PROJECT REPORT

ASSIGNMENT-2

CSE – 6363: MACHINE LEARNING

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SUPPORT VECTOR MACHINES

- SVMs are a type of supervised machine learning algorithm, meaning that they learn from labeled data.
- SVMs can be used for classification or regression tasks.
- SVMs work by finding a hyperplane in the data that separates the data points into two classes.
- The hyperplane is chosen in such a way that it maximizes the margin between the two classes.
- SVMs are powerful machine learning algorithms that can be used to solve a variety of problems.

1. The Negative Case:

The negative case in the SVM code is when the alpha values are at the endpoints of the line segment. In this case, the algorithm evaluates the objective function at the endpoints to determine which one to choose. If the objective function is lower at the lower endpoint, then the algorithm chooses the lower endpoint. If the objective function is higher at the higher endpoint, then the algorithm chooses the higher endpoint. If the objective function is the same at both endpoints, then the algorithm chooses the alpha value that is closer to its original value.

The negative case in the SVM code is an important case to consider because it can help to improve the performance of the algorithm.

Output:

Task 1:
Sample Shape and Target Shape : (100, 2) (100,)

Weights: [0.78463926 -0.9794459]

b: 0.16339714841159533

coef_: [[0.72617793 -0.88670346]]

intercept: [-0.08003618]

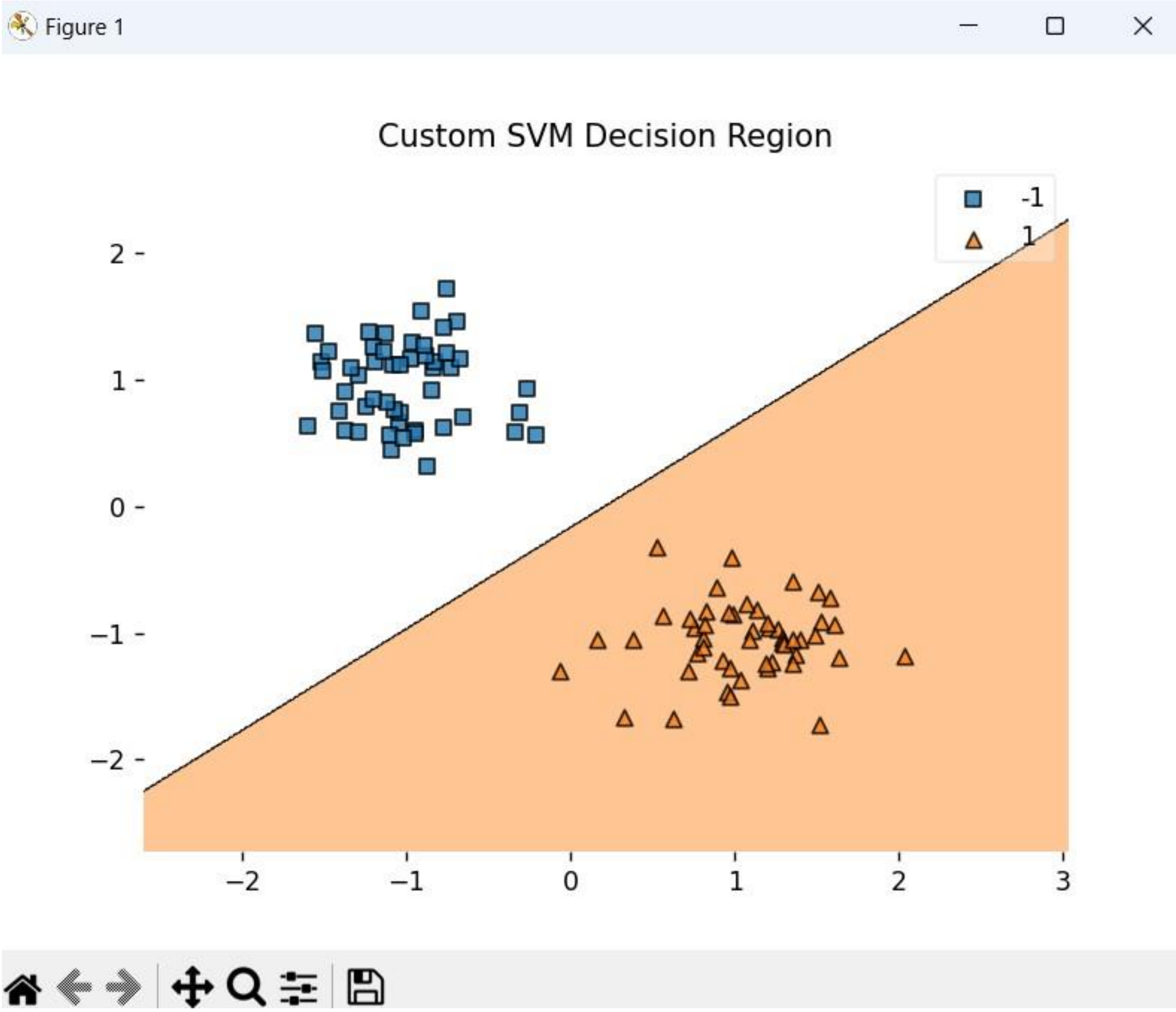
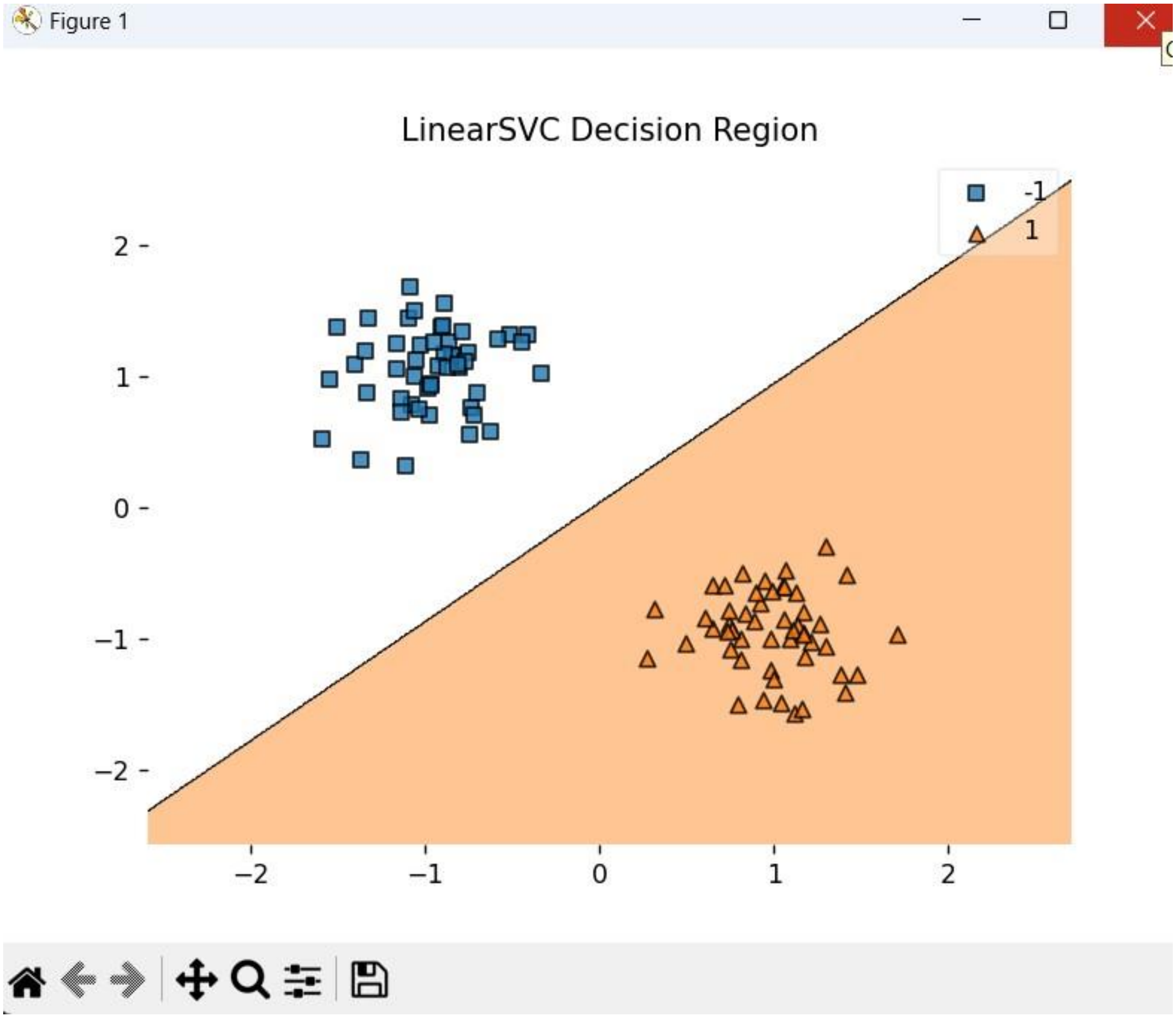


Figure 1
Custom SVM Decision Region
■ -1
▲ 1
2
1
0
−1
−2
−2
−1
0
1
2
3



Task 2:

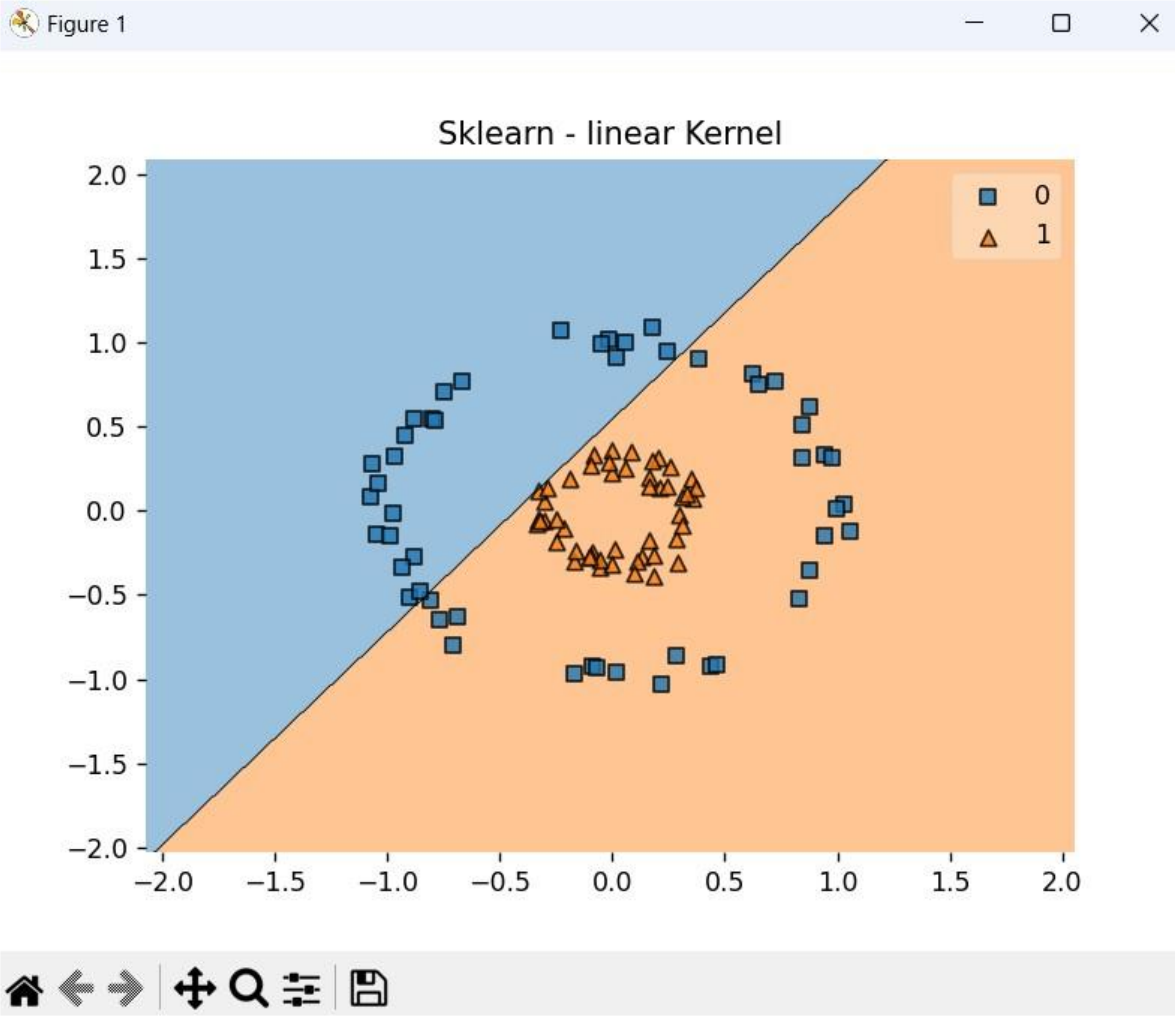
Kernel Matrix: [[25 121]
 [121 625]]
Is Positive Semidefinite: True

2. Non-Linear:

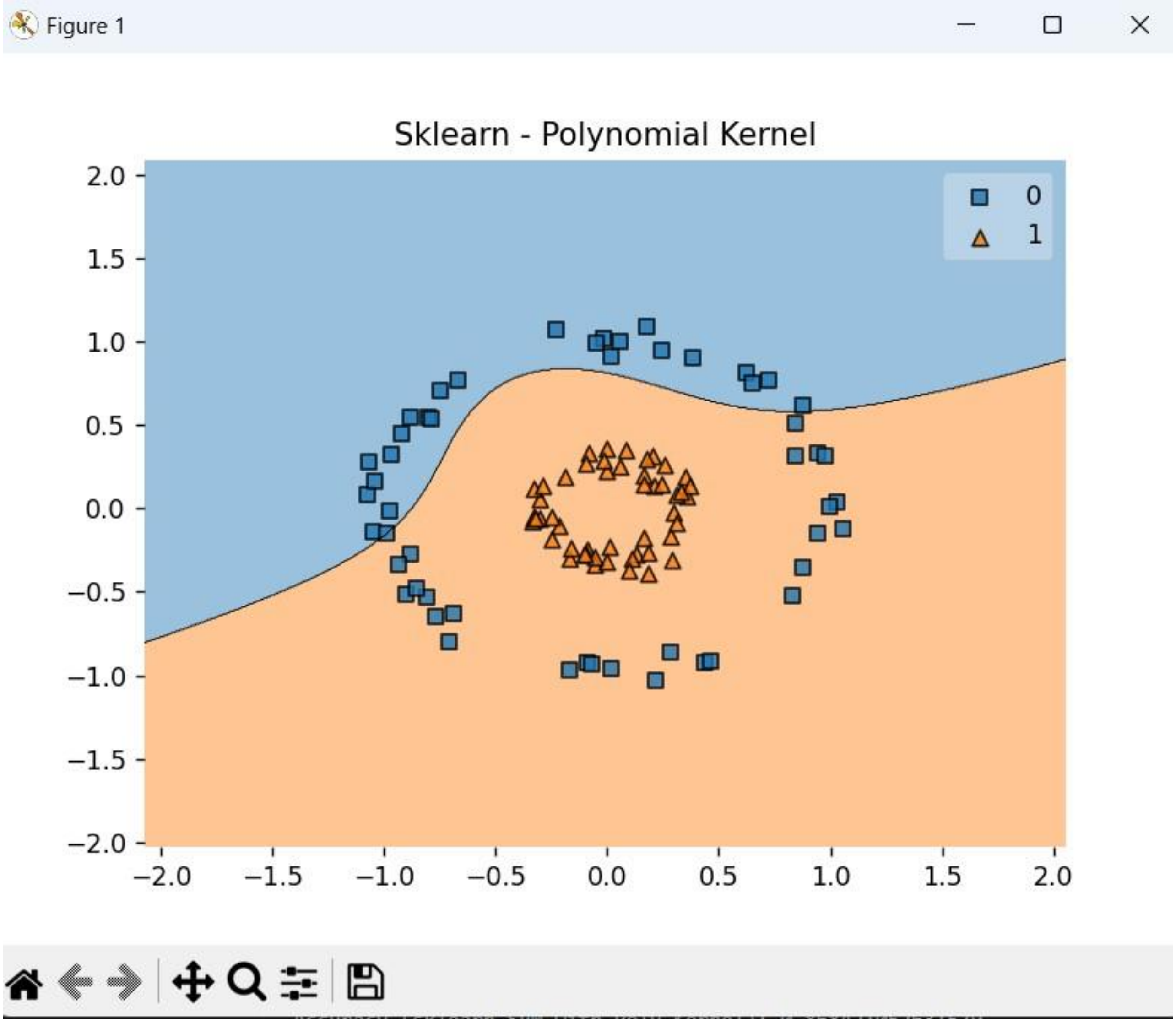
Non-linear SVMs are more complex than linear SVMs because they can learn non-linear relationships between the features. This makes them more powerful, but also more computationally expensive to train.

One way to train a non-linear SVM is to use a kernel function. A kernel function is a function that takes two data points as input and returns a similarity score. The kernel function is used to transform the data into a higher-dimensional space, where the data points are more likely to be linearly separable.

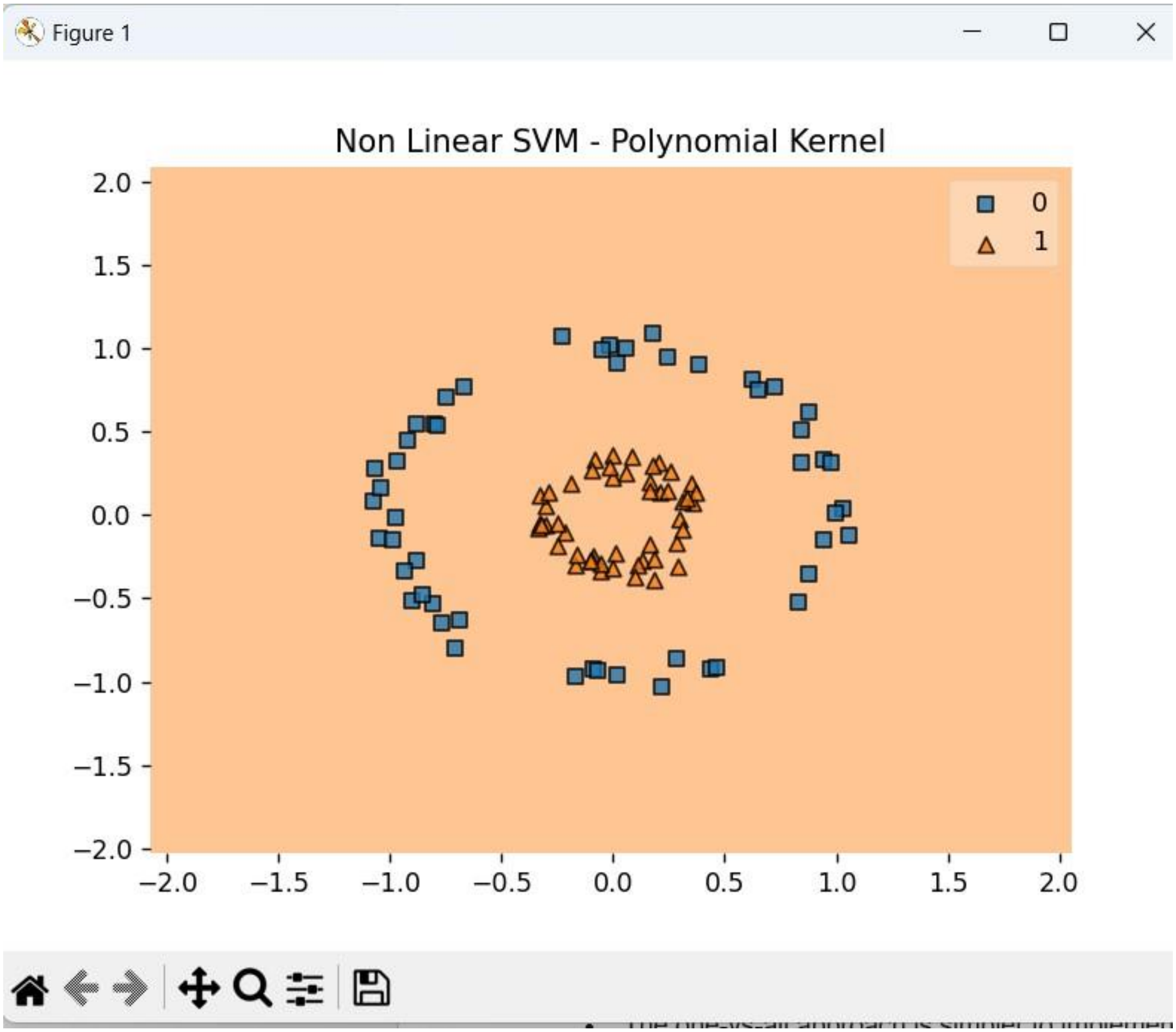
Output:



Accuracy (Non linear SVM - Polynomial Kernel): 0.50



Accuracy (sklearn SVC - Linear Kernel): 0.74



Accuracy (sklearn SVC - Polynomial Kernel): 0.76

3. Multi-Class SVM:

- Multi-class SVMs are used to classify data into more than two classes.
- In the one-vs-all approach, a separate SVM classifier is trained for each class. Each classifier is trained to distinguish between one class and all other classes.
- The one-vs-all approach is simpler to implement, but it can be less accurate than the one-vs-one approach.

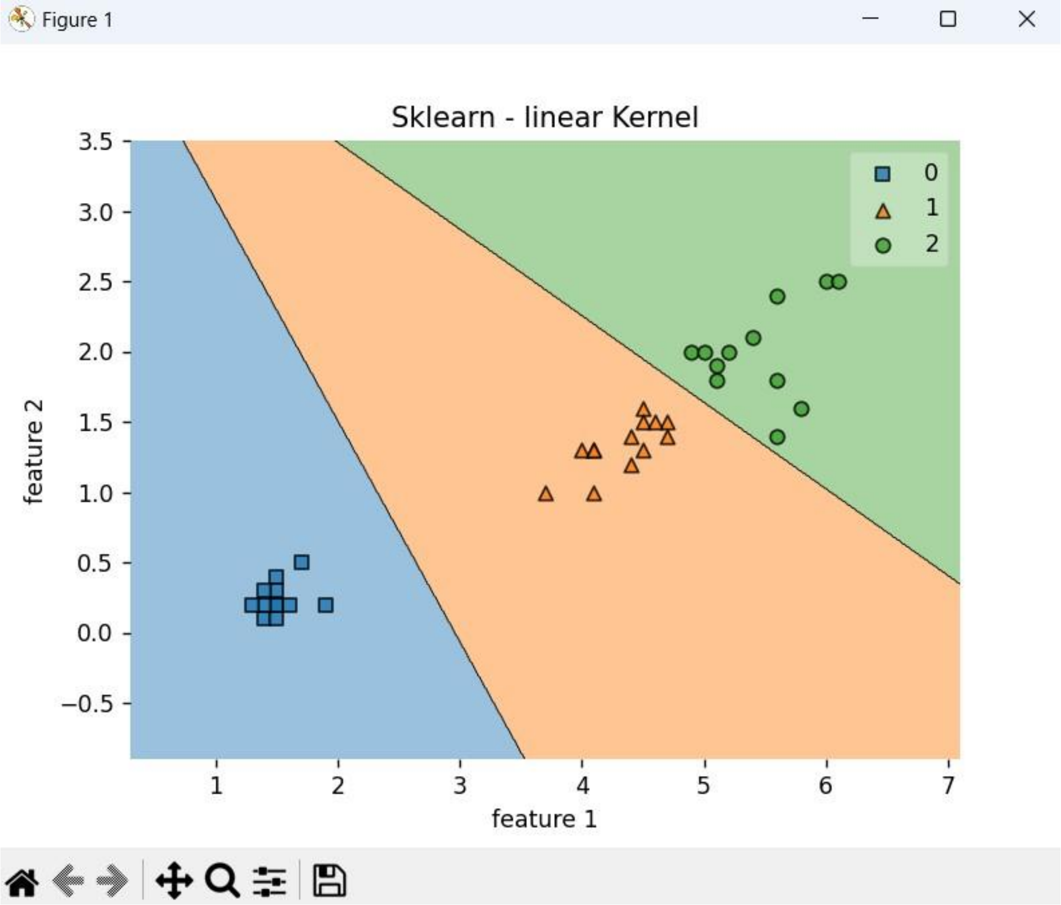
Output:

Accuracy (Multi SVM with Linear Kernel): 0.5526315789473685

Accuracy (Multi SVM with Poly Kernel): 0.39473684210526316

Accuracy (sklearn SVM with Linear Kernel): 1.0

Accuracy (sklearn SVM with Poly Kernel): 0.868421052631579



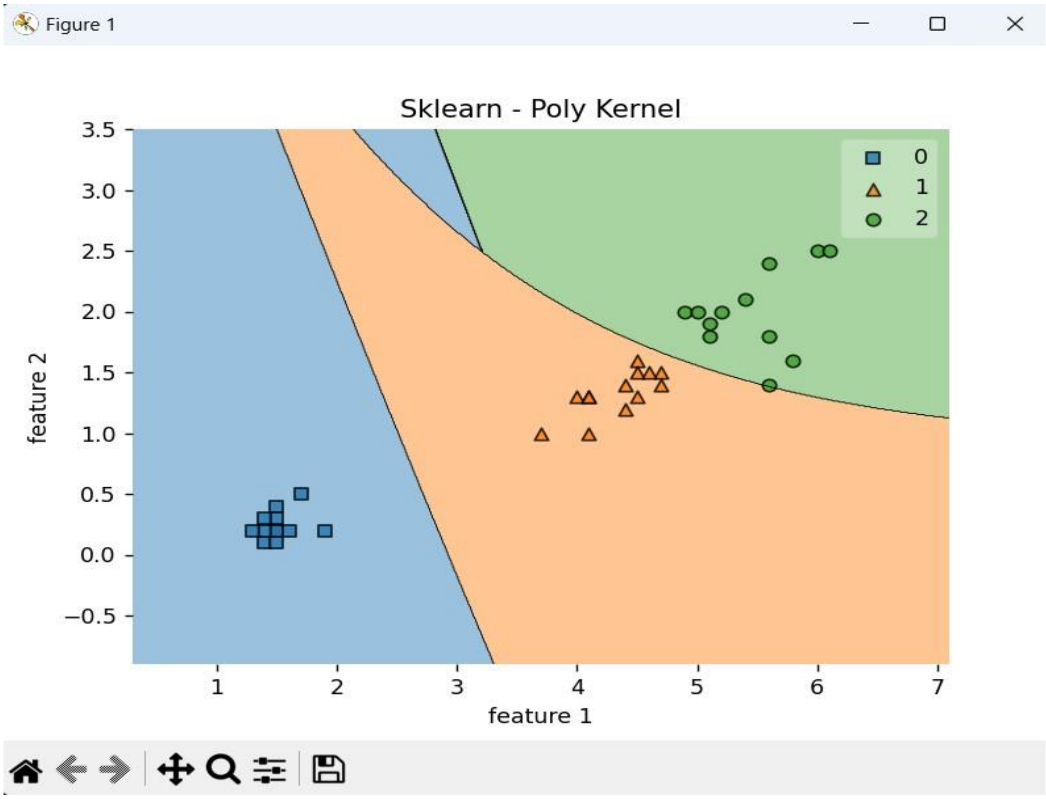


Figure 1
Sklearn - Poly Kernel
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
feature 2
1
2
3
4
5
6
7
feature 1
0
1
2

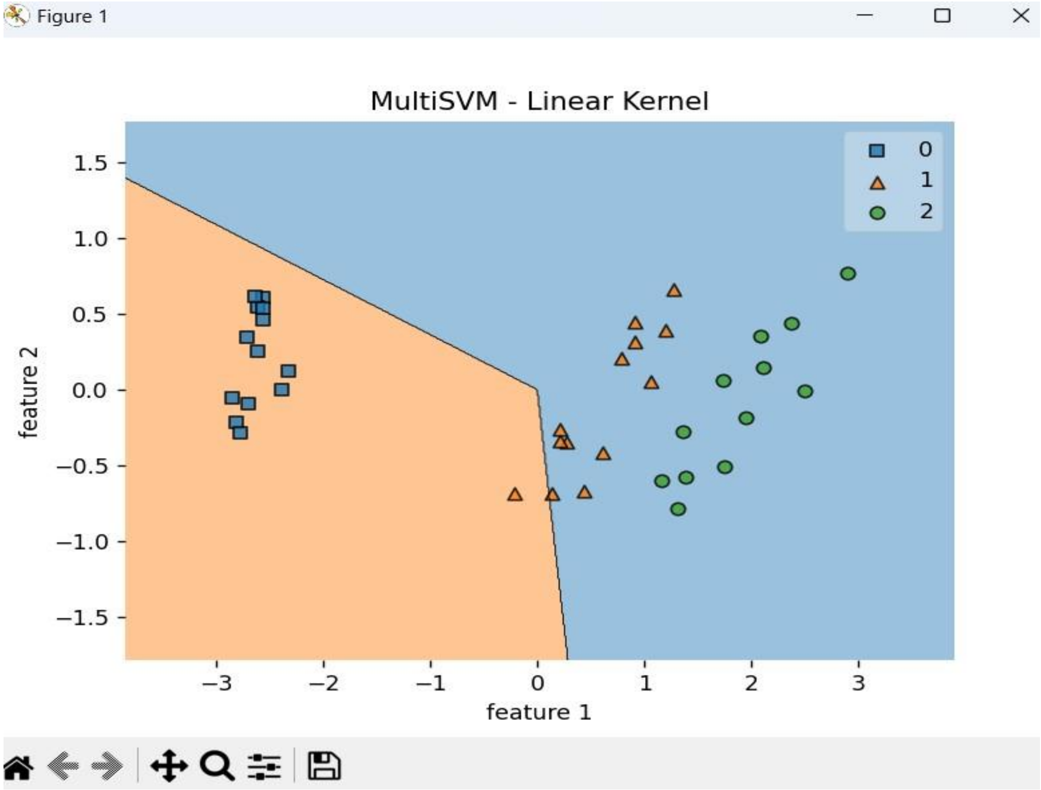
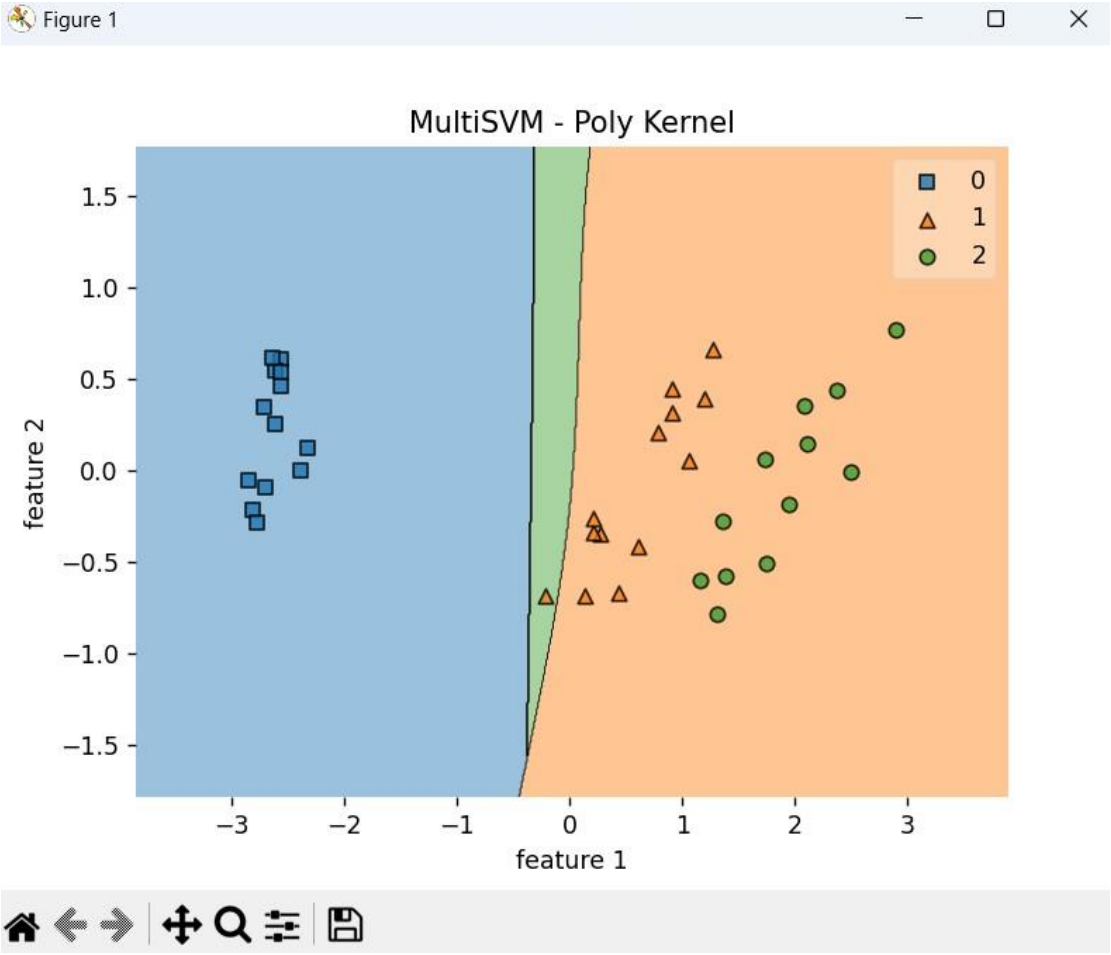


Figure 1
MultiSVM - Linear Kernel
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
feature 2
−3
−2
−1
0
1
2
3
feature 1
0
1
2



Learning Outcomes:

This assignment offered a comprehensive hands-on experience in implementing a Support Vector Machine task. In my project, I gained comprehensive hands-on experience in implementing a Support Vector Machine (SVM) task. I learned about the negative case in SVM code, its importance, and how the algorithm evaluates the objective function at the endpoints of the line segment to choose the appropriate alpha value.

I also learned about non-linear SVMs and why they are more powerful than linear SVMs. I learned how kernel functions are used to train non-linear SVMs, and I identified the most common kernel functions and their advantages and disadvantages. I also learned how to choose the appropriate kernel function for a given dataset and learning task.

I learned about multi-class SVMs and how they are different from binary SVMs. I identified the advantages and disadvantages of the one-vs-rest approach, and I learned how to choose the appropriate approach for a given dataset and learning task.