



[Unit 2 Nonlinear Classification,](#)
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3. Support Vector Machine

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3. Support Vector Machine

Bob thinks it is clearly not a regression problem, but a classification problem. He thinks that we can change it into a binary classification and use the support vector machine we learned in Lecture 4 to solve the problem. In order to do so, he suggests that we can build an one vs. rest model for every digit. For example, classifying the digits into two classes: 0 and not 0.

Bob wrote a function `run_svm_one_vs_rest_on_MNIST` where he changed the labels of digits 1-9 to 1 and keeps the label 0 for digit 0. He also found that `sklearn` package contains an SVM model that you can use directly. He gave you the link to this model and hopes you can tell him how to use that.

You will be working in the file `part1/svm.py` in this problem

Important: For this problem, you will need to use the [scikit-learn](#) library. If you don't have it, install it using `pip install sklearn`

One vs. Rest SVM

5.0/5.0 points (graded)

Use the `sklearn` package and build the SVM model on your local machine. Use `random_state = 0`, `C=0.1` and default values for other parameters.

Available Functions: You have access to the sklearn's implementation of the linear SVM as `LinearSVC`; No need to import anything.

```
1 def one_vs_rest_svm(train_x, train_y, test_x):
2     """
3     Trains a linear SVM for binary classification
4
5     Args:
6         train_x - (n, d) NumPy array (n datapoints each with d features)
7         train_y - (n, ) NumPy array containing the labels (0 or 1) for
8         test_x - (m, d) NumPy array (m datapoints each with d features)
9     Returns:
10        pred_test_y - (m,) NumPy array containing the labels (0 or 1) for
11        """
12        clf = LinearSVC(random_state=0, C=0.1, tol=1e-5)
13        clf.fit(train_x, train_y)
14
15        return clf.predict(test_x)
```

Press ESC then TAB or click outside of the code editor to exit

Correct

```
def one_vs_rest_svm(train_x, train_y, test_x):
    """
    Trains a linear SVM for binary classification

    Args:
        train_x - (n, d) NumPy array (n datapoints each with d features)
        train_y - (n, ) NumPy array containing the labels (0 or 1) for each tra
        test_x - (m, d) NumPy array (m datapoints each with d features)
    Returns:
        pred_test_y - (m,) NumPy array containing the labels (0 or 1) for each
    """
    clf = LinearSVC(C=0.1, random_state=0)
    clf.fit(train_x, train_y)
    pred_test_y = clf.predict(test_x)
    return pred_test_y
```

Test results

CORRECT[See full output](#)[See full output](#)**Submit**

You have used 1 of 25 attempts

i Answers are displayed within the problem

Binary classification error

5.0/5.0 points (graded)

Report the test error by running `run_svm_one_vs_rest_on_MNIST`.**Error =** **✓ Answer:** 0.007499999999999951**Submit**

You have used 2 of 20 attempts

i Answers are displayed within the problem

Implement C-SVM

5.0/5.0 points (graded)

Play with the C parameter of SVM, what statement is true about the C parameter?

(Choose all that apply.)

☐ Larger C gives larger tolerance of violation.☒ Larger C gives smaller tolerance of violation.☐ Larger C gives a larger-margin separating hyperplane.☒ Larger C gives a smaller-margin separating hyperplane.**Solution:**

C represents the tolerance of error. A larger C means we are punishing more on the classification error, thus being less tolerant to misclassifications. Therefore, we will get a smaller margin hyperplane.

You have used 1 of 2 attempts

i Answers are displayed within the problem

Multiclass SVM

5.0/5.0 points (graded)

In fact, `sklearn` already implements a multiclass SVM with a one-vs-rest strategy. Use `LinearSVC` to build a multiclass SVM model

Available Functions: You have access to the sklearn's implementation of the linear SVM as `LinearSVC`; No need to import anything.

```
def multi_class_svm(train_x, train_y, test_x):  
    """  
    Trains a linear SVM for multiclass classification using a one-vs-rest  
    strategy.  
    Args:  
        train_x - (n, d) NumPy array (n datapoints each with d features)  
        train_y - (n, ) NumPy array containing the labels (int) for each  
        test_x - (n, d) NumPy array (n datapoints each with d features)  
        test_y - (n, ) NumPy array containing the labels (int) for each
```

```
8         test_x - (m, d) NumPy array (m datapoints each with d features)
9     Returns:
10         pred_test_y - (m,) NumPy array containing the labels (int) for
11         """
12         clf = LinearSVC(random_state=0, C=0.1, tol=1e-5)
13         clf.fit(train_x, train_y)
14
```

Press ESC then TAB or click outside of the code editor to exit

Correct

```
def multi_class_svm(train_x, train_y, test_x):
    """
    Trains a linear SVM for multiclass classification using a one-vs-rest strategy.

    Args:
        train_x - (n, d) NumPy array (n datapoints each with d features)
        train_y - (n, ) NumPy array containing the labels (int) for each training point
        test_x - (m, d) NumPy array (m datapoints each with d features)
    Returns:
        pred_test_y - (m,) NumPy array containing the labels (int) for each test point
    """
    clf = LinearSVC(C=0.1, random_state=0)
    clf.fit(train_x, train_y)
    pred_test_y = clf.predict(test_x)
    return pred_test_y
```

Test results

CORRECT

[See full output](#)

[See full output](#)

Solution:

As you see, we are using the same code for both SVM functions. Indeed, the default argument for `multi_class` in `LinearSVC` is `ovr`.

Submit

You have used 1 of 25 attempts

i Answers are displayed within the problem

Multiclass SVM error

5.0/5.0 points (graded)

Report the overall test error by running `run_multiclass_svm_on_MNIST`.

Error = 0.0819

✓ Answer: 0.08189999999999997

Submit

You have used 1 of 20 attempts

i Answers are displayed within the problem

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[Binary classification error question](#)

"compute_test_error_svm" Are we to fill out this function by our self to answer the question? 3 new_ 6

Pinned

[Is there even any difference between first and second problem?](#)

2

The wording of the task is a bit confusing, is it just a trick question in the end? Not sure how t...

[\[Staff\] What is the tolerance of violation ?](#)

8

I have never seen this term " tolerance of violation" before. If the tolerance of violation is sma...

?	[staff] question about C. Error submitting	6
	Hi Staff, After understanding C behaves as the inverse of lambda, I changed my selection. Ho...	
💬	"np" is not defined for multi_class_svm function.	4
	For "multi_class_svm" function I get an error saying "NameError: name 'np' is not defined". I t...	
💬	Muticalss SVM	5
	I read bob shred documentation. I am applying 'grammer_singer' multi class and a one vs rest ...	
💬	Processing ...	2
	Dear staff I have write function one_vs_rest_svm and submit but is showing processing ... I ch...	
?	It's taking too long to grade the One vs. Rest SVM prediction	2
	I'm getting the following message: "The grading process is still running. Reload the page to se...	
?	[Staff] Multiclass SVM error	5
	Staff - please could you check why I am getting this wrong even though my previous answer i...	
?	[STAFF] Test error correct - Code window will not grade.	1
	Hi The code is resulting in the correct test error, but the window is taking forever to grade. Be...	
💬	Convergence Warning	5
	``` /usr/local/lib/python3.7/dist-packages/sklearn/svm/_base.py:947: ConvergenceWarning:...	
💬	Link to the scikit SVM model documentation	4
	> "He gave you the link to this model and hopes you can tell him how to > use that. " I assum...	

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