Homework 12

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In [67]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.svm import SVC
from sklearn.preprocessing import StandardScaler
import os
import warnings
warnings.filterwarnings("ignore")
```

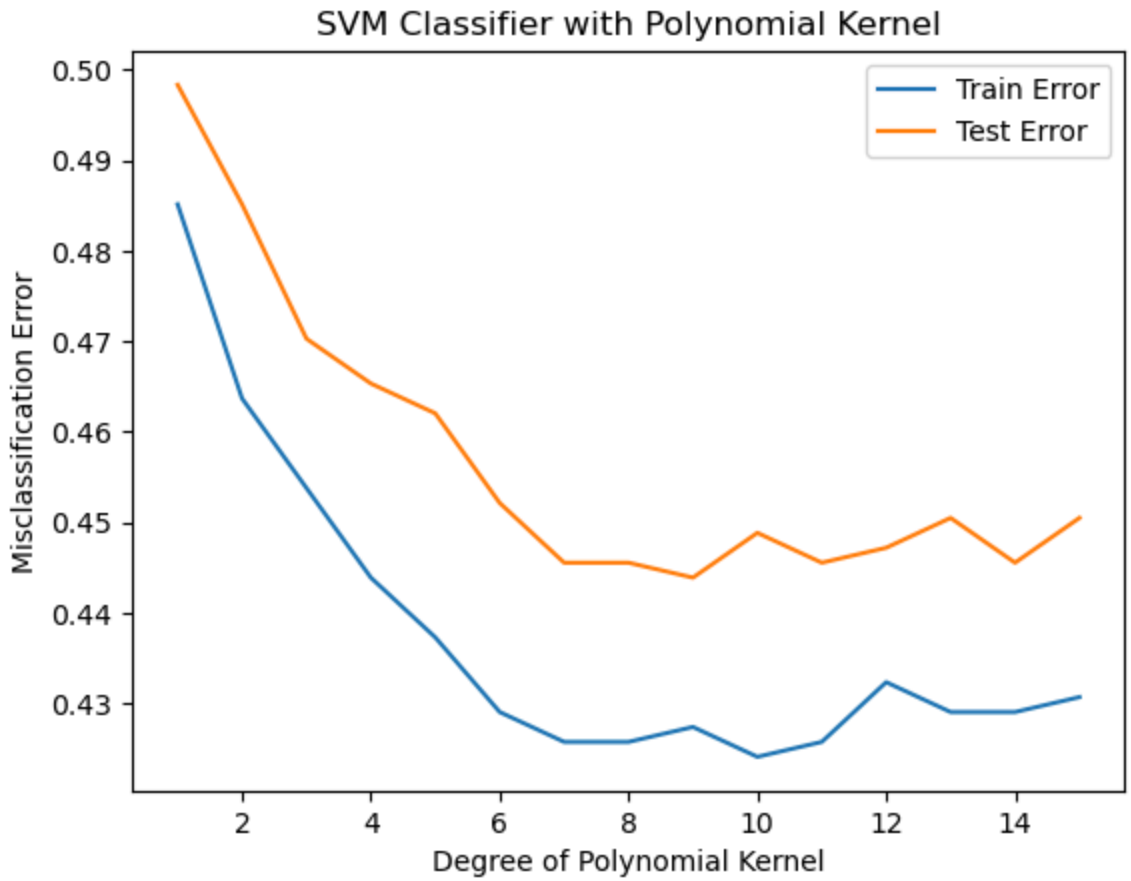
In [68]:
```
def poly_SVC(degrees):

    trn_errs = []
    tst_errs = []
    for degree in degrees:

        clf = SVC(C=1, kernel='poly', degree=degree)


        clf.fit(X_train, y_train)

        trn_err = 1 - clf.score(X_train, y_train)
        tst_err = 1 - clf.score(X_test, y_test)

        trn_errs.append(trn_err)
        tst_errs.append(tst_err)


    plt.plot(degrees, trn_errs, label='Train Error')
    plt.plot(degrees, tst_errs, label='Test Error')
    plt.xlabel('Degree of Polynomial Kernel')
    plt.ylabel('Misclassification Error')
    plt.title('SVM Classifier with Polynomial Kernel')
    plt.legend()
    plt.show()


def rbf_SVC(X_train, X_test, y_train, y_test):

    s = StandardScaler()
    X_train = s.fit_transform(X_train)
```

```
    X_test = s.transform(X_test)

    gammas = [2**-i for i in range(21)]


    trn_errs = []
    tst_errs = []
    for gamma in gammas:

        svm = SVC(C=1, kernel='rbf', gamma=gamma)

        svm.fit(X_train, y_train)

        trn_err = 1 - svm.score(X_train, y_train)
        tst_err = 1 - svm.score(X_test, y_test)

        trn_errs.append(trn_err)
        tst_errs.append(tst_err)

    plt.semilogx(gammas, trn_errs, label='Train Error')
    plt.semilogx(gammas, tst_errs, label='Test Error')
    plt.xlabel('Gamma (γ)')
    plt.ylabel('Misclassification Error')
    plt.title('SVM Classifier with RBF Kernel')
    plt.legend()
    plt.show()
```

In [69]:
```
path = "/Users/gaganullas19/Documents/Spring2024/AppliedMachineLearning/Homework_12"

hillvalley_X_train = pd.read_table(os.path.join(path, "hill-valley/X.dat"), delimiter=' ', header=None)
hillvalley_Y_train = pd.read_table(os.path.join(path, "hill-valley/Y.dat"), delimiter=' ', header=None)
hillvalley_X_test  = pd.read_table(os.path.join(path, "hill-valley/Xtest.dat"), delimiter=' ', header=None)
hillvalley_Y_test =  pd.read_table(os.path.join(path, "hill-valley/Ytest.dat"), delimiter=' ', header=None)
```

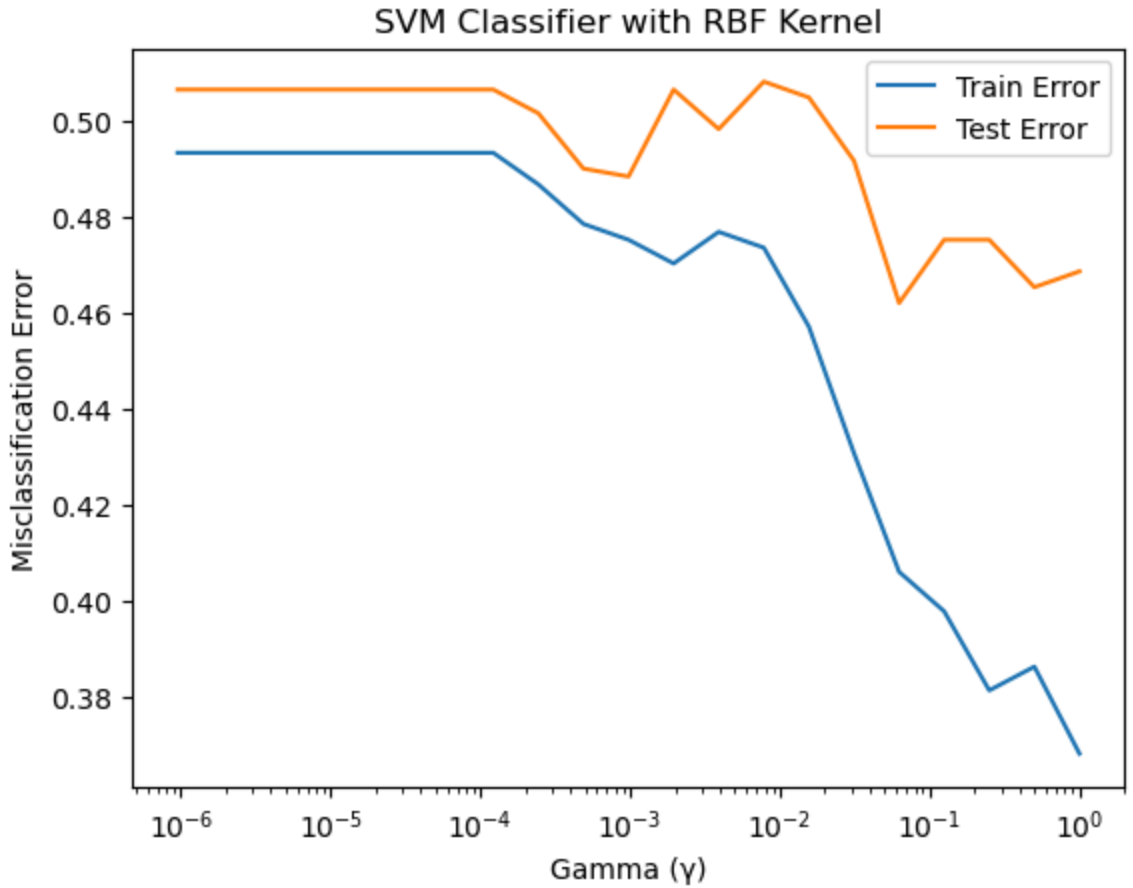
In [70]:
```
X_train, X_test, y_train, y_test = hillvalley_X_train,hillvalley_X_test,hillvalley_Y_train ,hillvalley_Y_test

degrees = range(1, 16)

print("----1 a-------")

poly_SVC(degrees)
```

```
----1 a-------
```



In [71]:
```
print("----1 b-------")
rbf_SVC(X_train, X_test, y_train, y_test)
```

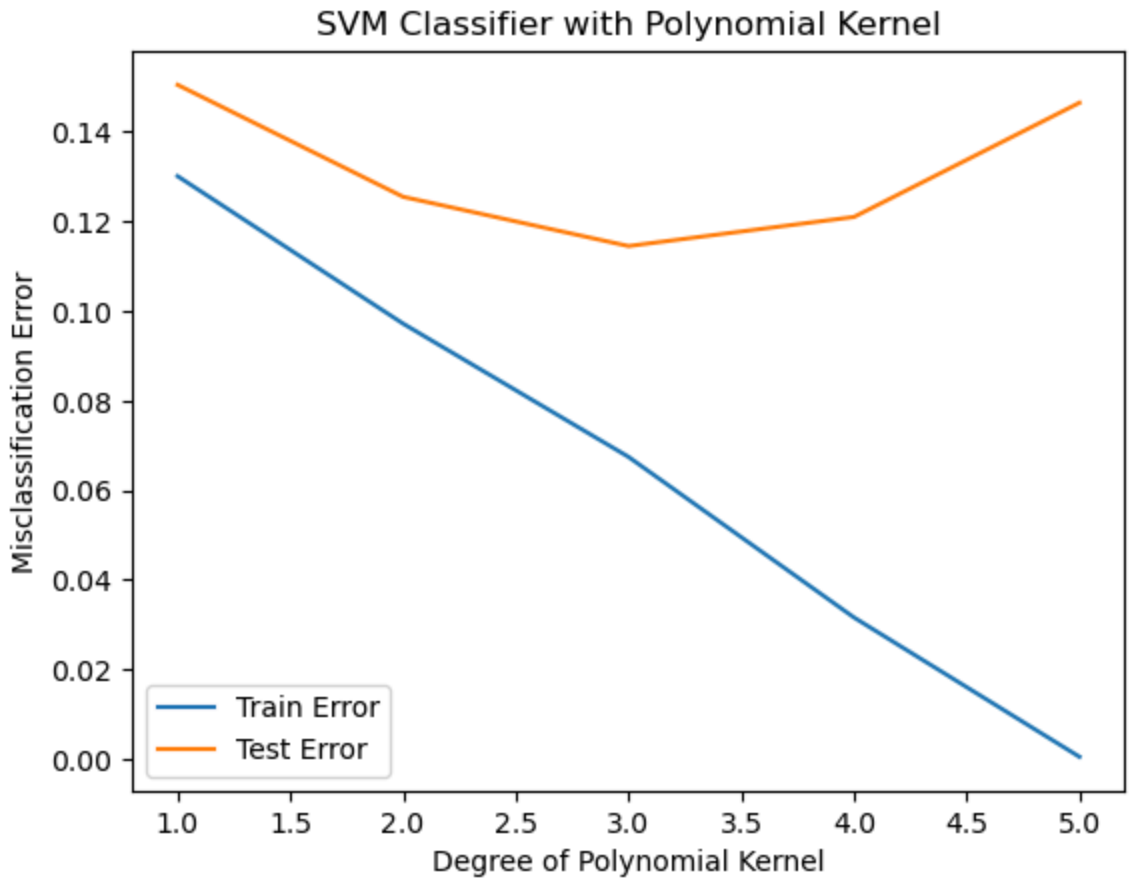
```
----1 b-------
```



In [72]:
```
satimage_X_train = pd.read_table(os.path.join(path, "satimage/X.dat"), delimiter=' ', header=None)
satimage_Y_train = pd.read_table(os.path.join(path, "satimage/Y.dat"), delimiter=' ', header=None)
satimage_X_test = pd.read_table(os.path.join(path,  "satimage/Xtest.dat"), delimiter=' ', header=None)
satimage_Y_test = pd.read_table(os.path.join(path,  "satimage/Ytest.dat"), delimiter=' ', header=None)
```

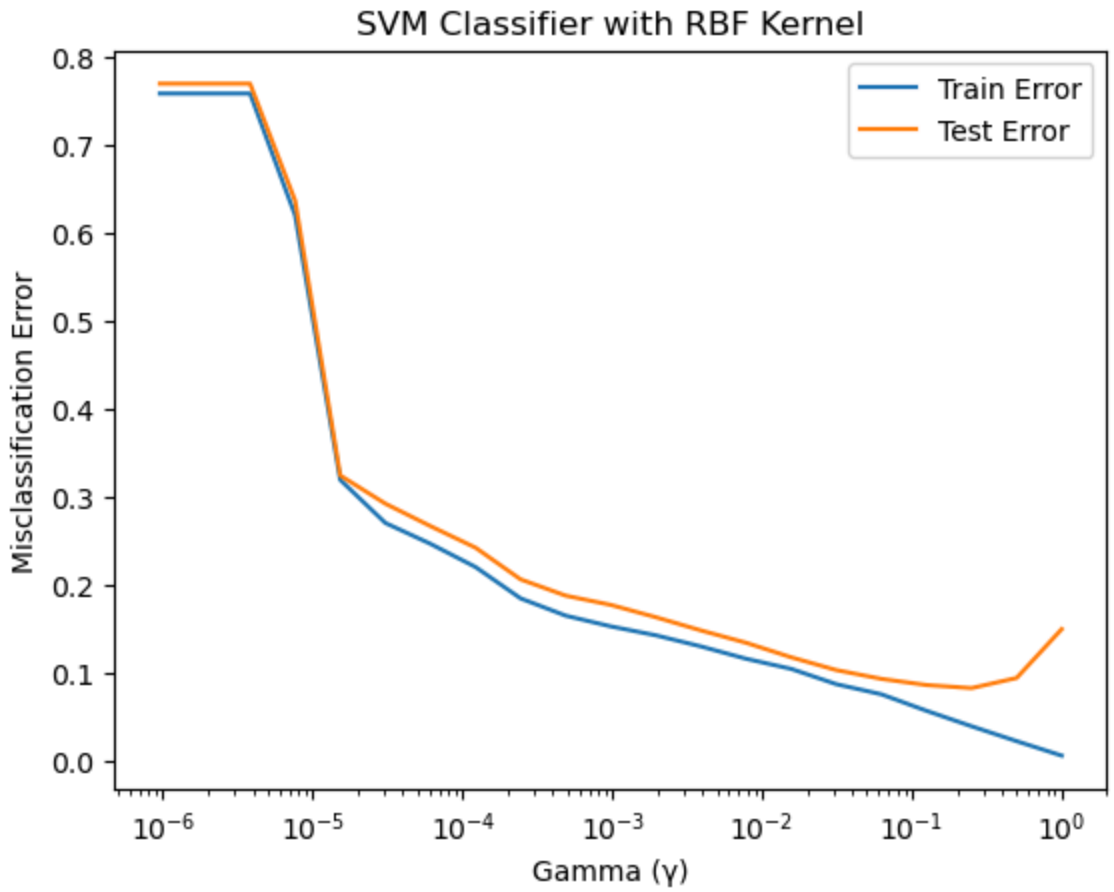
In [73]:
```
X_train, X_test, y_train, y_test = satimage_X_train,satimage_X_test,satimage_Y_train ,satimage_Y_test

degrees = range(1, 6)

print("----1 c-------")

poly_SVC(degrees)
```

```
----1 c-------
```



In [74]:
```
print("----1 d-------")
rbf_SVC(X_train, X_test, y_train, y_test)
```

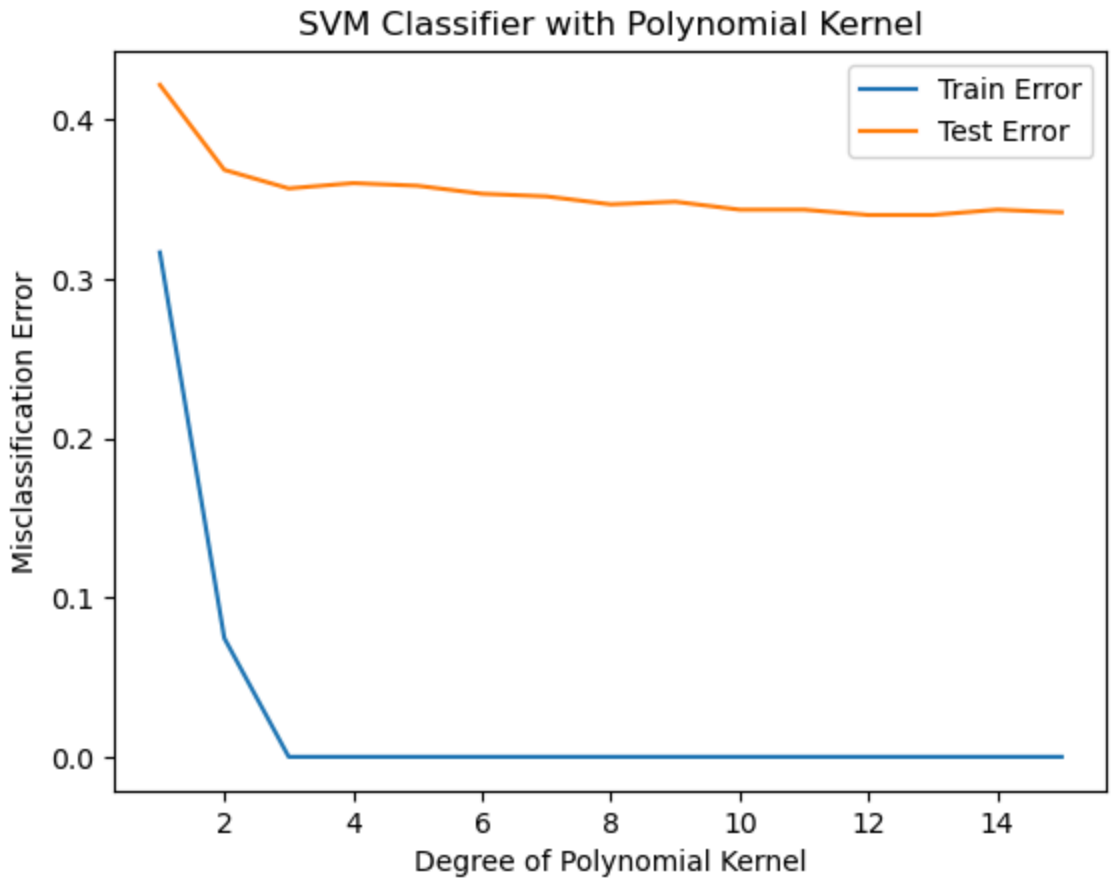
```
----1 d-------
```



In [75]:
```
X_train = pd.read_table(os.path.join(path, "MADELON/madelon_train.data"), delimiter=' ', header=None)
X_train = X_train.drop(X_train.columns[-1], axis=1)
y_train = pd.read_table(os.path.join(path, "MADELON/madelon_train.labels"), delimiter=' ', header=None)
X_test = pd.read_table(os.path.join(path, "MADELON/madelon_valid.data"), delimiter=' ', header=None)
X_test= X_test.drop(X_test.columns[-1], axis=1)
y_test = pd.read_table(os.path.join(path, "MADELON/madelon_valid.labels"), delimiter=' ', header=None)
```

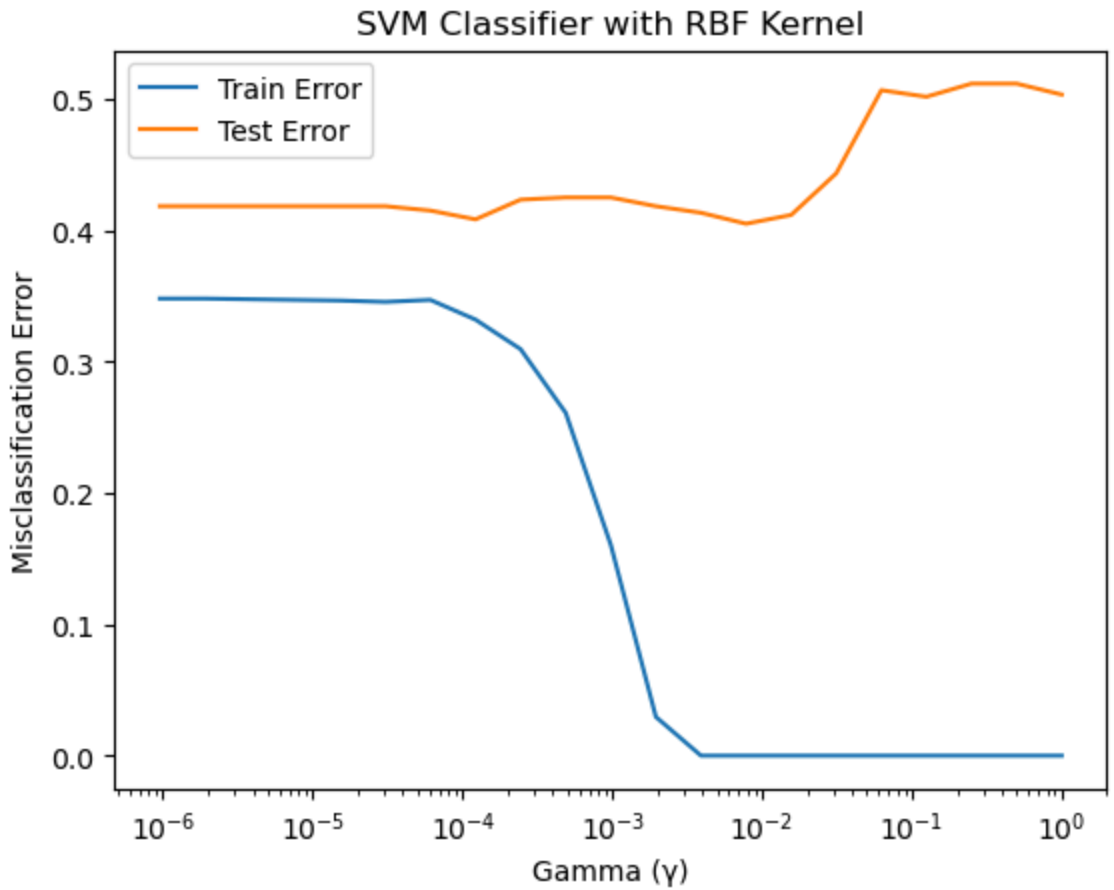
In [76]:
```
degrees = range(1, 16)

print("----1 e-------")

poly_SVC(degrees)
```

```
----1 e-------
```



In [77]:
```
print("----1 f-------")

rbf_SVC(X_train, X_test, y_train, y_test)
```

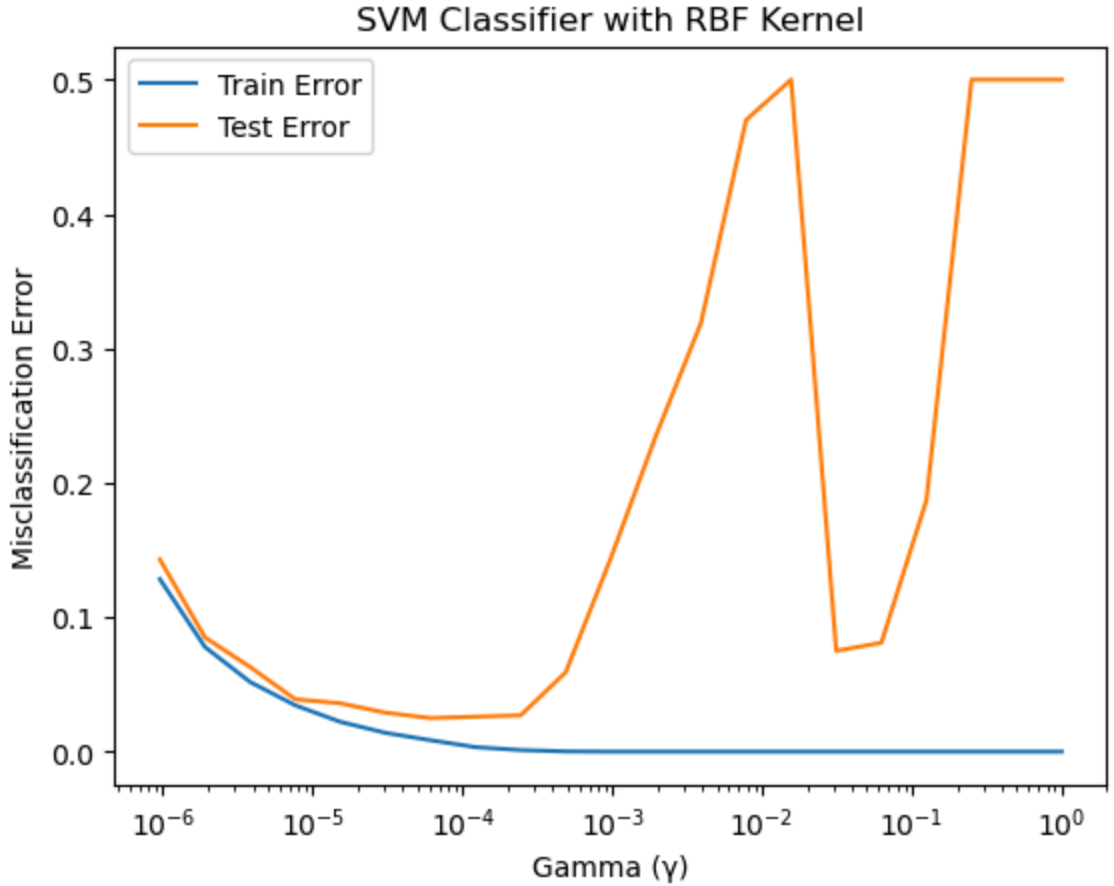
```
----1 f-------
```



In [79]:
```
path1 = "/Users/gaganullas19/Documents/Spring2024/AppliedMachineLearning/Homework_4/Gisette"
X_train = np.loadtxt(os.path.join(path1, "gisette_train.data"))
y_train = np.loadtxt(os.path.join(path1, "gisette_train.labels"))
X_test = np.loadtxt(os.path.join(path1, "gisette_valid.data"))
y_test = np.loadtxt(os.path.join(path1, "gisette_valid.labels"))

y_train = np.where(y_train == 1, 1, 0)
y_test = np.where(y_test == 1, 1, 0)
```

In [80]:
```
print("----1 g-------")

rbf_SVC(X_train, X_test, y_train, y_test)
```

```
----1 g-------
```


SVM Classifier with RBF Kernel
Train Error
Test Error
Misclassification Error
0.0
0.1
0.2
0.3
0.4
0.5
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
Gamma (γ)