CMPT 310, Spring 2019, Written Assignment 09

Due date: March 25, 2019

Problem 1. In the recursive construction of decision trees, it sometimes happens that a mixed set of positive and negative examples remains at a leaf node, even after all attributes have been used. Suppose that we have p positive examples and n negative examples. Show that the solution used by DECISION-TREE-LEARNING, which picks the majority classification, minimizes the absolute error over the set of examples at the leaf.

Problem 2. Continuing the Problem 1, show that the class probability $\alpha = p/(p+n)$ minimizes the sum of squared errors(SSE).

$$SSE = p(1-\alpha)^2 + n\alpha^2 \tag{1}$$

Problem 3 (Optional). Consider the problem of learning to play tennis (or some other sport with which you are familiar). Explain how this process fits into the general learning model. Describe the percepts and actions, and the types of learning the player must do. Describe the subfunctions the player is trying to learn in terms of inputs and outputs, and available example data. Is this supervised or reinforcement learning?

Problem 4 (Optional). Suppose we generate a training set from a decision tree and then apply decision-tree learning to that training set. Is it the case that the learning algorithm will eventually return the correct tree as the training-set size goes to infinity? Why or why not?

Problem 5 (Optional). A decision graph is a generalization of a decision tree that allows nodes (i.e., attributes used for splits) to have multiple parents, rather than just a single parent. The resulting graph must still be acyclic. Now, consider the XOR function of three binary input attributes, which produces the value 1 if and only if and odd number of the three input attributes has value 1.

() Draw a minimal-sized decision *tree* for the three-input XOR function.

() Draw a minimal-sized decision *graph* for the three-input XOR function.