MACHINE LEARNING (CSCI 8950): HOMEWORK-3

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Solution to 1(a):

1. (1,2,2,3) → +
2. (3,2,1,1) → -

Solution to 1(b): A label assignment that will make all samples correctly classifiable by the 3-Nearest Neighbour algorithm using Hamming Distance is as follows: (a=+, b=+, c=+, d=+). This way, all labels are positive and there is no scope for error.

Solution to 2(a): There is no possible perceptron to explain the classification of datapoints with the given label assignment. This is because the datapoints are not linearly separable, and perceptron can only explain a linearly separable dataset fully. We can, however, use a multi-layered perceptron to explain the datapoints in question.

Solution to 2(b): A label assignment that classifies all given samples correctly by the 3-nearest neighbour rule based on Euclidean distance is as follows: (a=-, b=-, c=+, d=+)

Solution to 3(a): Decision trees are an example of an algorithm that searches a complete space of hypotheses in an incomplete way. My intuitive way of understanding this is that traversal in a decision tree is synonymous with depth-first search.

Solution to 3(b): Candidate elimination searches through an incomplete space of hypotheses completely (Tom Mitchell). However, I could not find an algorithm that searches an incomplete space incompletely, and it also makes me wonder if searching an incomplete space incompletely can even be considered reliable in terms of performance.

Solution to 3(c): Perceptron stops as soon as it finds any hyperplane that separates the two classes, but support vector machine goes on to further find the most optimum hyperplane (out of all possible hyperplanes) based on the separation margin of the two classes.

Solution to 3(d): Support vector machine will always predict one hard class label for a datapoint, while perceptron can give the probability of that datapoint belonging to each class (based on its activation function). This way, perceptron can, at times, give a better idea of class membership based on the probability value.