SVM

April 29, 2018

1 Import

```
In [1]: import numpy as np
        import matplotlib.pyplot as plt
        from sklearn import svm
        from sklearn.grid_search import GridSearchCV
        from sklearn.linear_model import SGDClassifier
        from sklearn.model_selection import cross_val_score
        from sklearn.metrics import accuracy_score,confusion_matrix,classification_report
        from tensorflow.examples.tutorials.mnist import input_data
```

```
/usr/local/lib/python2.7/dist-packages/sklearn/cross_validation.py:41: DeprecationWarning: Thi
  "This module will be removed in 0.20.", DeprecationWarning)
/usr/local/lib/python2.7/dist-packages/sklearn/grid_search.py:42: DeprecationWarning: This modu
  DeprecationWarning)
/usr/local/lib/python2.7/dist-packages/h5py/__init__.py:36: FutureWarning: Conversion of the s
  from ._conv import register_converters as _register_converters


WARNING:tensorflow:From /usr/local/lib/python2.7/dist-packages/tensorflow/contrib/learn/python
Instructions for updating:
Use the retry module or similar alternatives.
```

2 Read Data

```
In [2]: mnist = input_data.read_data_sets("MNIST_data/", one_hot=False)
```

```
WARNING:tensorflow:From <ipython-input-2-f9584ef0ae80>:1: read_data_sets (from tensorflow.cont
Instructions for updating:
Please use alternatives such as official/mnist/dataset.py from tensorflow/models.
WARNING:tensorflow:From /usr/local/lib/python2.7/dist-packages/tensorflow/contrib/learn/python
Instructions for updating:
Please write your own downloading logic.
WARNING:tensorflow:From /usr/local/lib/python2.7/dist-packages/tensorflow/contrib/learn/python
Instructions for updating:
Please use tf.data to implement this functionality.
```

```
Extracting MNIST_data/train-images-idx3-ubyte.gz
WARNING:tensorflow:From /usr/local/lib/python2.7/dist-packages/tensorflow/contrib/learn/python/
Instructions for updating:
Please use tf.data to implement this functionality.
Extracting MNIST_data/train-labels-idx1-ubyte.gz
Extracting MNIST_data/t10k-images-idx3-ubyte.gz
Extracting MNIST_data/t10k-labels-idx1-ubyte.gz
WARNING:tensorflow:From /usr/local/lib/python2.7/dist-packages/tensorflow/contrib/learn/python/
Instructions for updating:
Please use alternatives such as official/mnist/dataset.py from tensorflow/models.
```

```
In [3]: train_img = mnist.train.images
        train_label = mnist.train.labels
        test_img = mnist.test.images
        test_label = mnist.test.labels
```

```
In [4]: valid_img = train_img[:5000]
        valid_label = train_label[:5000]
        train_img = train_img[5000:]
        train_label = train_label[5000:]
```

3 SVM

```
In [5]: C_range = 10.0 ** np.arange(-2, 2)
        gamma_range = 10.0 ** np.arange(-2, 2)
        param_grid = dict(gamma=gamma_range.tolist(), C=C_range.tolist())
        # Grid search for C, gamma, 3-fold CV
        print("Tuning hyper-parameters\n")
        clf = GridSearchCV(svm.SVC(), param_grid, cv=3, n_jobs=-2)

        clf.fit(train_img, train_label)
```

```
Out[5]: SVC(C=2, cache_size=200, class_weight=None, coef0=0.0,
          decision_function_shape='ovr', degree=3, gamma=0.0625, kernel='rbf',
          max_iter=-1, probability=False, random_state=None, shrinking=True,
          tol=0.001, verbose=False)
```

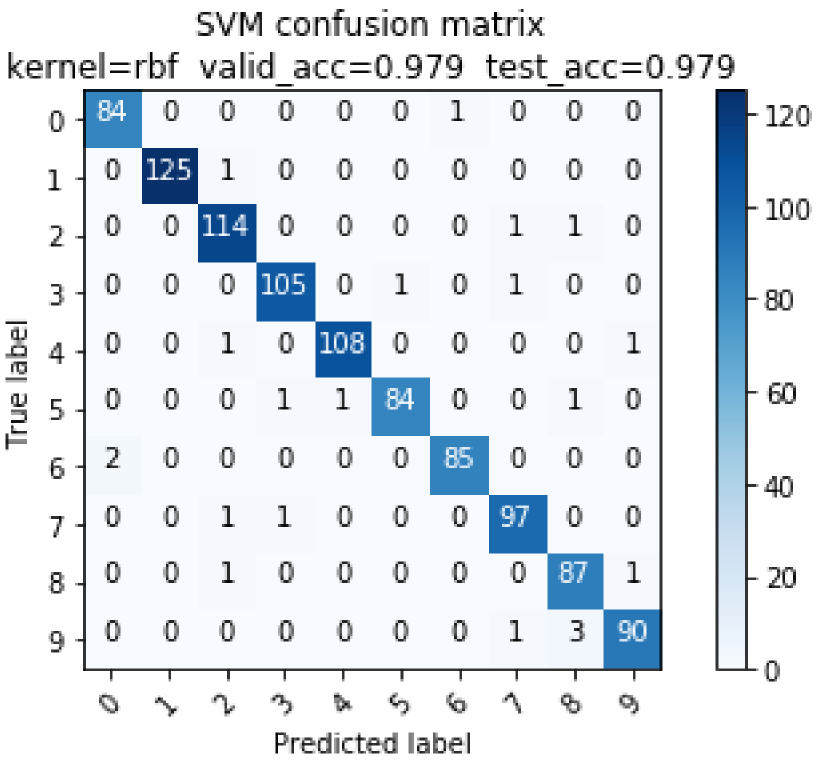
```
In [6]: valid_predictions=[]
        test_predictions=[]
        for i in range(1000):
            if i % 100 == 0:
                print('epoch ---> '+str(int(i/100)))
            valid_output = clf.predict([valid_img[i]])
            test_output = clf.predict([mnist.test.images[i]])
            valid_predictions.append(valid_output)
            test_predictions.append(test_output)
        confusion_m = confusion_matrix(mnist.test.labels[0:1000],test_predictions)

        print (classification_report(mnist.test.labels[0:1000],np.array(test_predictions)))

        print ('validation accuracy is :',accuracy_score(valid_label[0:1000],valid_predictions
        print ('test accuracy is :',accuracy_score(mnist.test.labels[0:1000],test_predictions)

        class_names = [chr(i) for i in range(ord('0'),ord('9')+1)]
```

```
epoch ---> 0
epoch ---> 1
epoch ---> 2
epoch ---> 3
epoch ---> 4
epoch ---> 5
epoch ---> 6
epoch ---> 7
epoch ---> 8
epoch ---> 9
             precision    recall  f1-score   support

          0       0.98      0.99      0.98        85
          1       1.00      0.99      1.00       126
          2       0.97      0.98      0.97       116
          3       0.98      0.98      0.98       107
          4       0.99      0.98      0.99       110
          5       0.99      0.97      0.98        87
          6       0.99      0.98      0.98        87
          7       0.97      0.98      0.97        99
          8       0.95      0.98      0.96        89
          9       0.98      0.96      0.97        94

avg / total       0.98      0.98      0.98      1000

('validation accuracy is :', 0.979)
('test accuracy is :', 0.979)
```

```
In [7]: import itertools

        def plot_confusion_matrix(cm, classes,
                                  normalize=False,
                                  title='Confusion matrix',
                                  cmap=plt.cm.Blues):
            """
            This function prints and plots the confusion matrix.
            Normalization can be applied by setting `normalize=True`.
            """
            if normalize:
                cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
                print("Normalized confusion matrix")
            else:
                print('Confusion matrix, without normalization')

            print(cm)

            plt.imshow(cm, interpolation='nearest', cmap=cmap)
            plt.title(title)
            plt.colorbar()
            tick_marks = np.arange(len(classes))
            plt.xticks(tick_marks, classes, rotation=45)
            plt.yticks(tick_marks, classes)

            fmt = '.2f' if normalize else 'd'
            thresh = cm.max() / 2.
            for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
                plt.text(j, i, format(cm[i, j], fmt),
                         horizontalalignment="center",
                         color="white" if cm[i, j] > thresh else "black")

            plt.tight_layout()
            plt.ylabel('True label')
            plt.xlabel('Predicted label')
```

```
In [8]: plot_confusion_matrix(confusion_m,classes=class_names,title='SVM confusion matrix\nker
```

```
Confusion matrix, without normalization
[[ 84   0   0   0   0   0   1   0   0   0]
 [  0 125   1   0   0   0   0   0   0   0]
 [  0   0 114   0   0   0   0   1   1   0]
 [  0   0   0 105   0   1   0   1   0   0]
 [  0   0   1   0 108   0   0   0   0   1]
 [  0   0   0   1   1  84   0   0   1   0]
 [  2   0   0   0   0   0  85   0   0   0]
 [  0   0   1   1   0   0   0  97   0   0]
 [  0   0   1   0   0   0   0   0  87   1]
 [  0   0   0   0   0   0   0   1   3  90]]
```


SVM confusion matrix
kernel=rbf valid_acc=0.979 test_acc=0.979

True label \ Predicted label	0	1	2	3	4	5	6	7	8	9
0	84	0	0	0	0	0	1	0	0	0
1	0	125	1	0	0	0	0	0	0	0
2	0	0	114	0	0	0	0	1	1	0
3	0	0	0	105	0	1	0	1	0	0
4	0	0	1	0	108	0	0	0	0	1
5	0	0	0	1	1	84	0	0	1	0
6	2	0	0	0	0	0	85	0	0	0
7	0	0	1	1	0	0	0	97	0	0
8	0	0	1	0	0	0	0	0	87	1
9	0	0	0	0	0	0	0	1	3	90

True label
Predicted label
0
20
40
60
80
100
120