

## Problem Set 4: Due Tuesday Dec. 1

### Problem 4.1 (11 points)

Write a program that implements the decision tree learning algorithm from the text (and lecture), focusing on some decision of interest to you in day-to-day life. In keeping with the discussion in the text, your decision should be a yes/no (essentially a classification) decision. (Examples, in case you need some: Should I pet this particular dog? Is this a movie I would wish to go see? Should I devote the day to study or not? Is this a candidate I'd wish to vote for?...)

Your example should use at least seven or eight features (these can all be binary, but need not be if you wish), and at least fifteen to twenty training examples, and at least five test examples. Note that your program should both construct the tree from part (b) below and, in a second phase, should test the tree as in part (c).

- a. Show your own imagined decision tree (i.e., the tree that you think you are using) for the decision. This is the tree that you (in some sense) "want" the algorithm to learn.
- b. Show the tree constructed by the decision tree algorithm. Discuss the differences (if any) between the tree constructed by your program and the tree in part a. Also summarize any features of your tree-learning program that you think are interesting or worth noting.
- c. Test your tree by using it to classify the test examples. How does it perform on these?

### Problem 4.2 (3 points)

In class we discussed the limitations of perceptrons in representing certain types of Boolean functions: some functions can be represented, others can't. Suppose, for instance, we have a perceptron with three inputs, labeled X, Y, and Z, and a single output OUT. It is easy to make a perceptron that computes the AND of these three values: the weights leading from inputs X, Y, and Z to OUT are 1 each, and the threshold for the perceptron is 2.5.

- a. Give two examples of three-input Boolean functions that can be represented by a perceptron, and provide the weights leading from X, Y, and Z (and the threshold) that implements this function.
- b. Give an example of a three-input Boolean function that *cannot* be represented by a perceptron, and create (by hand) a three-layer neural net that implements this function.