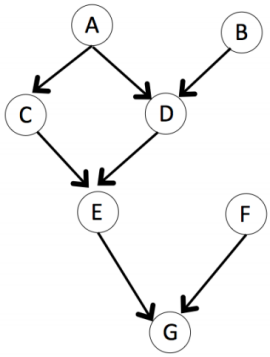
CSE 473: Artificial Intelligence
Assignment #5
Sunday, May 31, 2015
Due: Friday, June 5, 2015 beginning of class.

Reading Assignment: Read Chapter 14, Sections 1,2, and 4 carefully.

Students should work individually on this problem set – please no collaboration on the problems.

Problems:

1. Consider the Bayes Net shown below. The following questions are worth 1 point each with a negative point for incorrect answers (don't guess randomly). In (a) through (m), by independent we mean whether they are independent for any setting of the CPTs.



(a) Are A and F independent?
(b) Are A and F independent given G?
(c) Are A and G independent?
(d) Are A and G independent given C?
(e) Are A and G independent given C and D?
(f) Are A and G independent given B, C and D?
(g) Are A and B independent?
(h) Are A and B independent given C and D?
(i) Are C and D independent?
(j) Are C and D independent given A?
(k) Are C and D independent given E?
(l) Are C and D independent given A and E?
(m) Are C and D independent given A and F?

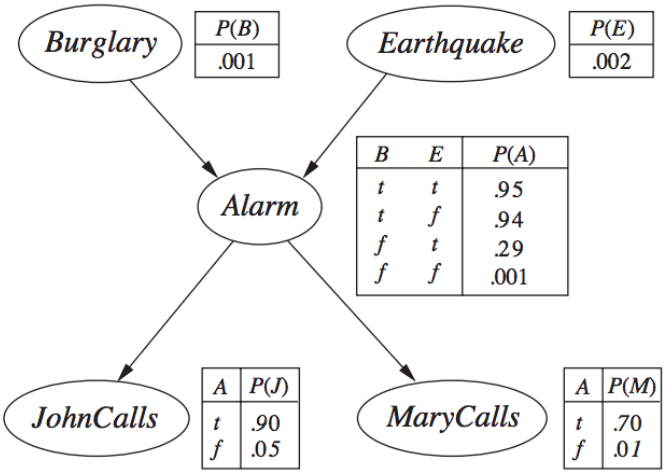
(n) Are there CPTs that would make G independent of F? If yes, provide CPT(s) for E, F, and/or G that do the job. If not, explain why.

2. (6 points, 3 for each question) Suppose my hat contains 3 quarters (a, b, and c) that appear identical, but in fact are subtly weighted so that the odds of getting heads upon a flip are 40%, 60% and 75%, respectively. You randomly pick one quarter from the hat and then flip it 3 times to generate outcomes X1, X2, and X3.

   (a) Show a Bayesian network corresponding to this scenario and include the relevant conditional probability tables.

   (b) Which coin is the mostly likely to have been drawn if the observed flips were heads, tails, heads? Show your work.

3. (12 points, 3 for each question) Consider the following Burglar alarm network (probabilities are given for the '+' cases):



   (a) Suppose one used variable elimination (VE) to compute $P(B|+j)$. What would be the dimensionality and size of the largest factor be if you used the elimination ordering (A, E, M)? In contrast to the lecture, please consider the size of the factors right after the join, *before* the summation. See slides on variable elimination.

   (b) What about (M, E, A)?

   (c) Use the more efficient ordering to compute the answer. Write the intermediate factors as tables.

   (d) Use VE to compute $P(B|+j, +e)$. (You dont have to write out all the factors on this one, just get the answer.) Why does the likelihood of a burglary change when we observe an earthquake? (Answer in terms of the graphical structure.)