3. Support Vector Machine

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Project due Oct 21, 2020 05:29 IST *Completed*

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.

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

    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 training data point
        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 test data point
    """
    try:
        svm = LinearSVC(random_state=0, C=0.1)
        svm.fit(train_x, train_y)
        pred_test_y = svm.predict(test_x)
        return pred_test_y
```

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

Correct

Test results

See full output

```
CORRECT
```

See full output

Submit

You have used 2 of 25 attempts

Binary classification error

5.0/5.0 points (graded)

Report the test error by running `run_svm_one_vs_rest_on_MNIST`.

Error = 0.007499999999999951 ✓ **Answer:** 0.007499999999999951

Submit You have used 1 of 20 attempts

ℹ Answers are displayed within the problem

Implement C-SVM

0.0/5.0 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.

Submit You have used 2 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 classifciation 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 data 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 data point
    """
    try:
        svm = LinearSVC(random_state=0, C=0.1)
        svm.fit(train_x, train_y)
        pred_test_y = svm.predict(test_x)
        return pred_test_y
```

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

Correct

Test results

See full output

```
CORRECT
```

See full output

Submit You have used 1 of 25 attempts

Multiclass SVM error

5.0/5.0 points (graded)

Report the overall test error by running `run_multiclass_svm_on_MNIST`.

Error $=$ 0.08189999999999997 ✓ **Answer:** 0.08189999999999997

Submit You have used 1 of 20 attempts

ℹ Answers are displayed within the problem

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Topic: Unit 2 Nonlinear Classification, Linear regression, Collaborative Filtering (2 weeks):Project 2: Digit recognition (Part 1) / 3. Support Vector Machine

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A tiny bit more on multi-class SVM
I got curious and dug around a bit more to understand what might be going on in LinearSVC when multi-class is being done, short of...
Pinned Community TA
3

Please provide code for wrong answers
Dear Staff, Please provide code for SVM A) Binary classification error B) Multi classification error
3

NotImplementedError !! Need Help !!
3

? ERROR IN BOTH CASES
If in both the questions we are doing the same thing ie one-vs-rest why in one case error is lower than the other? and it is lower by a...
2

Tips
Staff
8

? C parameter of SVM
How would you test or find out the effects of C on the SVM's tolerance of violation and separating hyperplane margins? If we play ar...
2

? Difference between binary and multiclass SVMs
Hi The binary SVM uses labels which have been split in a rather "conservative" way whereas the multiclass SVM splits the labels into ...
4

No difference between
"multi_class_svm" and "one_vs_rest_svm" I used the same code for both and it worked. Weird. Something is wrong.
10

? Hinge vs Square Hinge Loss?
The question states that we need to "use the support vector machine we learned in Lecture 4". Was not the loss function learnt in Le...
4

☑ One vs. Rest SVM: Understanding the python code
I managed to get the correct output by reading the scikit learn examples for LinearSVC, however I don't fully understand how the co...
3

How to interpret the test result?

How to interpret the test result? why following are correct? ## one_vs_rest_svm case train_y: [0 0 1 0 0 1 0 0 1 0 0 0 1 1 1 1 1] Submis... 1

? Tolerance of Violation

Is this a technical term with a specific meaning? 13

Nice article on "The Math behind Linear SVC Classifier"

https://www.kaggle.com/xingewang/the-math-behind-linear-svc-classifier 1

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