CS289A_HW01_CIFAR-10

January 30, 2017

In [1]:
```
%load_ext autoreload
```

In [2]:
```
%autoreload 2
```

In [12]:
```
from sklearn import svm
from scipy import io as spio
import numpy as np
import HW01_utils as utils
import trainfunctions as tf
```

In [26]:
```
_LOCAL_PATH = r"C:\Users\Mitch\Documents\Cal\2 - 2017 Spring\COMPSCI 289A
_DATA_PATH = "Data\hw01_data"

_DATA_DIR = _LOCAL_PATH + "\\" + _DATA_PATH
trainpath = r"cifar\train.mat"
```

In [8]:
```
valsetsize = 5000
samples = np.array([100, 200, 500, 1000, 2000, 5000])
hyperparams = np.logspace(-8,4,num=20)
```

In [9]:
```
# Load CIFAR-10 training data
cifardata = spio.loadmat(_DATA_DIR+'\\'+trainpath)
cifar = cifardata['trainX']
```

In [10]:
```
# Shuffle data before splitting
np.random.shuffle(cifar)
```

In [13]:
```
trainset,valset = utils.partition(valsetsize,cifar)
trainsetarrays,trainsetlabels = utils.separatelabels(trainset)
valsetarrays,valsetlabels = utils.separatelabels(valset)
```

In [14]:
```
Accs = np.empty((len(samples),len(hyperparams)))
i = 0 # sample index counter
for nsamples in samples:
    print(nsamples,'samples')
    j = 0 # hyperparameter index counter
    for hp in hyperparams:
        acc = tf.TrainAndScoreNsamples(trainsetarrays[:nsamples],trainsetl
        print('\tC =',hp,'\tAccuracy:',acc)
```

```
                Accs[i,j] = acc
                j+=1
            i+=1
        print(Accs)
```

```
100 samples
        C = 1e-08         Accuracy: 0.111
        C = 4.28133239872e-08         Accuracy: 0.1658
        C = 1.83298071083e-07         Accuracy: 0.1834
        C = 7.84759970351e-07         Accuracy: 0.1838
        C = 3.35981828628e-06         Accuracy: 0.1826
        C = 1.43844988829e-05         Accuracy: 0.1826
        C = 6.15848211066e-05         Accuracy: 0.1826
        C = 0.000263665089873         Accuracy: 0.1826
        C = 0.00112883789168         Accuracy: 0.1826
        C = 0.00483293023857         Accuracy: 0.1826
        C = 0.0206913808111         Accuracy: 0.1826
        C = 0.088586679041         Accuracy: 0.1826
        C = 0.379269019073         Accuracy: 0.1826
        C = 1.62377673919         Accuracy: 0.1826
        C = 6.95192796178         Accuracy: 0.1826
        C = 29.7635144163         Accuracy: 0.1826
        C = 127.42749857         Accuracy: 0.1826
        C = 545.559478117         Accuracy: 0.1826
        C = 2335.72146909         Accuracy: 0.1826
        C = 10000.0         Accuracy: 0.1826
200 samples
        C = 1e-08         Accuracy: 0.1026
        C = 4.28133239872e-08         Accuracy: 0.2272
        C = 1.83298071083e-07         Accuracy: 0.2622
        C = 7.84759970351e-07         Accuracy: 0.2466
        C = 3.35981828628e-06         Accuracy: 0.2466
        C = 1.43844988829e-05         Accuracy: 0.2466
        C = 6.15848211066e-05         Accuracy: 0.2466
        C = 0.000263665089873         Accuracy: 0.2466
        C = 0.00112883789168         Accuracy: 0.2466
        C = 0.00483293023857         Accuracy: 0.2466
        C = 0.0206913808111         Accuracy: 0.2466
        C = 0.088586679041         Accuracy: 0.2466
        C = 0.379269019073         Accuracy: 0.2466
        C = 1.62377673919         Accuracy: 0.2466
        C = 6.95192796178         Accuracy: 0.2466
        C = 29.7635144163         Accuracy: 0.2466
        C = 127.42749857         Accuracy: 0.2466
        C = 545.559478117         Accuracy: 0.2466
        C = 2335.72146909         Accuracy: 0.2466
        C = 10000.0         Accuracy: 0.2466
500 samples
```

```
        C = 1e-08         Accuracy: 0.2202
        C = 4.28133239872e-08         Accuracy: 0.295
        C = 1.83298071083e-07         Accuracy: 0.3008
        C = 7.84759970351e-07         Accuracy: 0.2842
        C = 3.35981828628e-06         Accuracy: 0.2708
        C = 1.43844988829e-05         Accuracy: 0.2714
        C = 6.15848211066e-05         Accuracy: 0.2714
        C = 0.000263665089873         Accuracy: 0.2714
        C = 0.00112883789168         Accuracy: 0.2714
        C = 0.00483293023857         Accuracy: 0.2714
        C = 0.0206913808111         Accuracy: 0.2714
        C = 0.088586679041         Accuracy: 0.2714
        C = 0.379269019073         Accuracy: 0.2714
        C = 1.62377673919         Accuracy: 0.2714
        C = 6.95192796178         Accuracy: 0.2714
        C = 29.7635144163         Accuracy: 0.2714
        C = 127.42749857         Accuracy: 0.2714
        C = 545.559478117         Accuracy: 0.2714
        C = 2335.72146909         Accuracy: 0.2714
        C = 10000.0         Accuracy: 0.2714
1000 samples
        C = 1e-08         Accuracy: 0.2632
        C = 4.28133239872e-08         Accuracy: 0.3164
        C = 1.83298071083e-07         Accuracy: 0.3306
        C = 7.84759970351e-07         Accuracy: 0.3148
        C = 3.35981828628e-06         Accuracy: 0.2934
        C = 1.43844988829e-05         Accuracy: 0.2934
        C = 6.15848211066e-05         Accuracy: 0.2934
        C = 0.000263665089873         Accuracy: 0.2934
        C = 0.00112883789168         Accuracy: 0.2934
        C = 0.00483293023857         Accuracy: 0.2934
        C = 0.0206913808111         Accuracy: 0.2934
        C = 0.088586679041         Accuracy: 0.2934
        C = 0.379269019073         Accuracy: 0.2934
        C = 1.62377673919         Accuracy: 0.2934
        C = 6.95192796178         Accuracy: 0.2934
        C = 29.7635144163         Accuracy: 0.2934
        C = 127.42749857         Accuracy: 0.2934
        C = 545.559478117         Accuracy: 0.2934
        C = 2335.72146909         Accuracy: 0.2934
        C = 10000.0         Accuracy: 0.2934
2000 samples
        C = 1e-08         Accuracy: 0.3
        C = 4.28133239872e-08         Accuracy: 0.3476
        C = 1.83298071083e-07         Accuracy: 0.345
        C = 7.84759970351e-07         Accuracy: 0.321
        C = 3.35981828628e-06         Accuracy: 0.3016
        C = 1.43844988829e-05         Accuracy: 0.291
```

```
        C = 6.15848211066e-05         Accuracy: 0.2906
        C = 0.000263665089873         Accuracy: 0.2906
        C = 0.00112883789168         Accuracy: 0.2906
        C = 0.00483293023857         Accuracy: 0.2906
        C = 0.0206913808111         Accuracy: 0.2906
        C = 0.088586679041         Accuracy: 0.2906
        C = 0.379269019073         Accuracy: 0.2906
        C = 1.62377673919         Accuracy: 0.2906
        C = 6.95192796178         Accuracy: 0.2906
        C = 29.7635144163         Accuracy: 0.2906
        C = 127.42749857         Accuracy: 0.2906
        C = 545.559478117         Accuracy: 0.2906
        C = 2335.72146909         Accuracy: 0.2906
        C = 10000.0         Accuracy: 0.2906
5000 samples
        C = 1e-08         Accuracy: 0.353
        C = 4.28133239872e-08         Accuracy: 0.3736
        C = 1.83298071083e-07         Accuracy: 0.3752
        C = 7.84759970351e-07         Accuracy: 0.3518
        C = 3.35981828628e-06         Accuracy: 0.3216
        C = 1.43844988829e-05         Accuracy: 0.3066
        C = 6.15848211066e-05         Accuracy: 0.2992
        C = 0.000263665089873         Accuracy: 0.2998
        C = 0.00112883789168         Accuracy: 0.2998
        C = 0.00483293023857         Accuracy: 0.2998
        C = 0.0206913808111         Accuracy: 0.2998
        C = 0.088586679041         Accuracy: 0.2998
        C = 0.379269019073         Accuracy: 0.2998
        C = 1.62377673919         Accuracy: 0.2998
        C = 6.95192796178         Accuracy: 0.2998
        C = 29.7635144163         Accuracy: 0.2998
        C = 127.42749857         Accuracy: 0.2998
        C = 545.559478117         Accuracy: 0.2998
        C = 2335.72146909         Accuracy: 0.2998
        C = 10000.0         Accuracy: 0.2998
[[ 0.111   0.1658  0.1834  0.1838  0.1826  0.1826  0.1826  0.1826  0.1826
   0.1826  0.1826  0.1826  0.1826  0.1826  0.1826  0.1826  0.1826  0.1826
   0.1826  0.1826]
 [ 0.1026  0.2272  0.2622  0.2466  0.2466  0.2466  0.2466  0.2466  0.2466
   0.2466  0.2466  0.2466  0.2466  0.2466  0.2466  0.2466  0.2466  0.2466
   0.2466  0.2466]
 [ 0.2202  0.295   0.3008  0.2842  0.2708  0.2714  0.2714  0.2714  0.2714
   0.2714  0.2714  0.2714  0.2714  0.2714  0.2714  0.2714  0.2714  0.2714
   0.2714  0.2714]
 [ 0.2632  0.3164  0.3306  0.3148  0.2934  0.2934  0.2934  0.2934  0.2934
   0.2934  0.2934  0.2934  0.2934  0.2934  0.2934  0.2934  0.2934  0.2934
   0.2934  0.2934]
 [ 0.3     0.3476  0.345   0.321   0.3016  0.291   0.2906  0.2906  0.2906
```

```
   0.2906  0.2906  0.2906  0.2906  0.2906  0.2906  0.2906  0.2906  0.2906
   0.2906  0.2906]
 [ 0.353   0.3736  0.3752  0.3518  0.3216  0.3066  0.2992  0.2998  0.2998
   0.2998  0.2998  0.2998  0.2998  0.2998  0.2998  0.2998  0.2998  0.2998
   0.2998  0.2998]]
```

```
In [15]: # Find the index of the maximum value in the accuracies table
         maxindex = np.array([int(len(Accs)*np.argmax(Accs)/(len(Accs.flatten()))),
         print('The index of the maximum accuracy ('+str(Accs[maxindex[0],maxindex[

         besthp = hyperparams[maxindex[1]]
         bestns = samples[maxindex[0]]
         # Determine which sample count-hyperparameter combination this corresponds
         print('This corresponds to a hyperparameter of C = '+ str(besthp) + ' when
```

```
The index of the maximum accuracy (0.3752) is: [5 2]
This corresponds to a hyperparameter of C = 1.83298071083e-07 when training on 5000
```

```
In [16]: from matplotlib import pyplot as plt
```

```
In [17]: hpC1 = 13
```

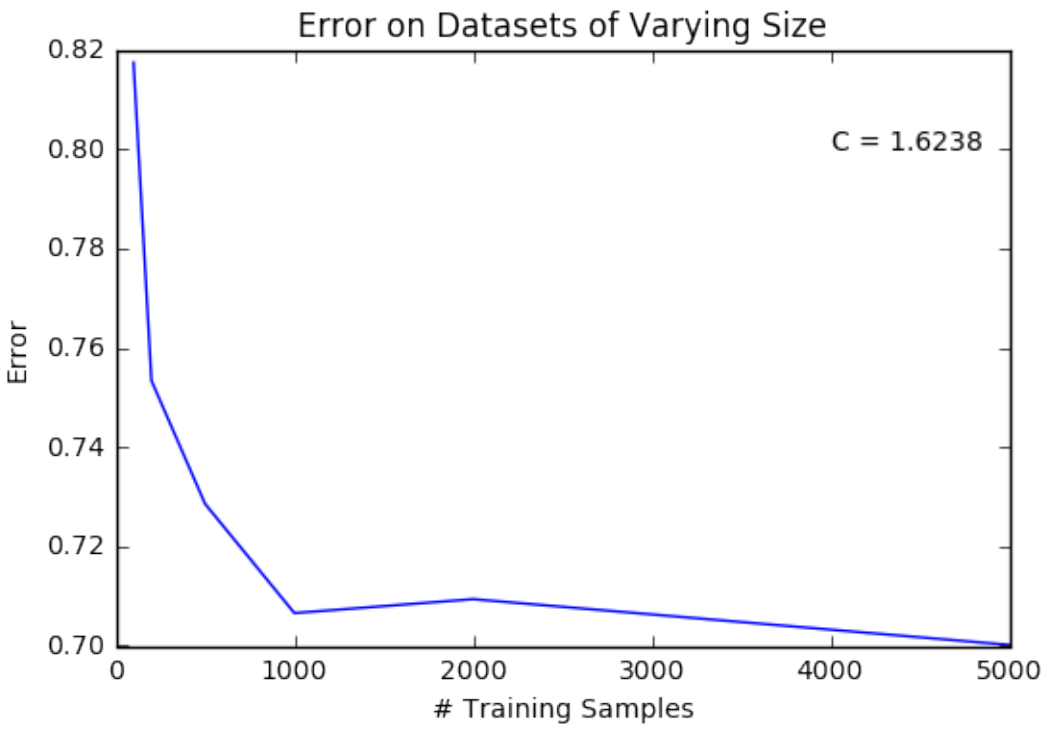
```
In [18]: errors = np.ones_like(Accs[:,hpC1])-Accs[:,hpC1]
```

```
In [39]: fig = plt.figure()
         plt.plot(samples,errors)
         plt.title('Error on Datasets of Varying Size')
         plt.xlabel('# Training Samples')
         plt.ylabel('Error')
         plt.text(4000,0.80,'C = '+str(round(hyperparams[hpC1],4)))
```

```
Out[39]: <matplotlib.text.Text at 0x170daddb2e8>
```

```
In [41]: plt.show()
```

```
<matplotlib.figure.Figure at 0x170dac40630>
```




```
In [40]: plt.savefig(_LOCAL_PATH+r'\Figures\CIFAR10_SampleAcc.jpg')

C:\Users\Mitch\Documents\Cal\2 - 2017 Spring\COMPSCI 289A - Intro to Machine Learni
```

```
In [43]: # Export data to csv files for report
         np.savetxt(_LOCAL_PATH+r'\CIFAR_Accuracies.csv',Accs,fmt='%f',delimiter=',
         np.savetxt(_LOCAL_PATH+r'\CIFAR_hyperparams.csv',hyperparams,fmt='%.8f',de
```