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CS1675

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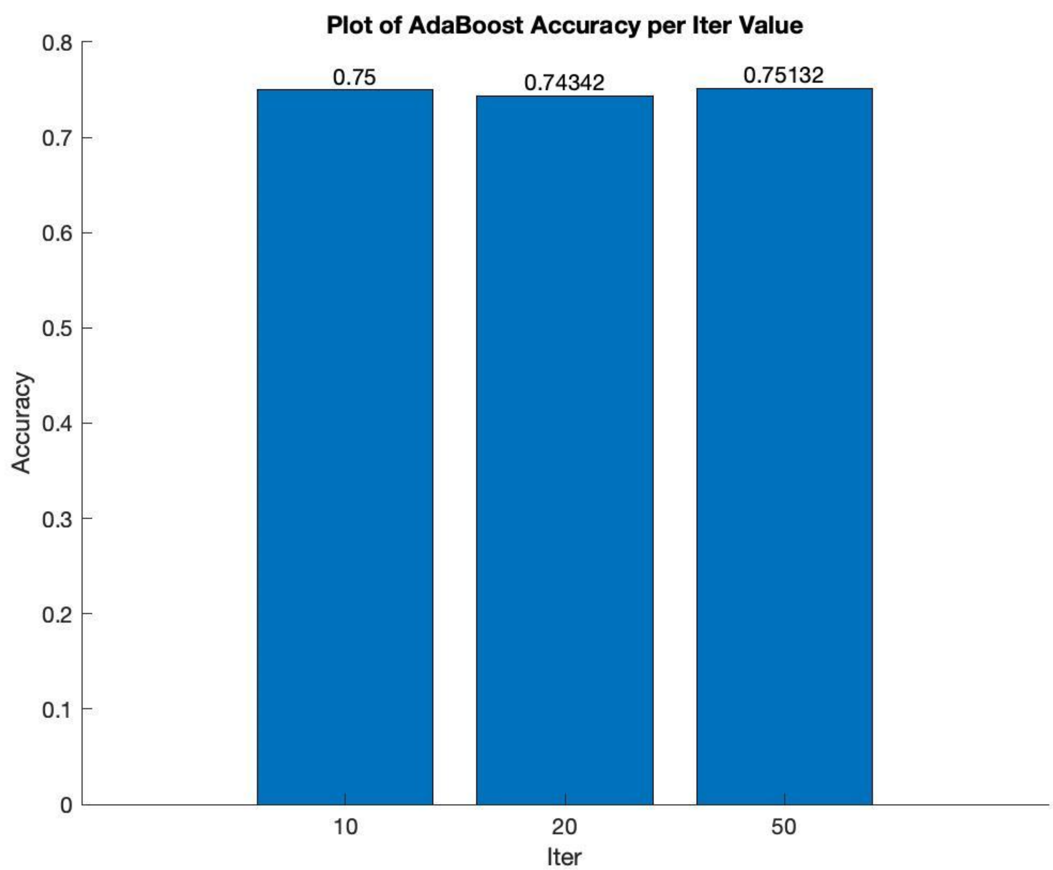
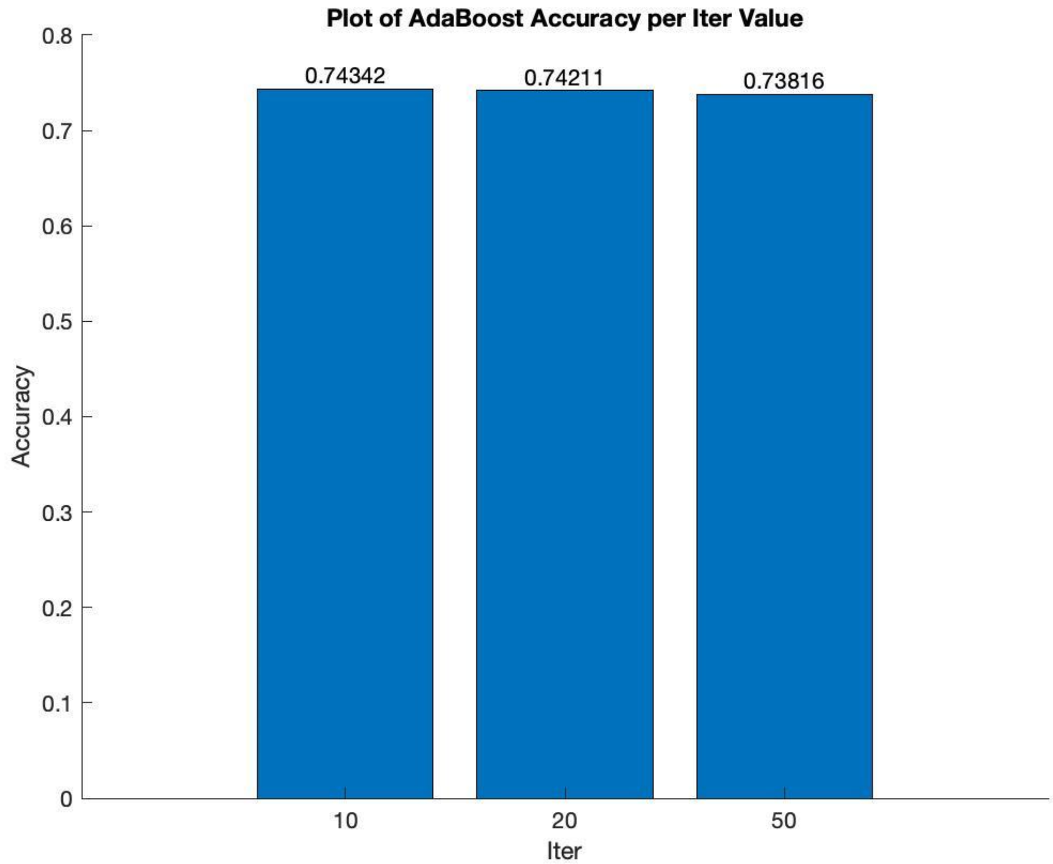
Homework 8 – Report

AdaBoost accuracies per number of iterations:

- 10 iterations: 0.7500
- 20 iterations 0.7434
- 50 iterations: 0.7513



Extra Credit:
AdaBoost_Extra accuracies per number of iterations:
- 10 iterations: 0.7434
- 20 iterations: 0.7421
- 50 iterations: 0.7382



I produced very similar accuracies for both the standard implementation and the extra credit implementations. I believe this occurs because the extra credit has you utilize the inverse of the predictions of classifiers that produce alpha values below 0. Alpha is only negative when epsilon has a value above 1/2 i.e. when the current classifier mislabels over half the training samples (this is why we use the inverse of the predictions – if the classifier correctly labels only 30% of the samples, then the inverse of its predictions will correctly classify 70% of the samples, assuming it is a binary classification problem). However, a classifier misclassifying over half of the samples contradicts the assumption of Boosting algorithms that the weak classifiers must perform better than chance, that is, better than a coin toss or 50% (as given in lecture slides 8-9). Therefore, it is not unexpected that neither the standard nor the extra credit implementations have produced alpha values below 0 in my <100 trial runs.

Part IV: Problem 1.3

We will use Bayes' Theorem to solve both parts of this problem:

$p(w|D) = \frac{p(D|w)p(w)}{p(D)}$ and $p(D) = \Sigma_w p(D|w)p(w)$

So, by Bayes' Theorem the probability of selecting an apple $p(a)$ is given by:

$p(a) = p(a|r)p(r) + p(a|b)p(b) + p(a|g)p(g) = \frac{3}{10} \cdot 0.2 + \frac{1}{2} \cdot 0.2 + \frac{3}{10} \cdot 0.6 = 0.34$

That is, the probability of selecting an apple $p(a)$ is given by the probability that you choose to select from the red box $p(r)$ times the probability you select an apple from the red box $p(a|r)$, plus the probability that you choose to select from the blue box $p(b)$ times the probability you select an apple from the blue box $p(a|b)$, plus the probability that you choose to select from the green box $p(g)$ times the probability you select an apple from the green box $p(a|g)$.

Also by Bayes' Theorem, the probability of having selected from the green box given that you selected an orange $p(g|o)$ is given by:

$p(g|o) = \frac{p(o|g)p(g)}{p(o)}$

Where the probability of selecting an orange in general $p(o)$ is given by:

$p(o) = p(o|r)p(r) + p(o|b)p(b) + p(o|g)p(g) = \frac{4}{10} \cdot 0.2 + \frac{1}{2} \cdot 0.2 + \frac{3}{10} \cdot 0.6 = 0.36$

That is, the probability of selecting an orange $p(o)$ is given by the probability that you choose to select from the red box $p(r)$ times the probability you select an orange from the red box $p(o|r)$, plus the probability that you choose to select from the blue box $p(b)$ times the probability you select an orange from the blue box $p(o|b)$, plus the probability that you choose to select from the green box $p(g)$ times the probability you select an orange from the green box $p(o|g)$.

So the probability of having selected from the green box given that you selected an orange $p(g|o)$ is:

$p(g|o) = \frac{p(o|g)p(g)}{p(o)} = \frac{\frac{3}{10} \cdot 0.6}{0.36} = 0.5$

That is, the probability of having selected from the green box given that you selected an orange $p(g|o)$ is given by the probability you choose to select from the green box $p(g)$ times the probability you select an orange from the green box $p(o|g)$, divided by the probability you choose an orange in general $p(o)$.