Homework3. Problem 2

Jae Dong Hwang

Decision Tree

Part 1.Run your DecisionTree algorithm on the SMS spam dataset (with the train/test split provided in the sample framework) using just the heuristic hand crafted features that were included with the initial framework and with minToSplit = 100 (no additional text features).

Report the accuracy on the hold out set. Include an error bound.

Include a visualization of the tree.

- Before changing feature selections
    - Accuracy: 0.9261119081779053, Lower: 0.9181816579663119, Upper: 0.9340421583894988
    - Decision Tree with minToStop=100 Feature 1:

...,>= 0.5:

...,...,Leaf: 515 vs 574

...,< 0.5:

...,Feature 2:

...,...,>= 0.5:

...,...,...,Leaf: 156 vs 26

...,...,< 0.5:

...,...,Feature 0:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 156 vs 23

...,...,...,< 0.5:

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 51 vs 5

...,...,...,...,< 0.5:

...,...,...,...,[1]

...,...,...,...,Feature 3:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 63 vs 11

...,...,...,...,...,< 0.5:

...,...,...,...,...,[1]

...,...,...,...,...,[1]

...,...,...,[0]

...,...,Feature 3:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 267 vs 214

...,...,...,< 0.5:

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 58 vs 13

...,...,...,...,< 0.5:

...,...,...,...,[1]

...,...,...,...,Feature 0:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 207 vs 180

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 207 vs 180

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[1]

...,...,...,...,...,...,[1]

...,...,...,...,...,[0]

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 12 vs 5

...,...,...,...,< 0.5:

...,...,...,...,[1]

...,...,...,...,Feature 0:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 76 vs 264

...,...,...,...,...,< 0.5:

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 76 vs 264

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[0]

...,...,...,...,...,...,[0]

...,...,...,...,...,[0]

...,Feature 0:

...,...,>= 0.5:

...,...,...,Leaf: 29 vs 1871

...,...,< 0.5:

...,...,Feature 3:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 21 vs 848

...,...,...,< 0.5:

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 6 vs 104

...,...,...,...,< 0.5:

...,...,...,...,Feature 2:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 0 vs 6

...,...,...,...,...,< 0.5:

...,...,...,...,...,[0]

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 6 vs 98

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[0]

...,...,...,...,...,...,[0]

...,...,...,...,Feature 2:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 0 vs 40

...,...,...,...,...,< 0.5:

...,...,...,...,...,[0]

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 15 vs 704

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[0]

...,...,...,...,...,...,[0]

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 2 vs 95

...,...,...,...,< 0.5:

...,...,...,...,[0]

...,...,...,...,Feature 2:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 0 vs 41

...,...,...,...,...,< 0.5:

...,...,...,...,...,[0]

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 6 vs 887

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[0]

...,...,...,...,...,...,[0]

...,...,Feature 3:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 0 vs 219

...,...,...,< 0.5:

...,...,...,Feature 0:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 0 vs 219

...,...,...,...,< 0.5:

...,...,...,...,[0]

...,...,...,...,[0]

...,...,...,Feature 2:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 0 vs 64

...,...,...,...,< 0.5:

...,...,...,...,[0]

...,...,...,...,Feature 4:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 0 vs 34

...,...,...,...,...,< 0.5:

...,...,...,...,...,[0]

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 1 vs 873

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[0]

...,...,...,...,...,...,[0]

Use cross validation to try a few values of minToSplit on this new training set. Then when you've selected a value for minToSplit:

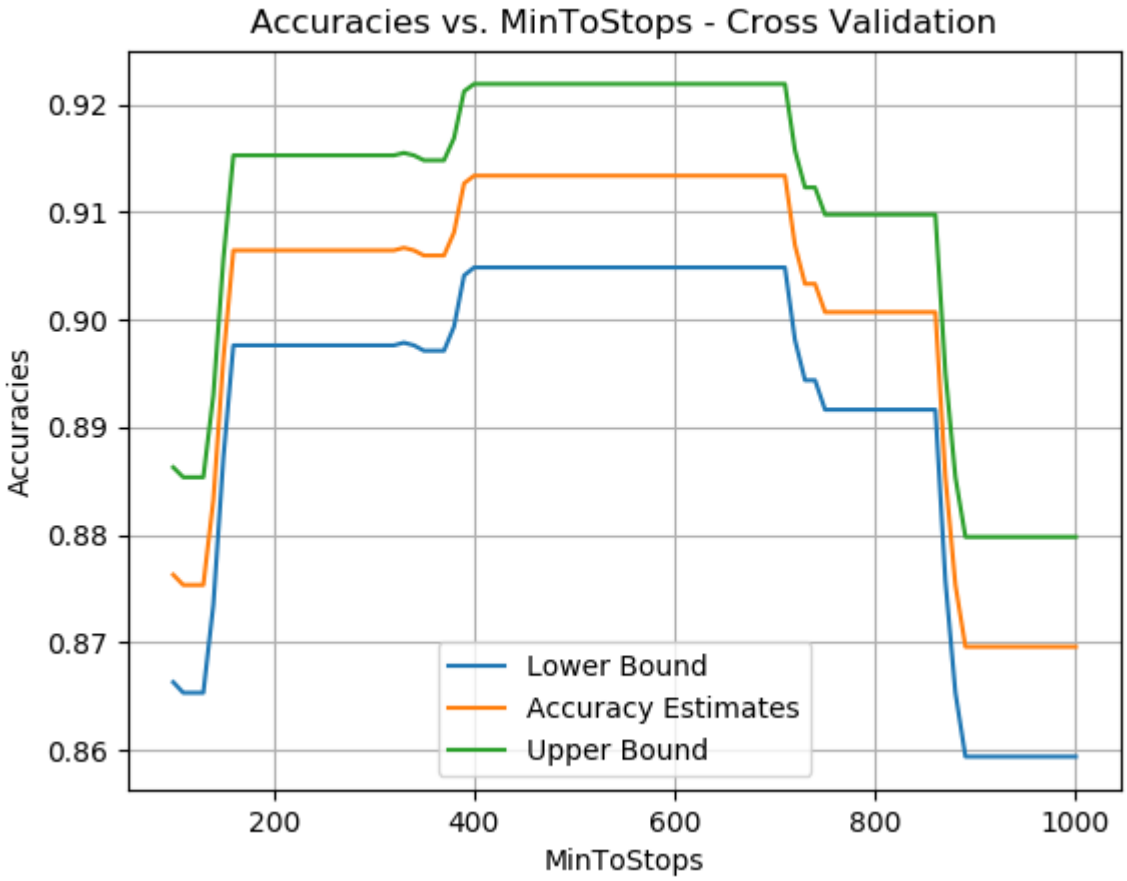
Describe what values of minToSplit you tried and which one turned out to be best.

Produce an ROC curve comparing this version (the continuous length and tuned minToSplit) to the original version (from above, with a 0/1 length feature with threshold 40 and minToSplit = 100). Clearly label which curve corresponds to which model.

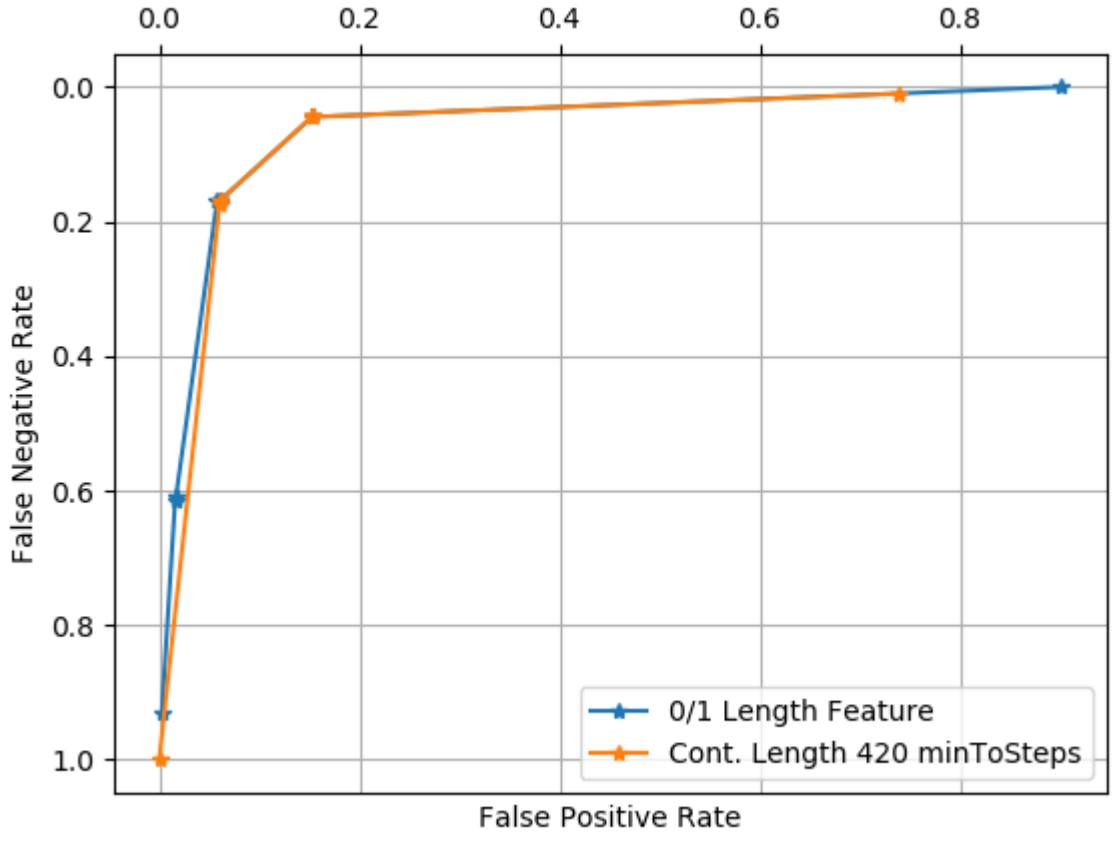
NOTE to produce an ROC curve you need to use a threshold for predicting 1/0 based on the fraction of samples at the leaf with the predicted label.

Produce a visualization of the updated model.

- I generated the below graph to see the trend of accuracies over range of minToStops. Using k=5, the accuracy reached between 400 minToStop and started dropping soon after 700.



- ROC curve was generated as below.



- Best accuracy 0.9232424677187948 with MinToStop 420
- Model visualization with min to stop 420 Feature 1:

...,>= 0.5:

...,...,Leaf: 515 vs 574

...,< 0.5:

...,Feature 2:

...,...,>= 0.5:

...,...,...,Leaf: 156 vs 26

...,...,< 0.5:

...,...,[1]

...,...,Feature 3:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 267 vs 214

...,...,...,< 0.5:

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 58 vs 13

...,...,...,...,< 0.5:

...,...,...,...,[1]

...,...,...,...,[1]

...,...,...,Feature 4:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 12 vs 5

...,...,...,...,< 0.5:

...,...,...,...,[1]

...,...,...,...,[0]

...,Feature 3:

...,...,>= 0.5:

...,...,...,Leaf: 21 vs 1067

...,...,< 0.5:

...,...,Feature 4:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 6 vs 112

...,...,...,< 0.5:

...,...,...,[0]

...,...,...,Feature 2:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 0 vs 45

...,...,...,...,< 0.5:

...,...,...,...,[0]

...,...,...,...,Feature 0:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 0 vs 5

...,...,...,...,...,< 0.5:

...,...,...,...,...,[0]

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 0 vs 37

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,[0]

...,...,...,...,...,...,Feature 0:

...,...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,...,Leaf: 11 vs 288

...,...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,...,[0]

...,...,...,...,...,...,...,Feature 0:

...,...,...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,...,...,Leaf: 4 vs 399

...,...,...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,...,...,[0]

...,...,...,...,...,...,...,...,[0]

...,...,Feature 4:

...,...,...,>= 0.5:

...,...,...,...,Leaf: 2 vs 133

...,...,...,< 0.5:

...,...,...,[0]

...,...,...,Feature 0:

...,...,...,...,>= 0.5:

...,...,...,...,...,Leaf: 3 vs 86

...,...,...,...,< 0.5:

...,...,...,...,[0]

...,...,...,...,Feature 0:

...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,Leaf: 2 vs 356

...,...,...,...,...,< 0.5:

...,...,...,...,...,[0]

...,...,...,...,...,Feature 0:

...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,Leaf: 2 vs 887

...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,Feature 2:

...,...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,...,Leaf: 0 vs 36

...,...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,...,[0]

...,...,...,...,...,...,...,Feature 0:

...,...,...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,...,...,Leaf: 2 vs 851

...,...,...,...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,...,...,...,[0]

...,...,...,...,...,...,...,...,...,[0]

...,...,...,...,...,...,...,Feature 0:

...,...,...,...,...,...,...,...,>= 0.5:

...,...,...,...,...,...,...,...,...,Leaf: 0 vs 477

...,...,...,...,...,...,...,...,...,< 0.5:

...,...,...,...,...,...,...,...,...,[0]

...,...,...,...,...,...,...,...,...,[0]
