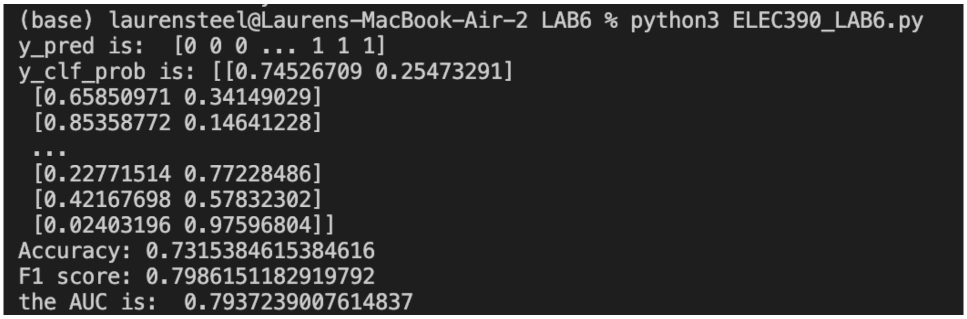


```python
# training
clf.fit(X_train, Y_train)

#obtain the predictions and probabilities
y_pred = clf.predict(X_test)
y_clf_prob = clf.predict_proba(X_test)
print('y_pred is: ', y_pred)
print('y_clf_prob is:', y_clf_prob)

# find the accuracy score
accuracy = accuracy_score(Y_test, y_pred)
print("Accuracy:", accuracy)

# confusion matrix
cm = confusion_matrix(Y_test, y_pred)
cm_display = ConfusionMatrixDisplay(cm).plot()
plt.show()

# compute F1 score
TN, FP, FN, TP = confusion_matrix(Y_test, y_pred).ravel()
precision = TP / (TP + FP)
recall = TP / (TP + FN)
f1_score = 2 * (precision * recall) / (precision + recall)
print("F1 score:", f1_score)

# plotting the ROC curve
fpr, tpr, _ = roc_curve(Y_test, y_clf_prob[:, 1], pos_label=clf.classes_[1])
roc_display = RocCurveDisplay(fpr=fpr, tpr=tpr).plot()
plt.show()

# calculating the AUC
auc = roc_auc_score(Y_test, y_clf_prob[:, 1])
print('the AUC is: ', auc)
```

```
the AUC is:  0.7937239007614837
(base) laurensteel@Laurens-MacBook-Air-2 LAB6 % 
```

*Figure 1: Screenshots of python code for lab 6 part 1.*

## Output



```
(base) laurensteel@Laurens-MacBook-Air-2 LAB6 % python3 ELEC390_LAB6.py
y_pred is:  [0 0 0 ... 1 1 1]
y_clf_prob is: [[0.74526709 0.25473291]
 [0.65850971 0.34149029]
 [0.85358772 0.14641228]
 ...
 [0.22771514 0.77228486]
 [0.42167698 0.57832302]
 [0.02403196 0.97596804]]
Accuracy: 0.7315384615384616
F1 score: 0.7986151182919792
the AUC is:  0.7937239007614837
```

*Figure 2: Output form the python code part 1.*

From Figure 2 shown above we can see that the accuracy of the model is approximately 0.714615.

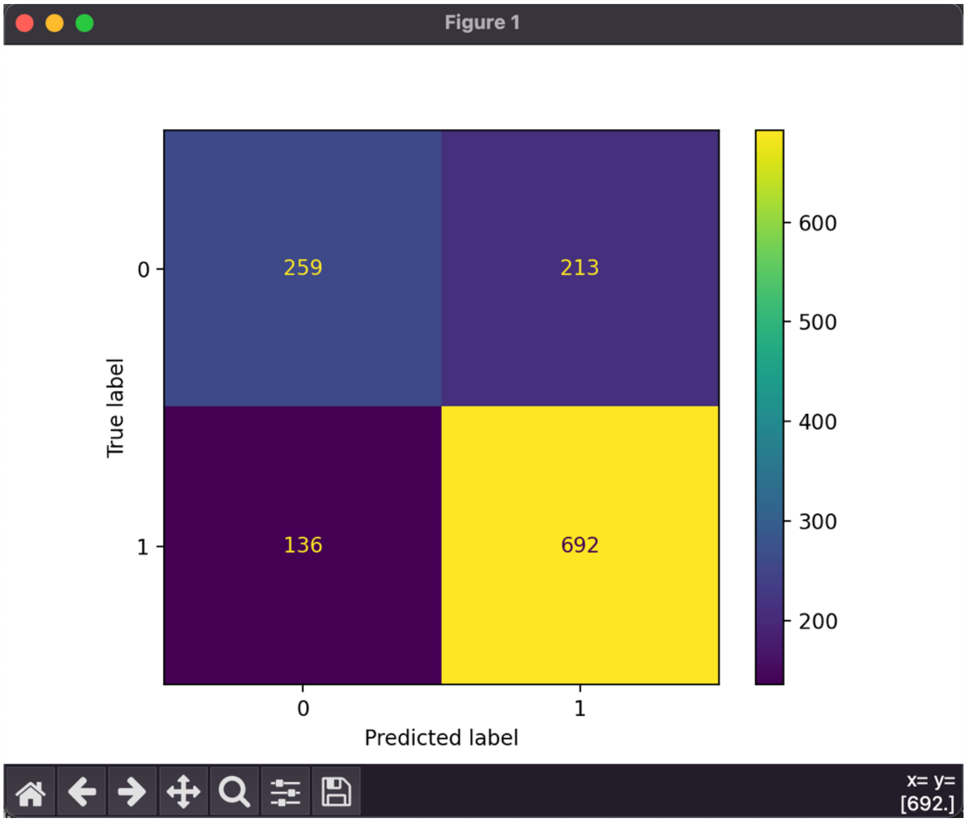


*Figure 3: Confusion Matrix*

Above in Figure 3 is the Confusion matrix produced by the code seen in Figure 1.

As seen in Figure 2 the F1 score is approximately 0.798615 and the AUC is 0.793723.

Finally, Figure 4 shown below is the ROC model.

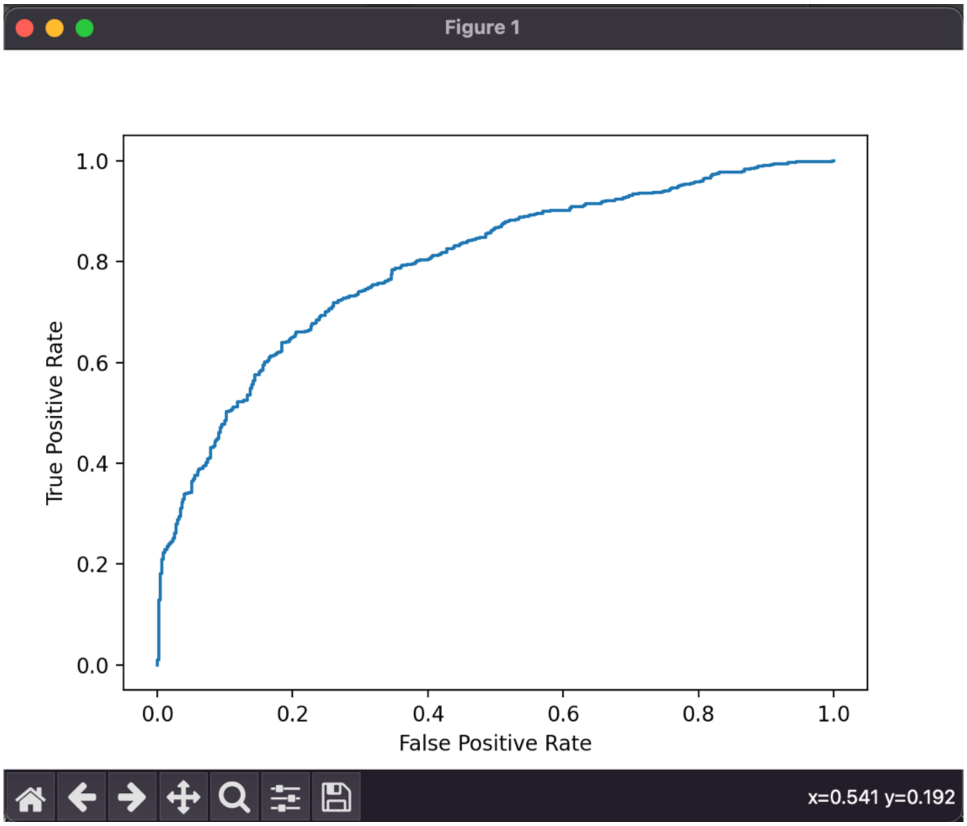
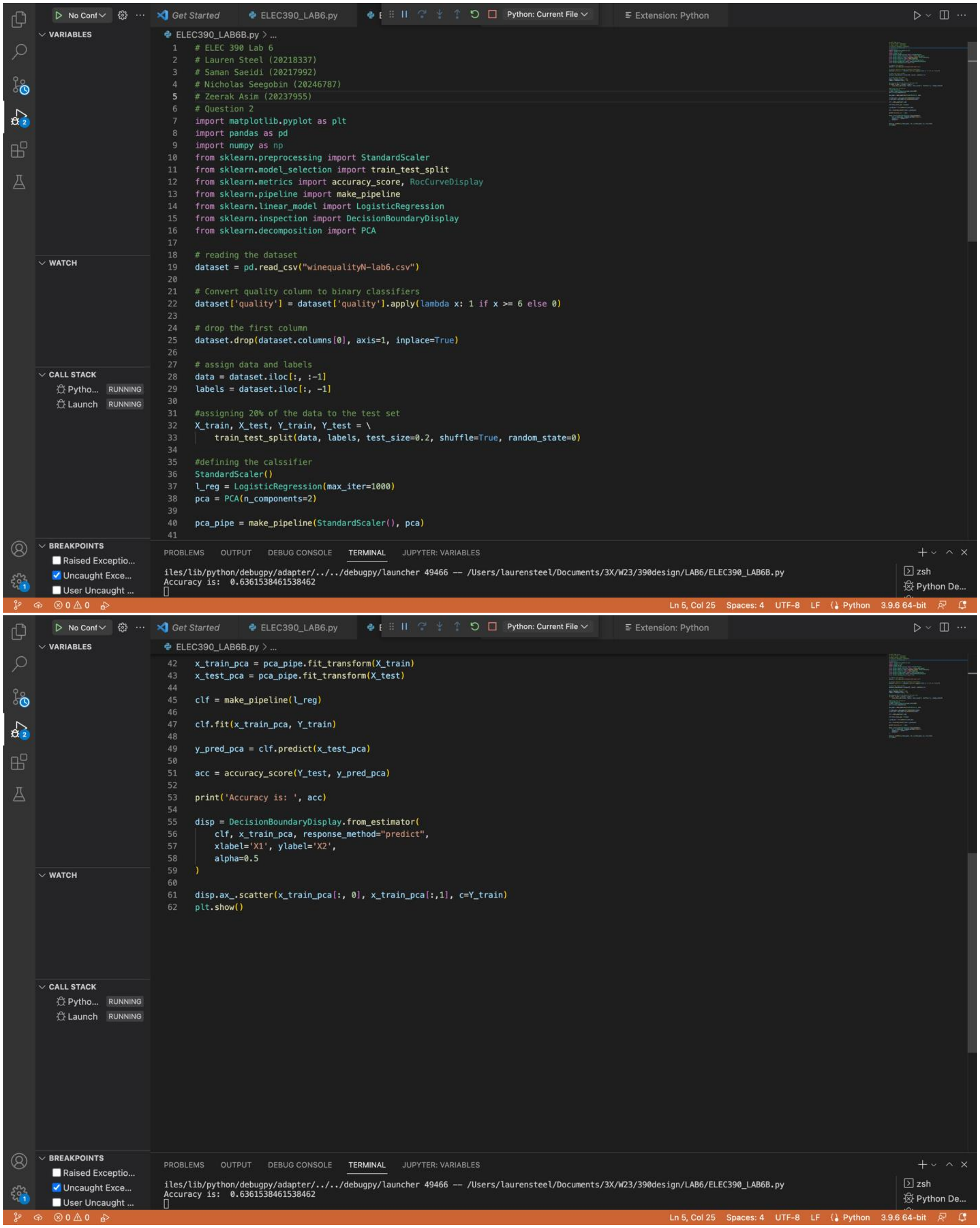


*Figure 4: ROC Model*

# Part 2

## Python Code



```python
# ELEC 390 Lab 6
# Lauren Steel (20218337)
# Saman Saeidi (20217992)
# Nicholas Seegobin (20246787)
# Zeerak Asim (20237955)
# Question 2
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, RocCurveDisplay
from sklearn.pipeline import make_pipeline
from sklearn.linear_model import LogisticRegression
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.decomposition import PCA

# reading the dataset
dataset = pd.read_csv("winequalityN-lab6.csv")

# Convert quality column to binary classifiers
dataset['quality'] = dataset['quality'].apply(lambda x: 1 if x >= 6 else 0)

# drop the first column
dataset.drop(dataset.columns[0], axis=1, inplace=True)

# assign data and labels
data = dataset.iloc[:, :-1]
labels = dataset.iloc[:, -1]

#assigning 20% of the data to the test set
X_train, X_test, Y_train, Y_test = \
    train_test_split(data, labels, test_size=0.2, shuffle=True, random_state=0)

#defining the calssifier
StandardScaler()
l_reg = LogisticRegression(max_iter=1000)
pca = PCA(n_components=2)

pca_pipe = make_pipeline(StandardScaler(), pca)

```

```
iles/lib/python/debugpy/adapter/../../debugpy/launcher 49466 -- /Users/laurensteel/Documents/3X/W23/390design/LAB6/ELEC390_LAB6B.py
Accuracy is:  0.6361538461538462
```

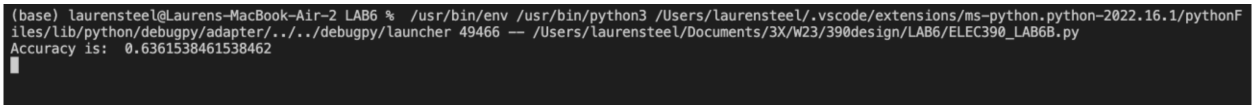
```python
x_train_pca = pca_pipe.fit_transform(X_train)
x_test_pca = pca_pipe.fit_transform(X_test)

clf = make_pipeline(l_reg)

clf.fit(x_train_pca, Y_train)

y_pred_pca = clf.predict(x_test_pca)

acc = accuracy_score(Y_test, y_pred_pca)

print('Accuracy is: ', acc)

disp = DecisionBoundaryDisplay.from_estimator(
    clf, x_train_pca, response_method="predict",
    xlabel='X1', ylabel='X2',
    alpha=0.5
)

disp.ax_.scatter(x_train_pca[:, 0], x_train_pca[:,1], c=Y_train)
plt.show()
```

```
iles/lib/python/debugpy/adapter/../../debugpy/launcher 49466 -- /Users/laurensteel/Documents/3X/W23/390design/LAB6/ELEC390_LAB6B.py
Accuracy is:  0.6361538461538462
```

*Figure 5: Screenshots of the python code for lab 6 part 2.*

## Output

Below in Figure 6 is a screenshot of the output developed by the code from Figure 5. As we can see in the image the accuracy of the model is approximately 0.636153.



```
(base) laurensteel@Laurens-MacBook-Air-2 LAB6 %  /usr/bin/env /usr/bin/python3 /Users/laurensteel/.vscode/extensions/ms-python.python-2022.16.1/pythonF
iles/lib/python/debugpy/adapter/../../debugpy/launcher 49466 -- /Users/laurensteel/Documents/3X/W23/390design/LAB6/ELEC390_LAB6B.py
Accuracy is:  0.6361538461538462
█
```

*Figure 6: Output from the python code part 2.*

## Training Data

Figure 7 is a representation of the training data and its decision boundary.

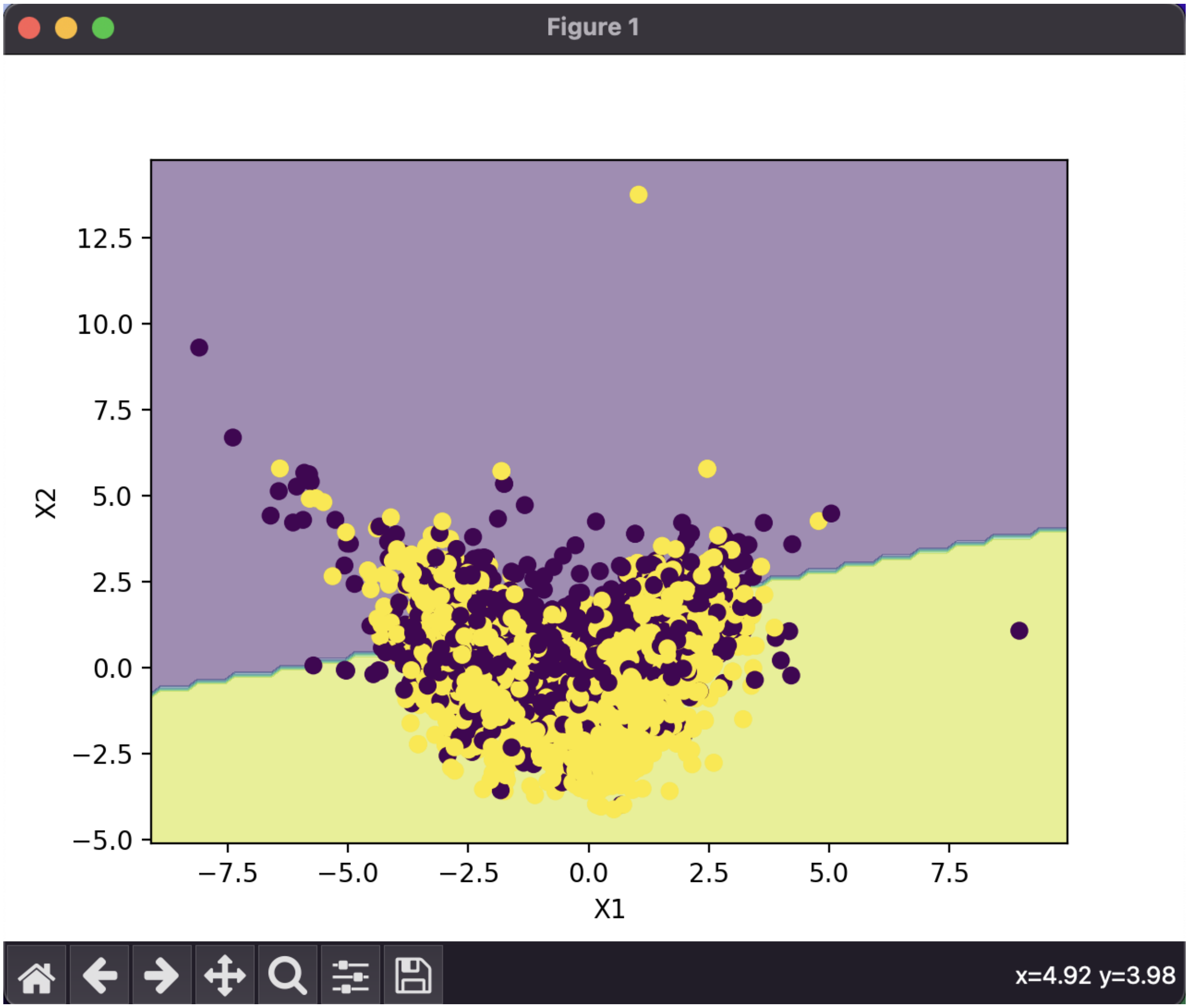


*Figure 7: Training data (reduced to 2 dimensions) and its decision boundary produced from the python code part 2.*

**Compare the accuracy of Part 2 with Part 1. What is your observation and why?**

As seen in the data presented above the accuracy of the model in part 1 is approximately 0.714615 while the accuracy of the model in part 2 is approximately 0.636153. Overall, a higher accuracy value is better because it shows that the model is making correct predictions more frequently. This makes sense as the model in part 2 only uses 2 components of the PCA instead of all the data.