CISC 3410 Fall 2012, Homework 8

1. From the joint distribution on page 29 of the notes for Lecture 9, compute:

   (a) $P(cavity)$
   (b) $\mathbf{P}(Toothache)$.
   (c) $\mathbf{P}(Toothache|cavity)$.
   (d) $P(catch \vee cavity)$
   (e) $\mathbf{P}(Cavity|toothache \vee catch)$

   Recall what the difference is between P and $\mathbf{P}$ (see page 25 of the notes).

   (25 points)

2. How many numbers do we need to specify all the necessary probability values for the network in Figure 1? How many would we need if there were no conditional independencies (if we didn't have the network)?

   (5 points)

3. Given the data in Figure 1, calculate the joint probability:

   $$P(m, \neg t, h, s, \neg c)$$

   (15 points)

4. Given the data in Figure 1, use stochastic simulation to construct an estimate of the full joint probabilities. I only want to see the results of the first 5 samples only.

   (15 points)

5. You take a test T to tell whether you have a disease D. The test comes back positive. You know that test is 95% accurate (the probability of testing positive when you do have the disease is 0.95, and the probability of testing negative when you don't have the disease is also 0.95). You also know that the disease is rare, only 1 person is 10,000 gets the disease.

   What is the probability that you have the disease?

   How would this change if the disease was more common, say affecting 1 person in 100?

   (20 points)

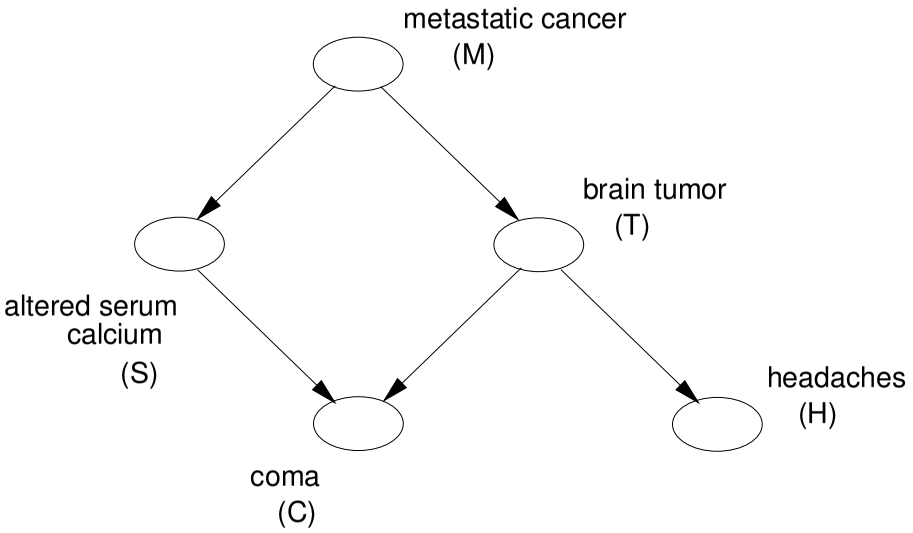
6. Here is a decision problem facing some recent graduates in computer science. Having finished their undergraduate degree, they have a choice between looking for a job, and going to graduate school to get a masters degree.

   If they choose to look for a job, they have a one in 10 chance of not finding a job using their degree, and a 90% chance of finding a job using their degree. If they don't find a job using their degree, they will have an average income of $20,000 for the next five years. If they find a job using their degree, they will have an average income of $70,000 for the next five years.

   If they choose to go to graduate school, they will have no income for 2 years, and it will cost them $50,000 (total) to be a student for those two years. At the end of their masters, they have a 5% chance of not finding a job using their degree(s) and thus have an average income of $20,000 for the next three years. They will have a 20% chance of finding a job that will pay them $120,000 on average for the three years, and a 75% chance of finding a job that will pay them $90,000 for the next three years.

   (a) What are the expected values of looking for a job right out their undergraduate degree and of going to graduate school?
   (b) What is the rational choice? Why?
   (c) If a student is very risk averse, what should they do?

   (20 points)



$P(M)$
0.1

M	$P(S \mid M)$
T	0.8
F	0.2

M	$P(T \mid M)$
T	0.7
F	0.1

S	T	$P(C \mid S,T)$
T	T	0.95
T	F	0.85
F	T	0.85
F	F	0.01

T	$P(H \mid T)$
T	0.9
F	0.7

Figure 1: The example Bayesian network.