Probabilistic Reasoning in AI - Assignment 3

Due Tuesday, April 13, 2004
Accepted without penalty until April 26, 2004

In this assignments you will work in *teams of 2 students* in order to code inference algorithms for Bayes networks.

1. [100 points]:

   In this part, you will code the junction tree algorithm for belief networks. One person in the team should code the methods that construct the junction tree (moralization of the belief network, triangulation and construction of the minimum spanning tree. You can use the algorithms from Jordan's textbook, or any other algorithms of your choice, provided that you acknowledge your sources. The second person will code the methods for manipulating the potentials, message passing and responding to queries. The code skeleton can be downloaded from the web page.

   Note that besides the files associated with the junction tree algorithm, you will have to look at the file Menu.java, it contains code that reads a query from the user. Modify this file so it sends the query to the Message Passing Data Structures. Introduce the evidence in the query by calling the method `introduceEvidence(String evidence)` on the CliqueTree. Print out the probability associated with the query.

   What to turn in: e-mail your code, as a .tar archive, to Rohan (rshah3@cs.mcgill.ca). The code should be *working* and *documented*. Also submit a hard copy report of the tests you ran on the provided test network. Show the output of the program for the requested queries and indicate the time it took to answer the queries.

2. [100 points]:

   In this, part, you will code approximate inference methods for belief networks. The first person will code likelihood weighting, and the second person will code Gibbs sampling. You should answer the queries requested in the code. Because these algorithms rely on random number, you should attempt to answer each query 3 times. For likelihood weighting, plot a graph showing the number of instances generated, on the x-axis, and probability prediction, on the y-axis, together with the correct probability. For Gibbs sampling, you will have a "burn-in" period, followed by sample collection. You have two parameters that you can experiment with: the duration of the burn-in period, and the number of steps you allow between samples. Show graphs with the probability estimate on the y-axis, and each of these parameters, on the x-axis. Similarly to likelihood weighting, show a graph with the number of samples on the x-axis, and the probability estimate on the y-axis., for one of the parameter settings explored above. Show also a graph with two curves, one for Gibbs sampling and one for likelihood weighting, in which you show number of instances on the x-axis, and computation time on the y-axis. Explain your results.

   Write a commentary section, discussing the advantages and disadvantages of each method. The reports for both questions are written jointly by both students.