Midterm

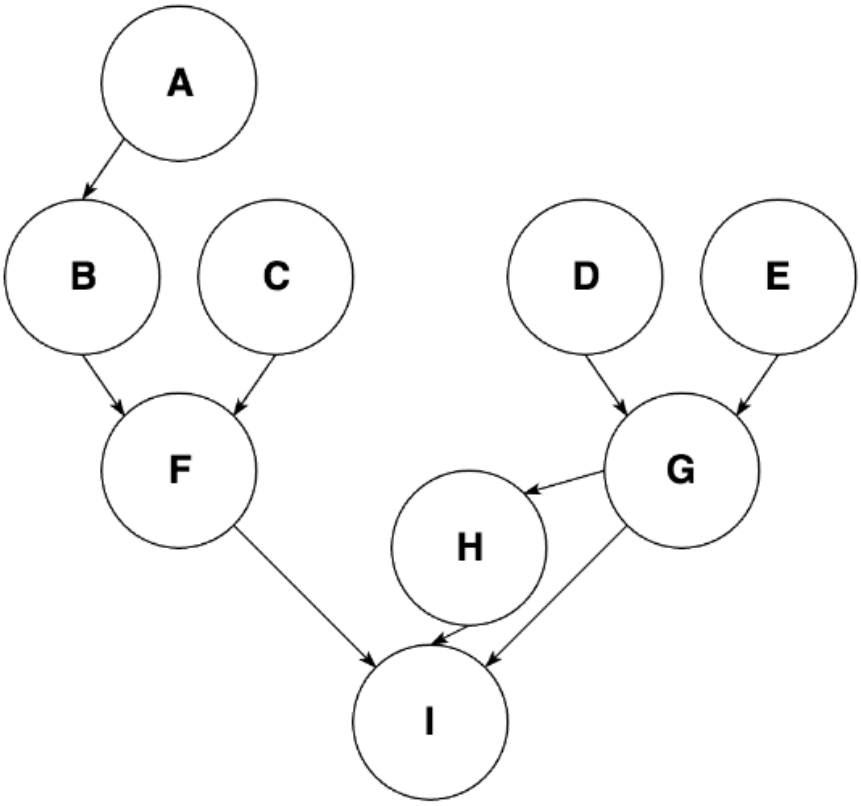
Part 4 of 5 - Probability and Inference

Question 26 of 33

0.0 Points

Consider the following Bayes net (bayes_net1.png). Your goal is to calculate a distribution P(I=i) for all possible values of i.

If you could pick one node to "inspect" (i.e., could have some value of that node as evidence), which one would simplify your calculation the most? Please provide your rationale for your choice.



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I would pick node F. This is because we know from Equation 14.3 in the book that P(I|A, B, C, D, E, F, G, H) = P(I | Parents(I)) = P(I | F, G, H). However, we know that F has 3 parent nodes, G only has 2, and H only has 1. So knowing F simplifies the calculation most.

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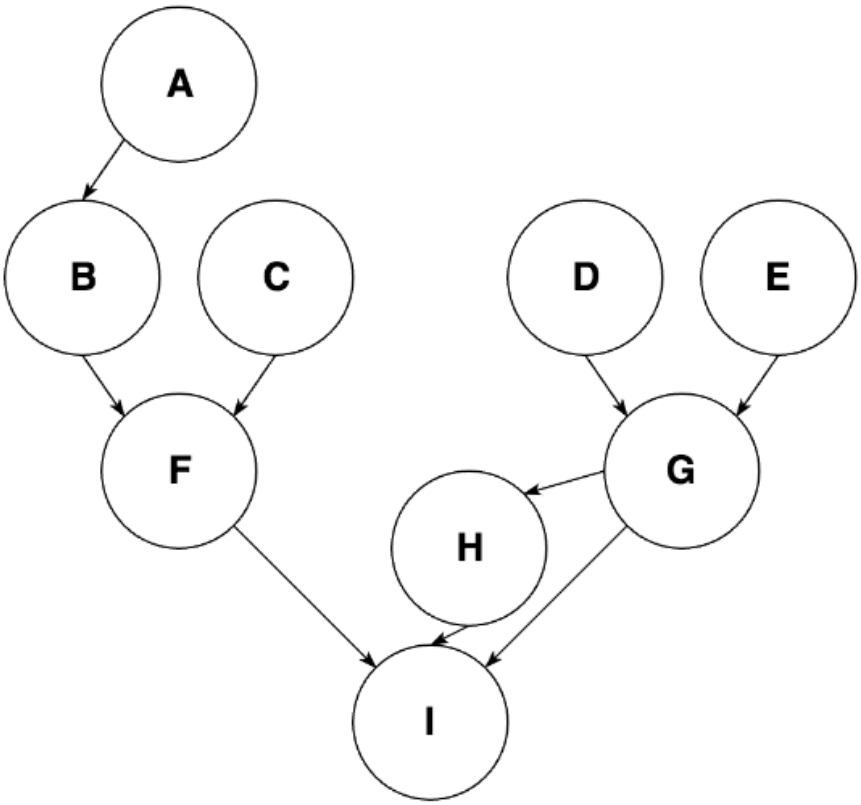
0.0 Points

What would be the new best node(s) to inspect given that you have as evidence some value for B? Please provide your rationale.



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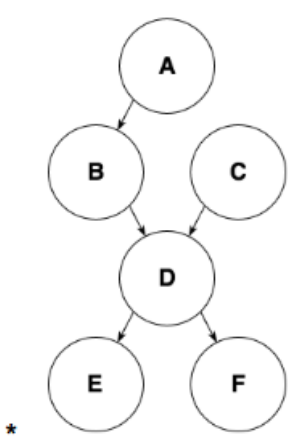
G is now the best node.

We know from Equation 14.3 in the book that P(I|A, B, C, D, E, F, G, H) = P(I | Parents(I)) = P(I | F, G, H). However, if we now know B, then F only has 1 unknown parent node. G has 2, and H only has 1. So knowing G now would simplify the calculation most.

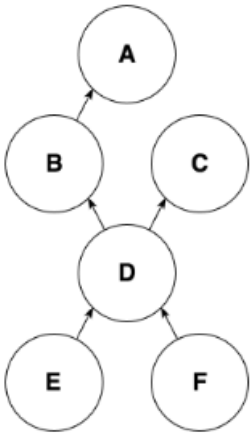
Question 28 of 33

0.0 Points

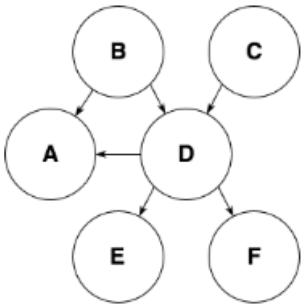
Mark all net topologies in (bayes_net2.png) which are equivalent to the topology marked *. For purposes of this question, a topology is equivalent if it introduces no extraneous dependencies [i.e., a dependency of A on some node N where P(A|N) = P(A) for each possible value of N] and there exists some set of conditional probability distributions for each of its nodes which, for all possible assignments of (A,B,C,D,E,F), will yield the same calculated probability as the original net.



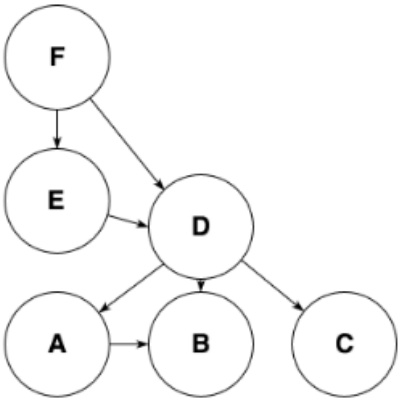
*



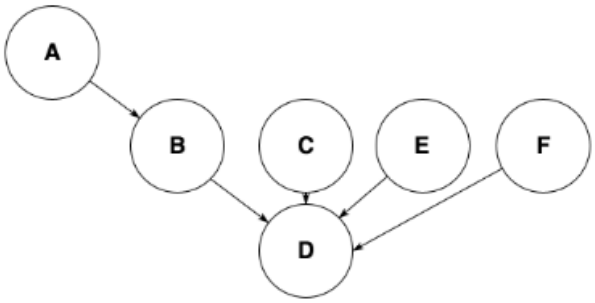
A



B



C



D

- [ ] A. A
- [x] B. B
- [ ] C. C
- [ ] D. D

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0.0 Points

Indicate how many states would need to be enumerated to calculate the distribution P(D) by enumeration for each net above, assuming that each variable has two possible values and no evidence is provided. A state is one assignment of variables, e.g. A=0 & B=1 or A=0, B=0, C=0 and D=0.

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For *, D has 3 parent nodes: A, B, C. Thus there are 2^3 = 8 states needed to calculate the distribution P(D).

For A, D has 2 parent nodes: E, F. Thus there are 2^2 = 4 states needed to calculate the distribution P(D).

For B, D has 2 parent nodes: B, C. Thus there are 2^2 = 4 states needed to calculate the distribution P(D).

For C, D has 2 parent nodes: E, F. Thus there are 2^2 = 4 states needed to

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0.0 Points

This week you will be taking your midterm in CS6600.5: Manmade Intellects. The class has a reputation for difficult exams, so you want to plan your studying to yield the highest grade possible.

Fortunately, the professor wants to see all his students do well, so he has prepared a study guide to inform your planning. Unfortunately, the professor has a very self-referential sense of humor, so the study guide comes in the form of a Bayes net describing the questions which will appear on the exam and the impact of any given skill on your performance for each question (bayes_net3.png).

The probabilities of getting each question right are listed in the tables above. For brevity, S=true or simply S denotes having studied skill S, S=false or simply !S denotes not having studied, Q=true or simply Q denotes getting question Q correct, and Q=false or simply !Q denotes having missed it. (This model assumes that question grading is all or nothing: that is, that no partial credit is awarded for any question. It is left as an exercise to the student to determine how accurate the model is.)

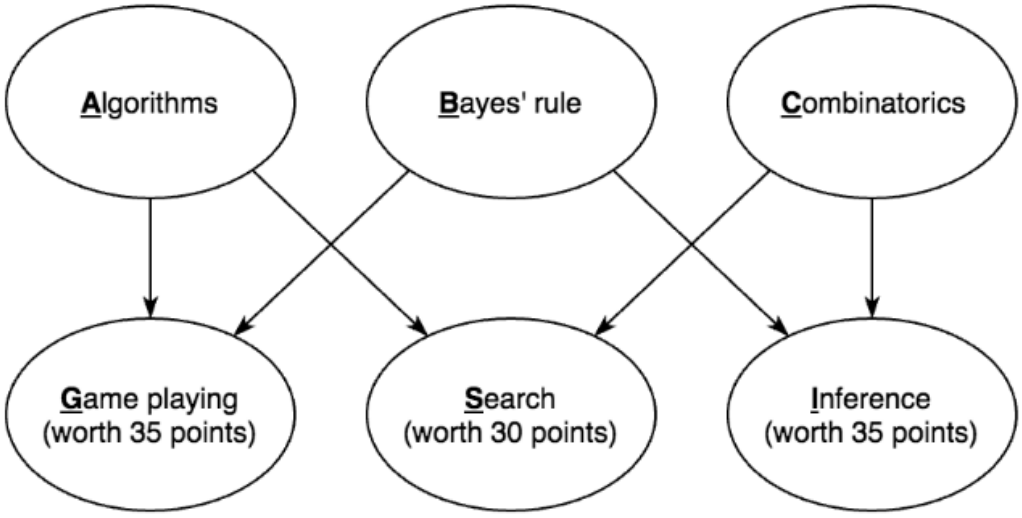
i) Suppose you have time to practice only one skill. Which one would you pick and why? Support your answer by calculating the expected value of your exam score for each choice, and show your work.

ii) Now suppose you have already studied Algorithms and have time to study one additional area. Does your answer change? Again, support your answer by calculating the expected value of your exam score for each choice.

iii) Suppose the prior probabilities that the average student will study each skill are given by P(A) = 0.8, P(B) = 0.4, and P(C) = 0.6. What median grade would you expect on the exam? Show all work.

iv) After the exam, you find that the actual median grade is 65. What are the chances of scoring at least this well without having studied Bayes' rule? Show all work.

BONUS:
v) After the exam, you compare scores with your close friend, and find that you outscored them. Without knowing the specific scores each of you achieved, what are the odds that you studied Bayes' rule? What are the odds that they studied Bayes' rule? Show all work.



	P(G)
P(G|!A,!B)	0.3
P(G|!A,B)	0.75
P(G|A,!B)	0.75
P(G|A,B)	0.95

	P(S)
P(S|!A,!C)	0.2
P(S|!A,C)	0.7
P(S|A,!C)	0.7
P(S|A,C)	0.9

	P(I)
P(I|!B,!C)	0.1
P(I|!B,C)	0.65
P(I|B,!C)	0.65
P(I|B,C)	0.85

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Google Drive Link with work: https://drive.google.com/open?id=0B2Shy51eMGmFZzJHclFsOHVMYm8 (Starting Page 6)

i) I would choose Bayes rule because the expected value of the Exam score given not A, B, not C is the highest. Value is 55. See work in attached google drive link (Page 6).

ii) I would choose to study Bayes rule again because E(Exam | A, B, !C) > E(Exam | A, !B, C). See work in attached google drive link (Page 7)

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