CIS 530 Introduction to Artificial Intelligence

CIS 730 Artificial Intelligence

Fall 2013

Homework 7 of 10: Problem Set (PS7)

Reasoning and Learning, Part I:

Probabilistic Reasoning (Inference and Causality),

Version Spaces, and Decision Trees

Assigned: Sun 10 Nov 2013

Due: Mon 18 Nov 2013 (before midnight)

The purpose of this assignment is to exercise your basic understanding of machine learning.

This homework assignment is worth a total of 20 points.

Each problem is worth 20% for CIS 730 students and 25% for CIS 530 students.

Upload a copy of your solution (scanned or typed) to your K-State drop box before the due date.

References

TETRAD: <http://www.phil.cmu.edu/projects/tetrad/>

1. (530/730) TETRAD. Download TETRAD v4.3.10-6 from <http://bit.ly/stIbQh> and refer to the manual (under Help → TETRAD Manual).

Create the following Bayesian networks, including CPTs, using TETRAD:

* + - 1. The murder trial BN.
      2. The Burglary network
      3. The Asia network.
      4. The 5-node Sprinkler network from lecture.

Save the networks and turn in PS7\_1a.tet and PS7\_1b.tet. In your final homework, you will use TETRAD to implement Bayesian network structure learning from data.

1. (530/730) Version Spaces: Active Learning (Query-by-Example).

Consider the concept and training instances in this “sunburn” example:

<http://bit.ly/1fvo30t>

After the first two examples, what is the best active learning query?

1. (530/730) Decision Trees. Simulate the behavior of ID3 on the full data set given in Problem PS7-2 above. Show your calculation of conditional entropy *H*(*D* | *A*) and information gain *I*(*D*, *A*) = *H*(*D*) – *H*(*D* | *A*), where *H*(*D*) is the entropy of data set *D* prior to testing *A*.
2. (530/730) Multi-layer Perceptrons and Parity.
   * + 1. Construct by hand a neural network that computes the converse nonimplication function of two inputs *A* and *B*:

<http://en.wikipedia.org/wiki/Converse_nonimplication>

Make sure to specify what sort of units you are using.

* + - 1. Can a simple perceptron represent ? (Hint: Is it a parity function of its inputs). Describe what happens to the weights of a four-input, step-function perceptron, beginning with all weights set to 0.1, as examples of the parity function arrive.

1. (730 only) Backpropagation of Error. Suppose that a training set contains only a single example, repeated 100 times. In 80 of the 100 cases, the single output value is 1; in the other 20, it is 0. What will a backpropagation network predict for this example, assuming that it has been trained and reaches a global optimum? (*Hint*: to find the global optimum, differentiate the error function and set to zero.)

Class participation (required). On or before the due date, please post to KSOL and the class mailing list (CIS530-L or CIS730-L) a brief discussion of the differences between transformational and derivational analogy, as discussed in class on Fri 08 Nov 2013. In your own words, what is the relationship between the methods discussed above and case-based reasoning? What about instance-based learning, especially using nearest-neighbor? (Give a concrete example from among the applications we have discussed in class.)

Coming Up Next

Machine Problem 8 (due Fri 30 Nov 2012) – Reasoning and Learning Part II: The Waikato Environment for Knowledge Analysis (WEKA), Artificial Neural Networks (ANNs), Genetic Algorithms (GAs), Natural Language Processing (NLP), and Vision