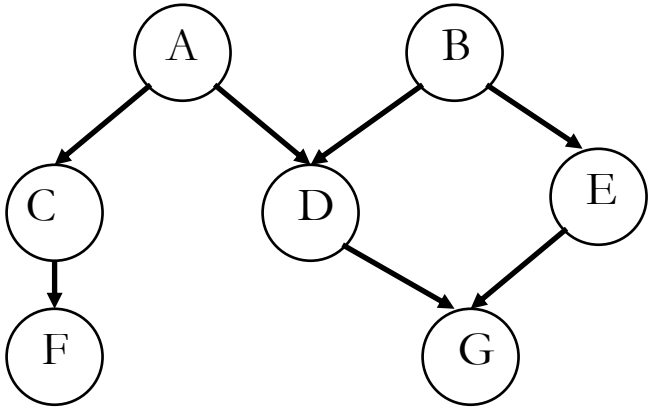
Homework Week 6



1. Consider the belief network. Each variable is binary-valued (e.g., A has values a and ~a, B has values b and ~b, etc). Probability tables are stored at each node. For purposes of expressing your answers, you can assume that P(~x|…) is explicitly stored, as well as P(x|…) (i.e., do not compute P(~x|…) as 1 - P(x|…). **For each of the following express the probability only in terms of probabilities found in the probability tables of the network and that involve the minimal number of variables necessary.** To facilitate grading, use '~' for negation, '|' for conditioning, and order variables within a product alphabetically by the variable value on the left hand sides of '|' in the case of conditional probabilities.

a) P(a,b,c,d,e,f,g) = ? = P(A) * P(B) * P(C | A) * P(D | A, B) * P(E | B) * P(F | C) * P(G | D, E)

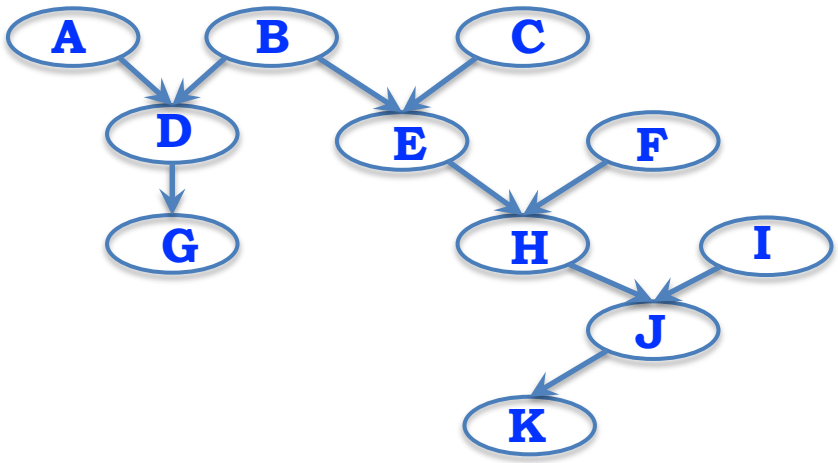
b) P(e|b, c) = ? = P(E | B)

c) P(f|a) = ? = P(F | C) P(C | A) + P(F | ~C) P(~C | A)
= P(F | C)

d) P(b,d,e) = ? = P(A) P(B) P(D | A, B) P(E | B) + P(~A) P(B) P(D | ~A, B) P(E | B)

e) P(b|e) = ? = P(E | B) P(B) / P(E | B) P(B) + P(E | ~B) P(~B)

2. Consider the following Bayesian network.



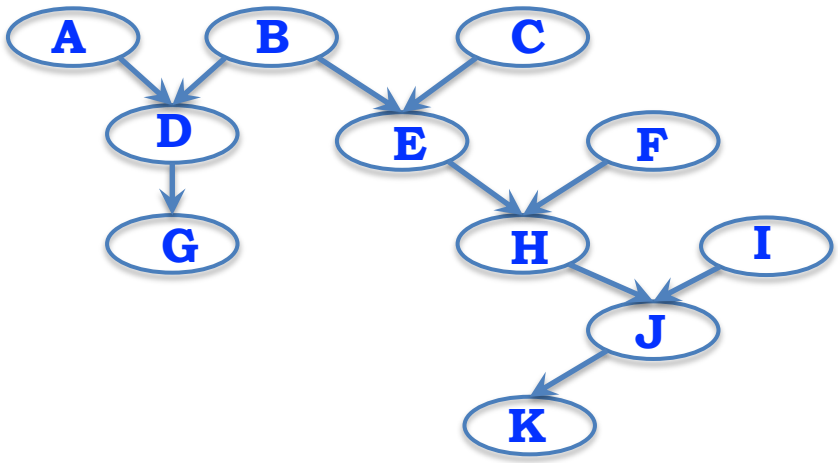
a) Can knowledge of the value of **A** affect your belief in the value of **F**? Yes or No?

No

b) Explain your answer to (a):

Following the network, there is no arc that leads from node A to F.

2 continued. Consider the following Bayesian network (same as previous page).



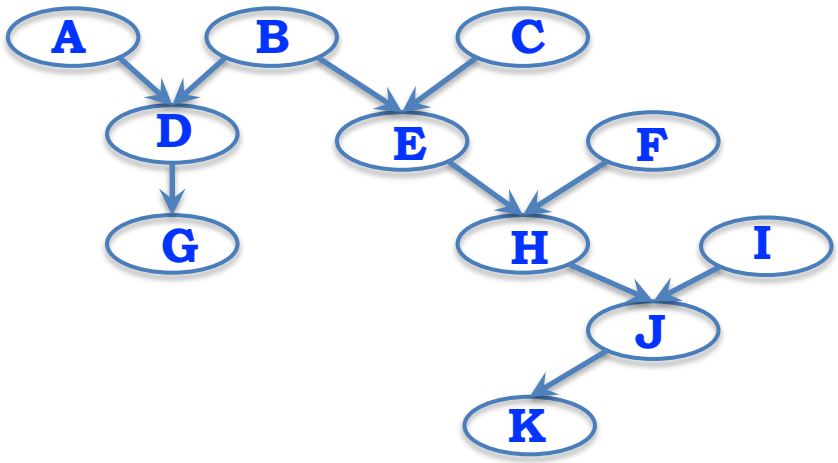
c) Can knowledge of the value of **G** affect your belief in the value of **F**? Yes or No?

No

d) Explain your answer to (c):

Following the network, there is no arc that leads from node G to F.

2 continued. Consider the following Bayesian network (same as previous page).



e) Know other relationships between pairs of variables given the structure of the Bayesian network and be able to explain each

The nodes are influenced by their parent, symbolized by the arc/edge pointing in the direction of the arrow.

3. Indicate the truth of each statement

a) The product rule for a and b, $P(a \wedge b) = P(a|b)P(b)$ applies only when a and b are statistically independent

True or False

b) The semantics of a Bayesian net are such that each node is conditionally independent of its non-descendants given its parents

True or False

c) Variables X and Y are independent if $P(X \wedge Y) = P(X)*P(Y)$ for all possible values of X and Y

True or False

d) Variables X and Y are independent if $P(Y|X) = P(Y)$ for all possible values of X and Y

True or False

e) Variables X and Y are independent if $P(X \wedge Y) = P(X)+P(Y)$ for all possible values of X and Y for all possible values of X and Y

True or False

f) Variable Z is conditionally independent of X given Y if $P(X \wedge Z \mid Y) = P(X|Y)+P(Z|Y)$ for all possible values of X, Z, and Y

True or False

g) Variable Z is conditionally independent of X given Y if $P(X \wedge Z \mid Y) = P(X|Y)*P(Z|Y)$ for all possible values of X, Z, and Y

True or False