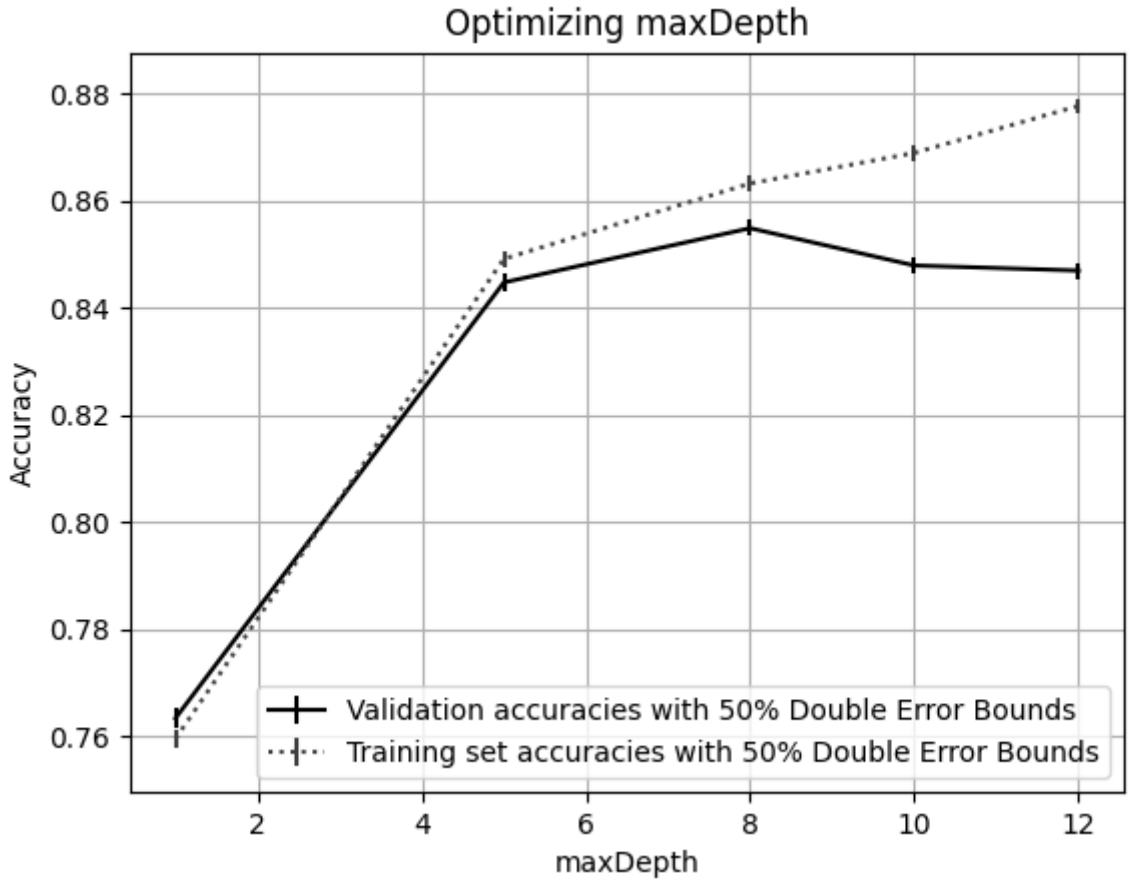
Assignment 5

Decision Trees -- Max Depth

Weighted

weights = 1 for all x

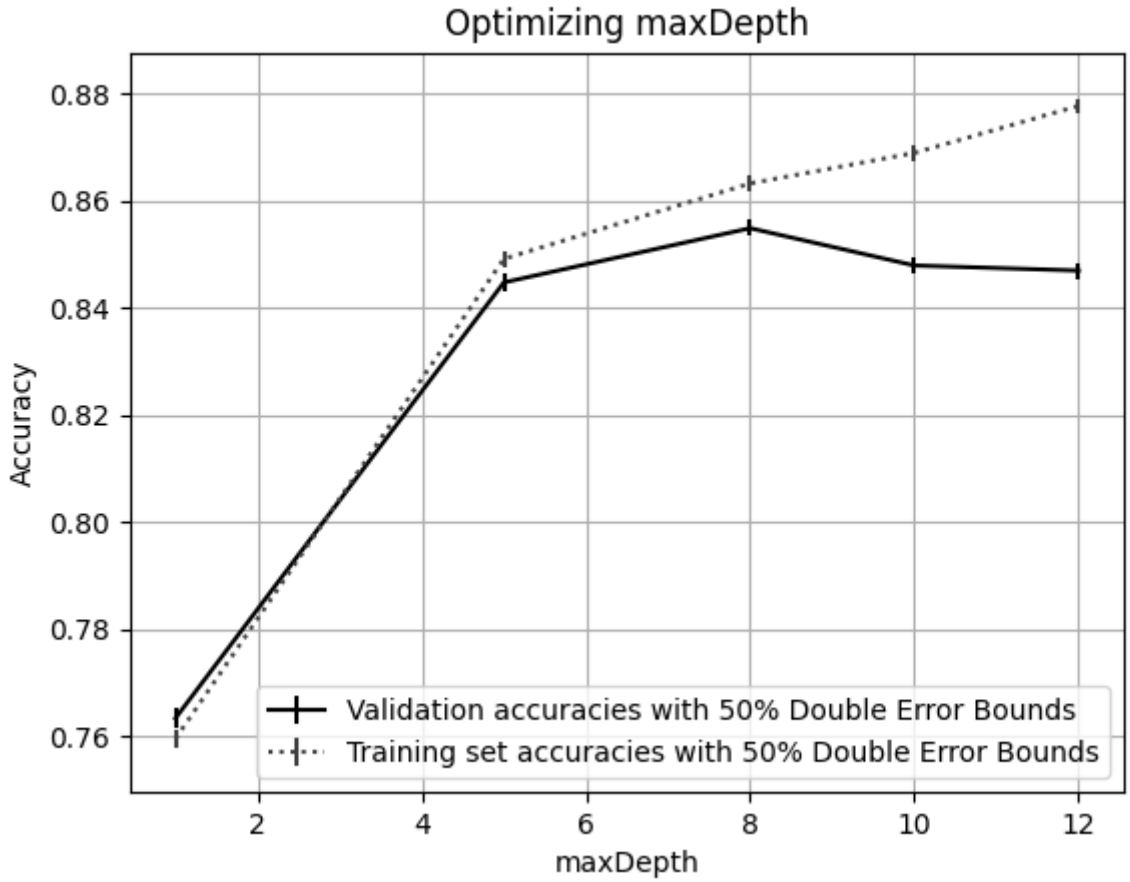
maxDepth	accuracy	lower bound	upper bound	runtime
1	0.763308	0.761516	0.7651	1360.87
5	0.84474	0.843213	0.846267	2844.62
8	0.85488	0.853394	0.856365	3156.67
10	0.847909	0.846395	0.849423	3229.52
12	0.846958	0.84544	0.848476	3281.8



As seen by the divergence between the train and validation set accuracy in the graph above, there is certainly overfitting occurring when maxDepth is increased past 8. Train set accuracy continues to increase, whereas validation set accuracy decreasing significantly. This indicates an inability to generalize.

Normal

maxDepth	accuracy	lower bound	upper bound	runtime
1	0.763308	0.761516	0.7651	432.149
5	0.84474	0.843213	0.846267	806.261
8	0.85488	0.853394	0.856365	887.701
10	0.847909	0.846395	0.849423	910.152
12	0.846958	0.84544	0.848476	926.142

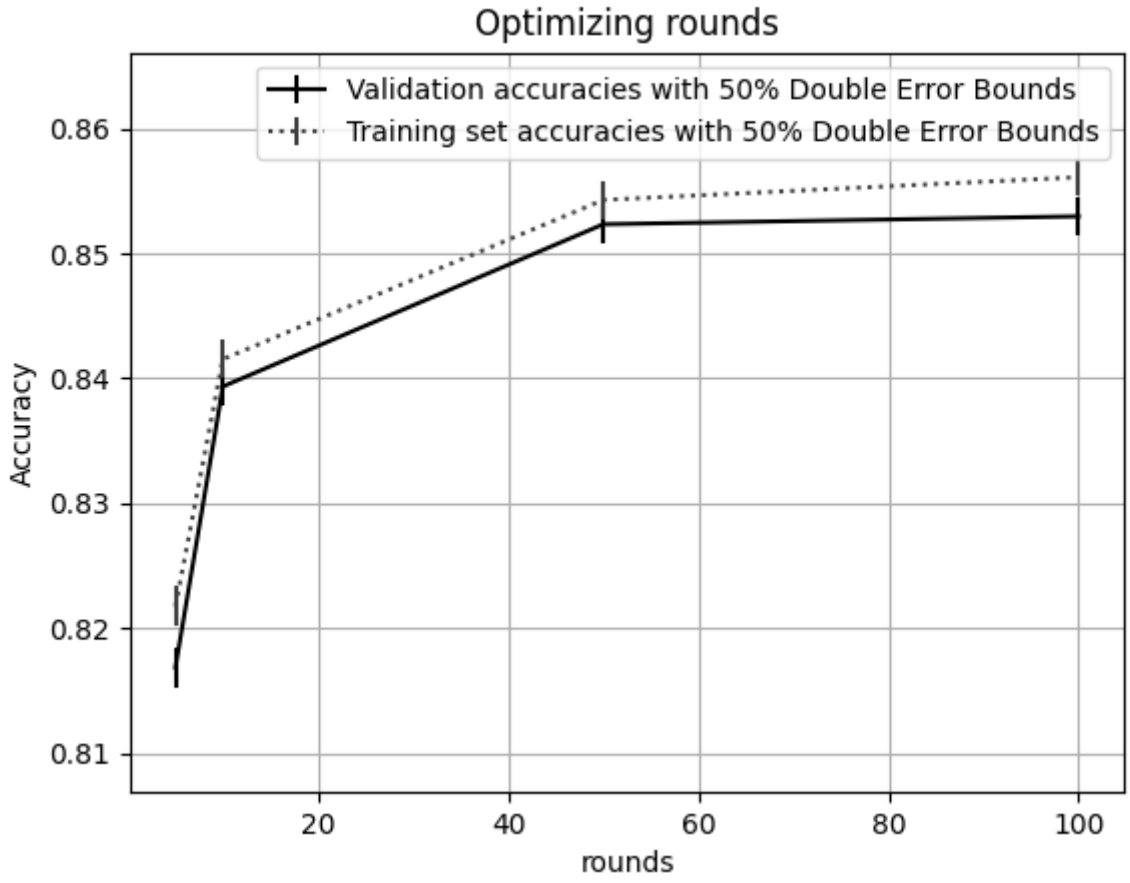


Exact same analysis as the weighted tree--just ran both of them as a sanity check for my weighted decision tree algorithm. Overfitting here as well--divergence of train set and validation set accuracy.

AdaBoost - Rounds

`maxDepth = 1` for underlying trees.

rounds	accuracy	lower bound	upper bound	runtime
5	0.816857	0.815226	0.818488	20.3457
10	0.839354	0.837805	0.840902	40.1198
50	0.852345	0.850849	0.853841	185.55
100	0.852978	0.851485	0.854472	321.768

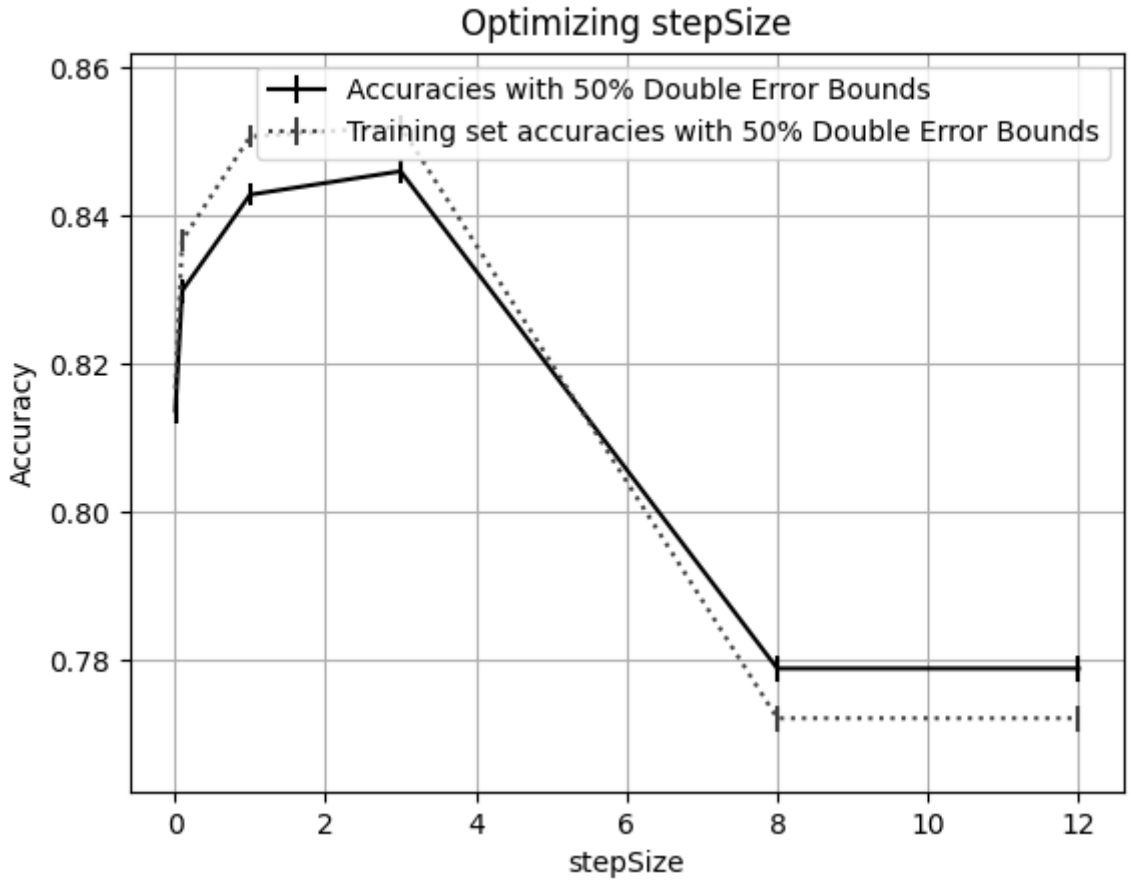


The sweep over rounds for AdaBoost isn't as conclusive in regards to over/underfitting as the sweeps for decision trees were. This makes sense as AdaBoost with maxDepth set to 1 for the underlying decision tree is pretty resistant to overfitting. Potentially could sweep further.

Logistic Regression -- stepSize

`convergence = 0.0001`

stepSize	accuracy	lower bound	upper bound	runtime
0.01	0.813688	0.812046	0.81533	1070.1
0.1	0.829848	0.828263	0.831432	490.446
1	0.842839	0.841304	0.844374	242.321
3	0.846008	0.844486	0.84753	145.417
8	0.778834	0.777084	0.780584	4.54278
12	0.778834	0.777084	0.780584	4.62754



As we discussed in class, logistic regression is a high-bias algorithm, and the graph above reflects that--there is no overfitting (often associated with algorithms with high variance) and potential underfitting (often associated with algorithms with high bias).

Analysis

In the above tables and graphs, we see much expected behavior amongst the analyzed algorithms. The decision tree -- a low bias, high variance algorithm -- ultimately overfit the data after maxDepth hit a certain threshold (8). AdaBoost, paired with decision trees with a maxDepth of 1 (which reduces it's ability to overfit), generally increased with additional rounds--AdaBoost is designed to deal with the variance problems of powerful algorithms, so it makes sense that it did not overfit even as the number of rounds was increased. Logistic Regression did not overfit, but it also could not produce *quite* as accurate of a model as the other model types either -- being a high bias model, logistic regression was unable to fully represent the concept at hand.