CS 6375
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Problem Set 3
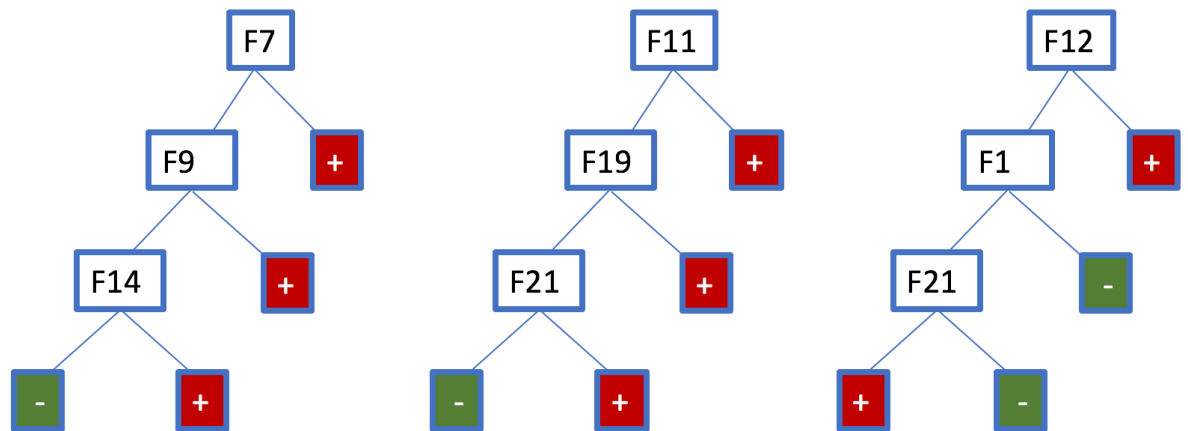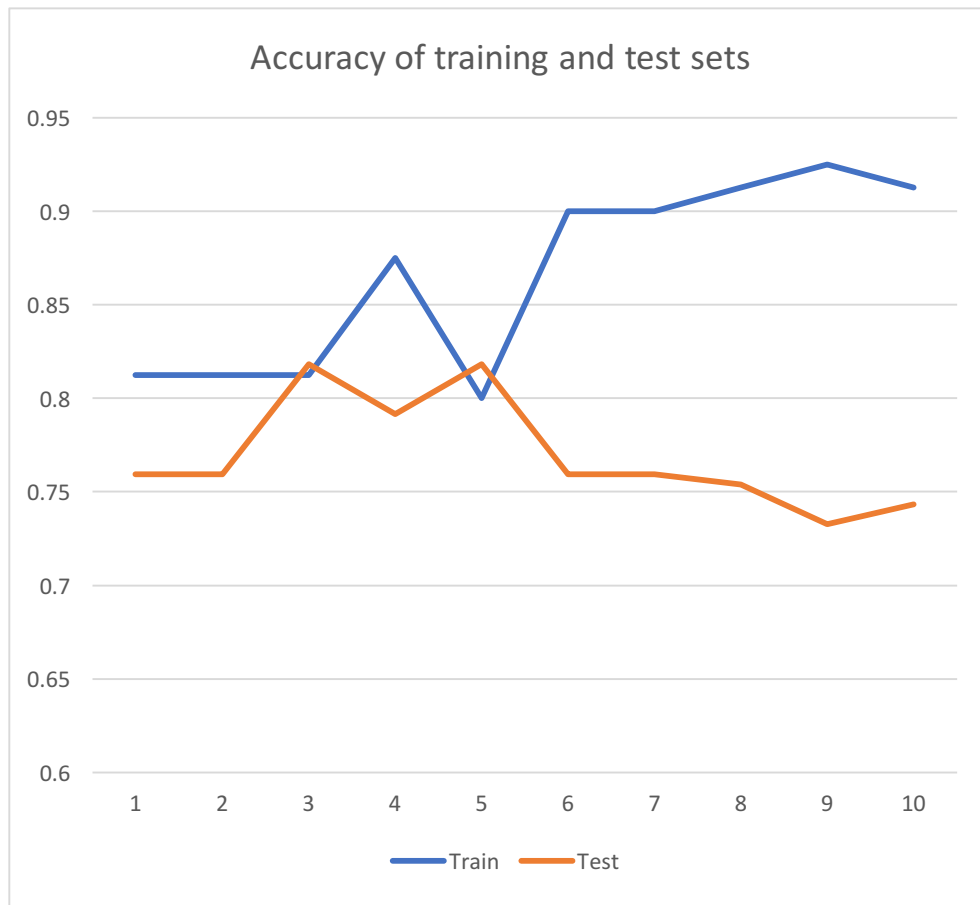Date: October 19, 2017

Problem 2:

1.
   a. The 3 selected trees are (in order left to right):

The errors are respectively: 0.1875, 0.2692, 0.3404.

   b. Run the adaBoost algorithm for 10 rounds.

Iteration	Train	Test
1	0.8125	0.7594
2	0.8125	0.7594
3	0.8125	0.8182
4	0.875	0.7914
5	0.8	0.8182
6	0.9	0.7594
7	0.9	0.7594
8	0.9125	0.754
9	0.925	0.7326
10	0.9125	0.7433

Accuracy of training and test sets

2. Coordinate descent
   a. When running coordinate descent, I just iterate over the trees in the order that I built them. After completing 500 loops over all trees, I get the **exponential loss of 39.691**.
      The values of alpha are listed at the end of this paper. There are 88 alpha values, each correspond to a tree in the hypothesis space.

   b. The accuracy of the classifier trained by **coordinate descent is 0.7005**.

   c. The accuracy of **adaBoost with M=20 is 0.668**.
      The alphas learned by adaBoost are very different from the ones learned by coordinate descent. No alpha value of adaBoost is negative, but there are many negative alphas in coordinate descent. Also, because we use M=20 in adaBoost, alpha would have at most 20 nonzero values. Meanwhile, alpha with coordinate descent has 44 nonzero values.

List of alphas generated by coordinate descent:

alpha 0 : 0
alpha 1 : -2.11136914605
alpha 2 : 0
alpha 3 : -0.764582190176
alpha 4 : 0
alpha 5 : -0.492332893361
alpha 6 : 0
alpha 7 : -0.414782041468
alpha 8 : 0
alpha 9 : -4.40585498748
alpha 10 : 0
alpha 11 : -2.81003779319
alpha 12 : 0
alpha 13 : 0.801991500919
alpha 14 : 0
alpha 15 : 0.519026835117
alpha 16 : 0
alpha 17 : 0.31751616799
alpha 18 : 0
alpha 19 : 0.141265303489
alpha 20 : 0
alpha 21 : 0.137296705114
alpha 22 : 0
alpha 23 : 0.108798260393
alpha 24 : 0
alpha 25 : 0.608145225077
alpha 26 : 0
alpha 27 : 0.322854292652
alpha 28 : 0
alpha 29 : 4.02545218409
alpha 30 : 0
alpha 31 : 2.67532600282
alpha 32 : 0
alpha 33 : -2.7467516857
alpha 34 : 0
alpha 35 : -2.09493771074
alpha 36 : 0
alpha 37 : 1.97905322099
alpha 38 : 0
alpha 39 : 0.754239138272
alpha 40 : 0
alpha 41 : 0.387701528922
alpha 42 : 0
alpha 43 : 0.256301751523
alpha 44 : 0
alpha 45 : -0.453426019943

alpha 46 : 0
alpha 47 : -0.277082109197
alpha 48 : 0
alpha 49 : 0.794651871233
alpha 50 : 0
alpha 51 : 0.386217574122
alpha 52 : 0
alpha 53 : 2.21784860527
alpha 54 : 0
alpha 55 : 1.68657589332
alpha 56 : 0
alpha 57 : 0.803818634551
alpha 58 : 0
alpha 59 : 0.783771319516
alpha 60 : 0
alpha 61 : 0.732113848047
alpha 62 : 0
alpha 63 : 0.588022904909
alpha 64 : 0
alpha 65 : 2.75415169632
alpha 66 : 0
alpha 67 : 2.69231034457
alpha 68 : 0
alpha 69 : 1.94955498116
alpha 70 : 0
alpha 71 : 1.93019470963
alpha 72 : 0
alpha 73 : 0.0518860455339
alpha 74 : 0
alpha 75 : 0.033996854833
alpha 76 : 0
alpha 77 : 0.317123147077
alpha 78 : 0
alpha 79 : 0.209027302585
alpha 80 : 0
alpha 81 : 0.167907866749
alpha 82 : 0
alpha 83 : 0.115825356003
alpha 84 : 0
alpha 85 : 0.369651353905
alpha 86 : 0
alpha 87 : 0.171223180525