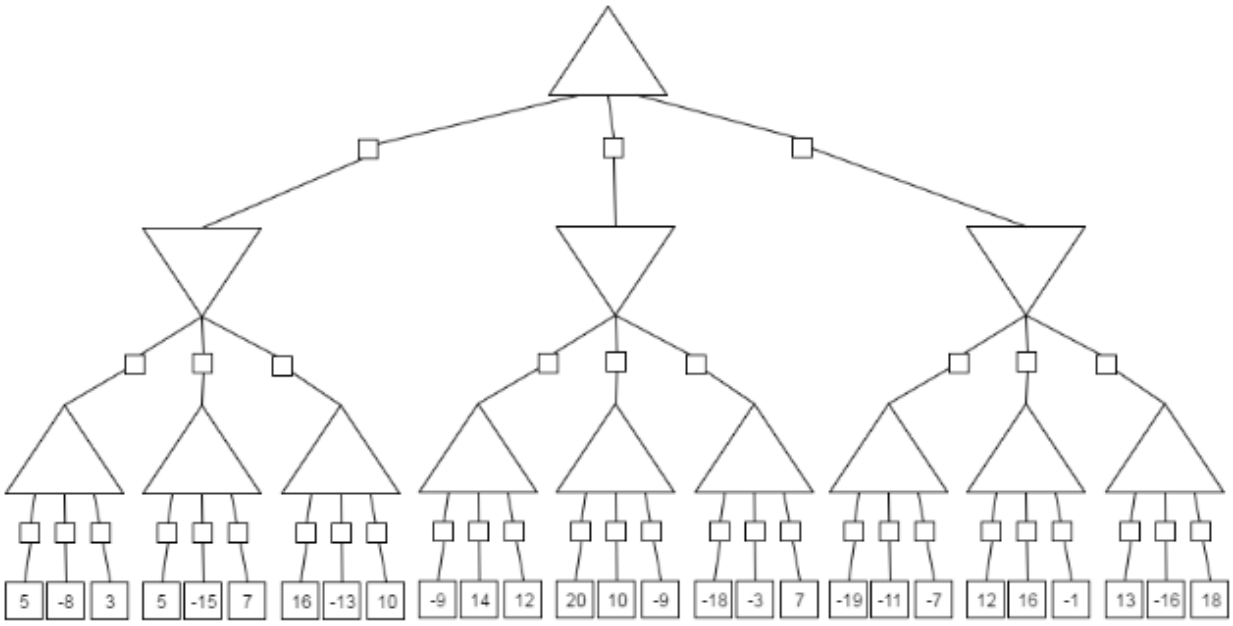
Midterm

Part 1 of 5 - Game Tree Search

Here (tree.png) is a game tree of depth 3 and breadth 3 with respective evaluation function outputs. Use the game tree to answer the following questions. Note that the whole tree must be considered for these questions. Also note that if an entire branch would be checked off, there is no need to check off all of the nodes in the subsequent depth levels.

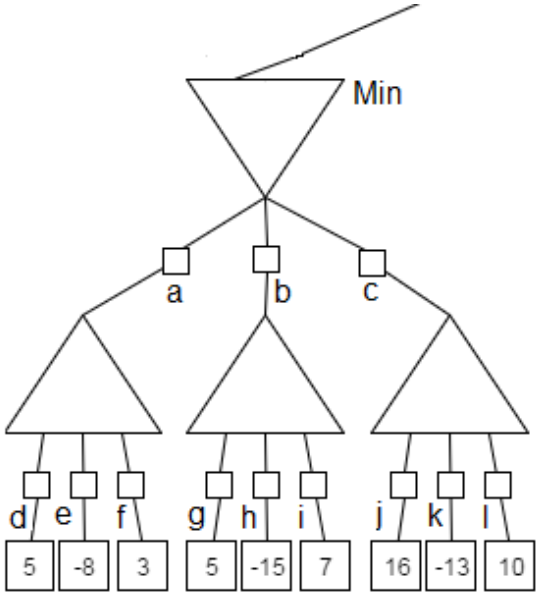
Attachments



Question 1 of 33

0.0 Points

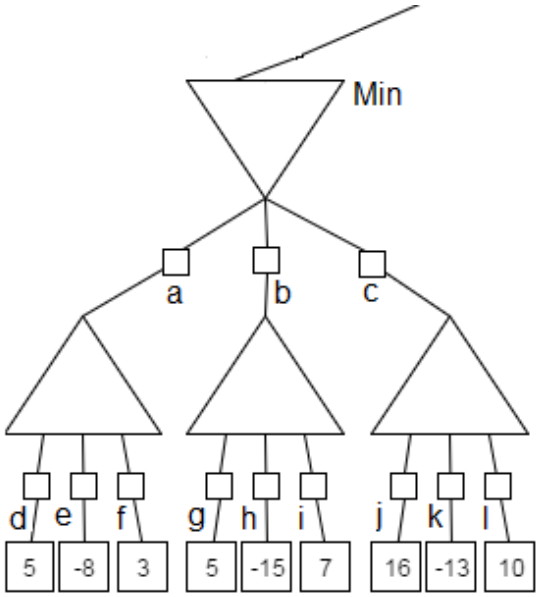
Which nodes of (subtree1.png) should be pruned by alpha-beta search?:



- [ ] A. A
- [ ] B. B
- [ ] C. C
- [ ] D. D
- [ ] E. E
- [ ] F. F

- [ ] G. G
- [x] H. H
- [x] I. I
- [ ] J. J
- [x] K. K
- [x] L. L

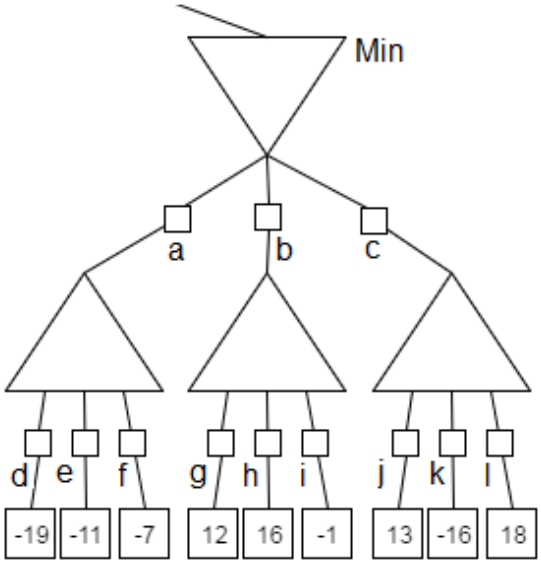
Question 2 of 33 0.0 Points



In the given subtree, what will be the final value in "Min"? 5

Question 3 of 33 0.0 Points

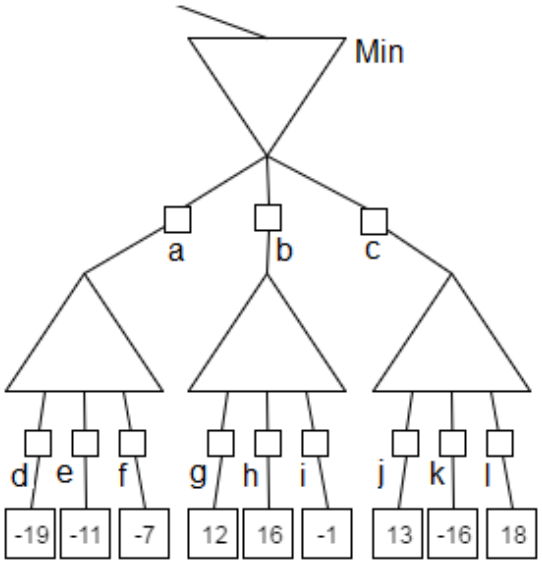
In (subtree2.png), which nodes would be pruned by alpha-beta?



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

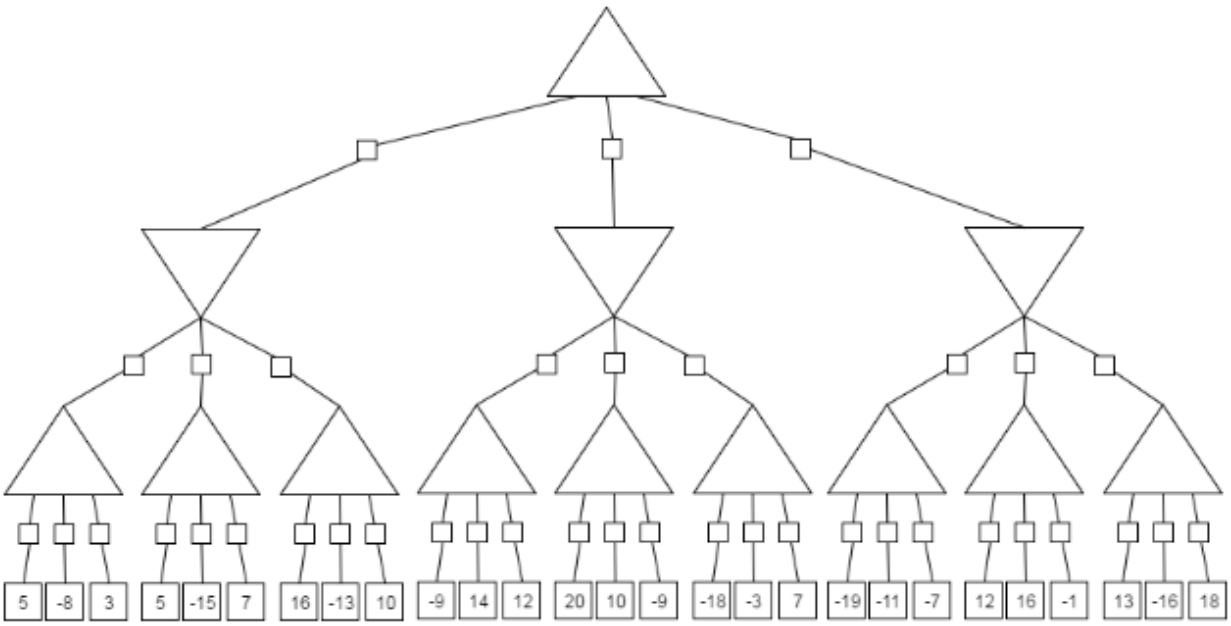
- [ ] F. F
- [ ] G. G
- [ ] H. H
- [ ] I. I
- [ ] J. J
- [ ] K. K
- [ ] L. L

Question 4 of 33 0.0 Points



In the given subtree, what will be the final value in "Min"? -7

Question 5 of 33 0.0 Points



What is the final output of the game tree? 7

Question 6 of 33 0.0 Points

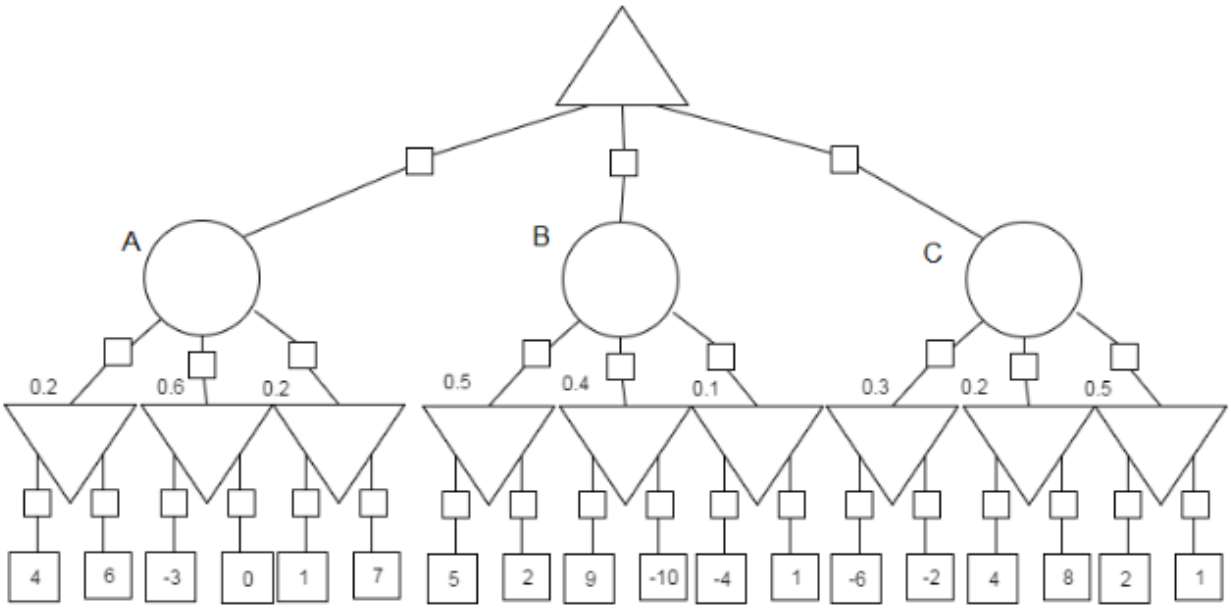
In total, how many nodes were pruned? 8

Question 7 of 33

0.0 Points

In the provided expectiminimax tree (expectimax.png), with an evaluation function bounded between [-10, 10], what are the values of nodes A, B, and C? If any nodes are pruned, use an inequality operator as necessary. Please provide your answers in the following format:

A: ____
B: ____
C: ____



(Maximum number of characters: 60000)

Source
Style
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Size

A: -0.8
B: <= -2
C: -0.5

See work in attached google drive link: https://drive.google.com/open?id=0B2Shy51eMGmFZzJHclFsOHVMYm8 (starting page 2)

Question 8 of 33

0.0 Points

Explain how the evaluation function for Queen's Isolation changes for a 3-player variation. You may use pseudocode to help clarify your explanation. (hint: how would the output of the evaluation function change?)

(Maximum number of characters: 60000)

Show/Hide Rich-Text Editor

3 player variation of queen's isolation is the same as 2 player, but now 3 players want to be the last to move instead of 2. As an evaluation function, you take your moves minus the number of first opponent's moves minus the number of second opponent's moves.

Question 9 of 33

0.0 Points

One optimization for alpha-beta pruning includes reordering nodes to allow more pruning. Would this still be an effective strategy in a 3-player game? Why or why not? (Answers without justification receive no credit)

(Maximum number of characters: 60000)

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No, this would not be an effective strategy in a 3-player game. Citing the class resource: http://www.cc.gatech.edu/~thad/6601-gradAI-fall2015/Korf_Multi-player-Alpha-beta-Pruning.pdf, the issue is that in the average case, the asymptotic branching factor of shallow pruning is b. In addition because there is a cost to reordering nodes, even if

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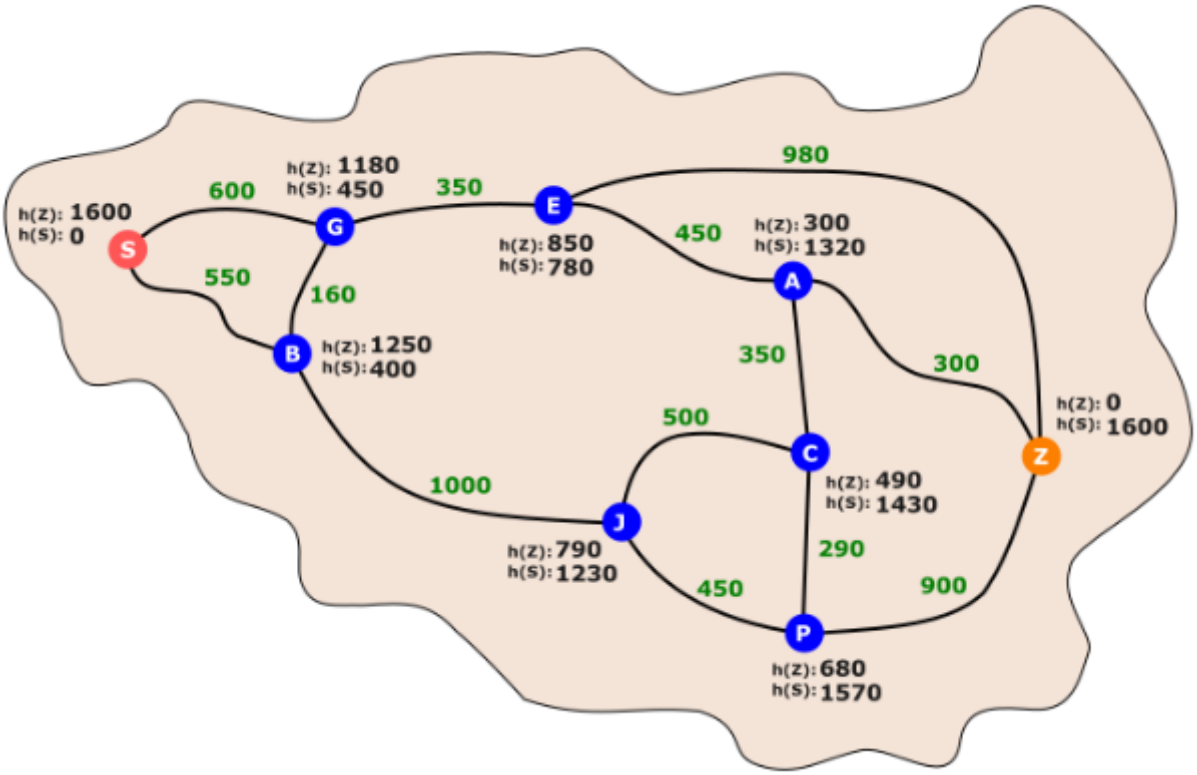
Midterm

Part 2 of 5 - Graph Search

The attached map (search_graph.png) will be used for the questions in this section. The green text corresponds to the true cost of a given edge, h(Z) is the straight-line distance from a node to the goal node Z, and h(S) is the straight-line distance from a node to the start node S.

Attachments



Question 10 of 33 0.0 Points

Which nodes are in the explored set of the search from S to Z if we use Breadth First Search?

- [ ] A. A
- [x] B. B
- [ ] C. C
- [x] D. E
- [x] E. G
- [x] F. J
- [ ] G. P
- [x] H. S
- [ ] I. Z

Question 11 of 33 0.0 Points

Please write the path found by a breadth first search from S to Z. Please format your answer as a comma-separated list of nodes from S to Z.

(Maximum number of characters: 60000)

Show/Hide Rich-Text Editor

S,G,E,Z

Question 12 of 33 0.0 Points

Which nodes are in the explored set of the search from S to Z if we use Uniform Cost Search?

- [x] A. A
- [x] B. B
- [ ] C. C
- [x] D. E
- [x] E. G
- [x] F. J
- [ ] G. P
- [x] H. S
- [x] I. Z

Question 13 of 33 0.0 Points

Please write the path found by a uniform cost search from S to Z. Please format your answer as a comma-separated list of nodes from S to Z.

(Maximum number of characters: 60000)

Show/Hide Rich-Text Editor

S,G,E,A,Z

Question 14 of 33 0.0 Points

Which nodes are in the explored set of the search from S to Z if we use Bi-directional A* Search?

- [x] A. A
- [x] B. B
- [ ] C. C
- [x] D. E
- [x] E. G
- [ ] F. J
- [ ] G. P
- [x] H. S
- [x] I. Z

Question 15 of 33 0.0 Points

Please write the path found by a bi-directional A* search from S to Z. Please format your answer as a comma-separated list of nodes from S to Z.

(Maximum number of characters: 60000)

Show/Hide Rich-Text Editor

S,G,E,A,Z

Question 16 of 33 0.0 Points

Which of the following Search Algorithms are optimal?

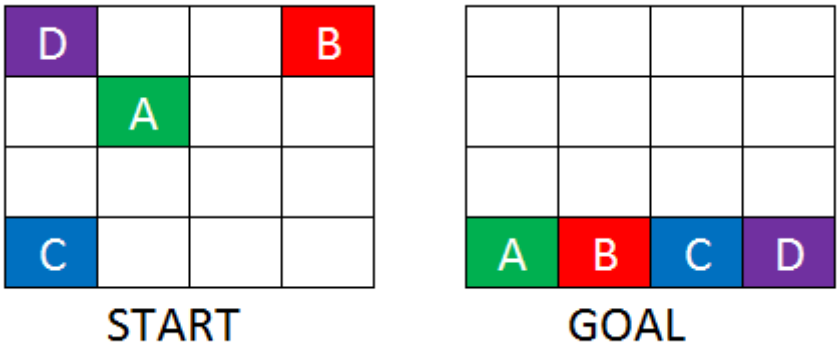
- [x] A. A*
- [ ] B. Depth First Search
- [x] C. Memory Deepening A*
- [x] D. Uniform Cost Search
- [ ] E. Iterative Deepening Depth First Search

Question 17 of 33 0.0 Points

Which of the following Search Algorithms are complete?

- [x] A. A*
- [x] B. Breadth First Search
- [ ] C. Greedy Best-First Search
- [ ] D. Depth First Search
- [x] E. Uniform Cost Search

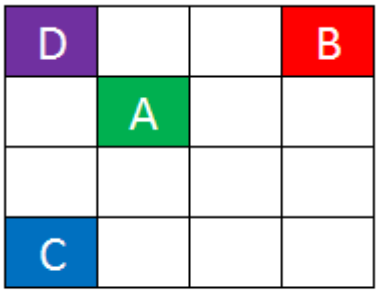
Question 18 of 33 0.0 Points



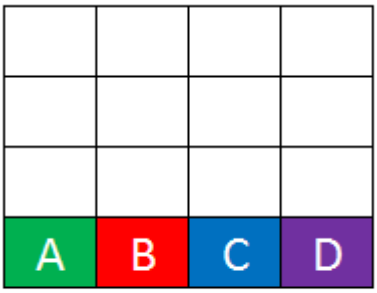
In the tile problem attached (manhattan_problem.png), what is the Manhattan Distance to get from the Start to the Goal State if each tile can only move in horizontal or vertical distances of 1? 16

Question 19 of 33 0.0 Points

In the tile problem attached (manhattan_problem.png), does Manhattan Distance constitute an admissible heuristic?



START



GOAL

- (•) True
- ( ) False

Reset Selection

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Midterm

Part 3 of 5 - Simulated Annealing

For each of the following moves, assuming the problem is trying to maximize the objective function, what is the probability of accepting each move?

Question 20 of 33 0.0 Points

If the Current State (E) has an objective score of 100, the Potential New State (E') has an objective score of 70, and the Temperature is 40, what is the probability of accepting the Potential New State? 0.4724

Question 21 of 33 0.0 Points

If the Current State (E) has an objective score of 200, the Potential New State (E') has an objective score of 150, and the Temperature is 70, what is the probability of accepting the Potential New State? 0.4895

Question 22 of 33 0.0 Points

If the Current State (E) has an objective score of 150, the Potential New State (E') has an objective score of 200, and the Temperature is 100, what is the probability of accepting the Potential New State? 1

Question 23 of 33 0.0 Points

If the Current State (E) has an objective score of 100, the Potential New State (E') has an objective score of 80, and the Temperature is 20 what is the probability of accepting the Potential New State? 0.3679

Question 24 of 33 0.0 Points

If the Current State (E) has an objective score of 200, the Potential New State (E') has an objective score of 230, and the Temperature is 150, what is the probability of accepting the Potential New State? 1

Question 25 of 33 0.0 Points

If the Current State (E) has an objective score of 150, the Potential New State (E') has an objective score of 90, and the Temperature is 250, what is the probability of accepting the Potential New State? 0.7866

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Midterm

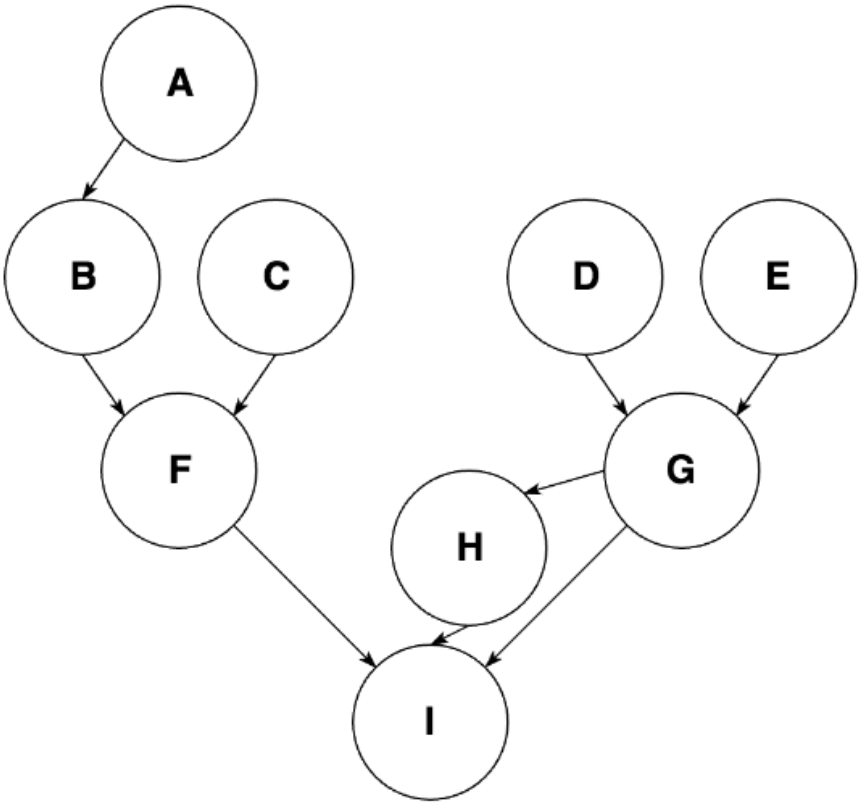
Part 4 of 5 - Probability and Inference

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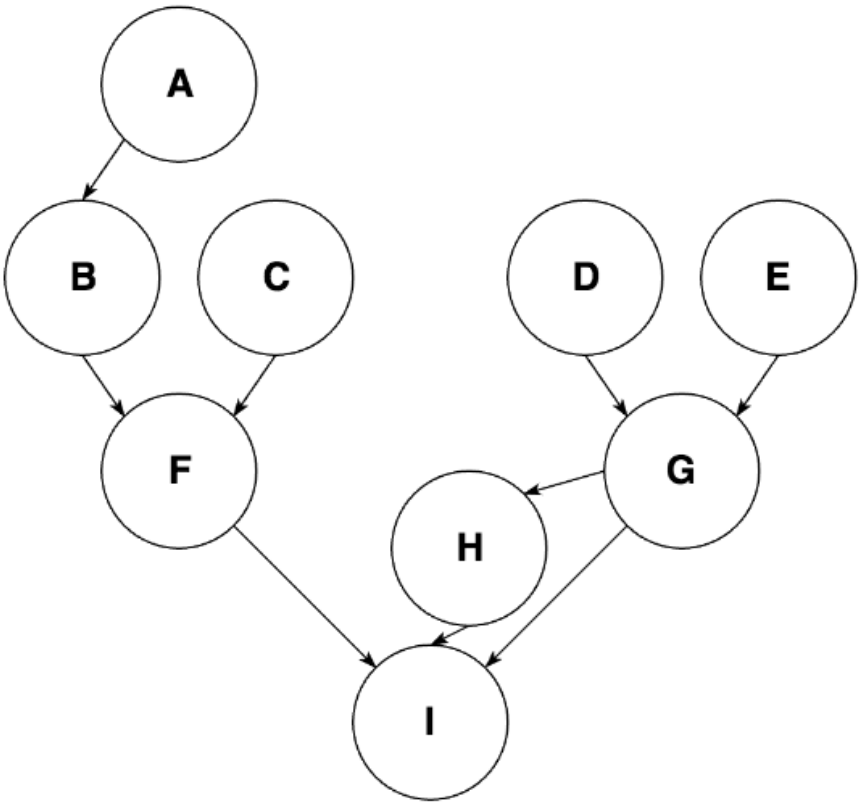
I would pick node F. This is because we know from Equation 14.3 in the book that P(I|A, B, C, D, E, F, G, H) = P(I | Parents(I)) = P(I | F, G, H). However, we know that F has 3 parent nodes, G only has 2, and H only has 1. So knowing F simplifies the calculation most.

Question 27 of 33

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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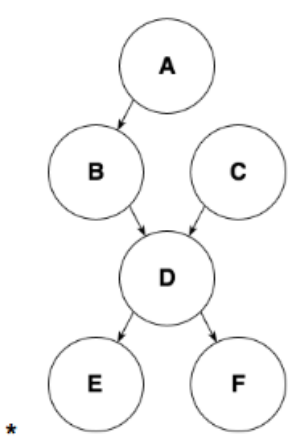
G is now the best node.

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.

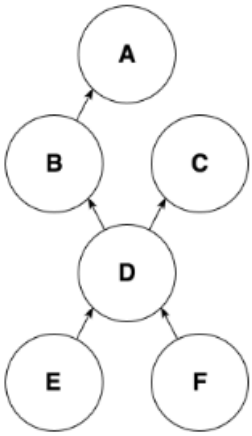
Question 28 of 33

0.0 Points

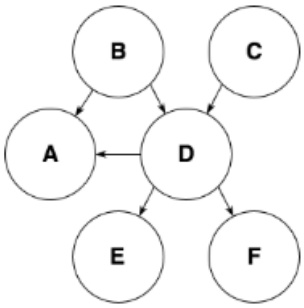
Mark all net topologies in (bayes_net2.png) which are equivalent to the topology marked *. For purposes of this question, a topology is equivalent if it introduces no extraneous dependencies [i.e., a dependency of A on some node N where P(A|N) = P(A) for each possible value of N] and there exists some 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.



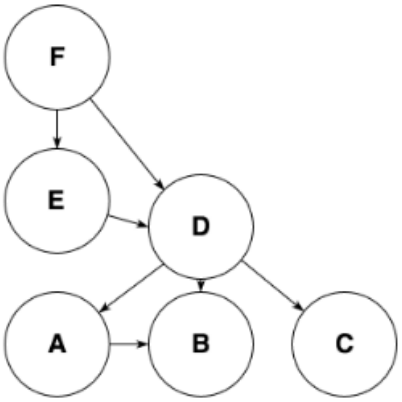
*



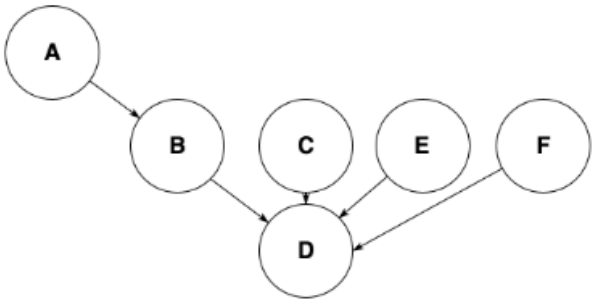
A



B



C



D

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

Question 29 of 33

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.

(Maximum number of characters: 60000)

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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

Question 30 of 33

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.)

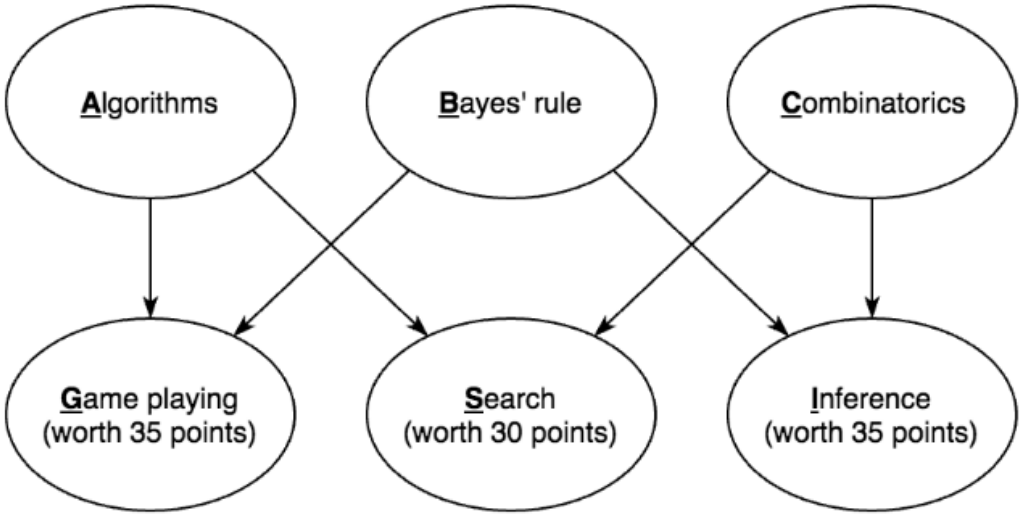
i) Suppose you have time to practice only one skill. Which one would you pick and why? Support your answer by calculating the expected value of your exam score for each choice, and show your work.

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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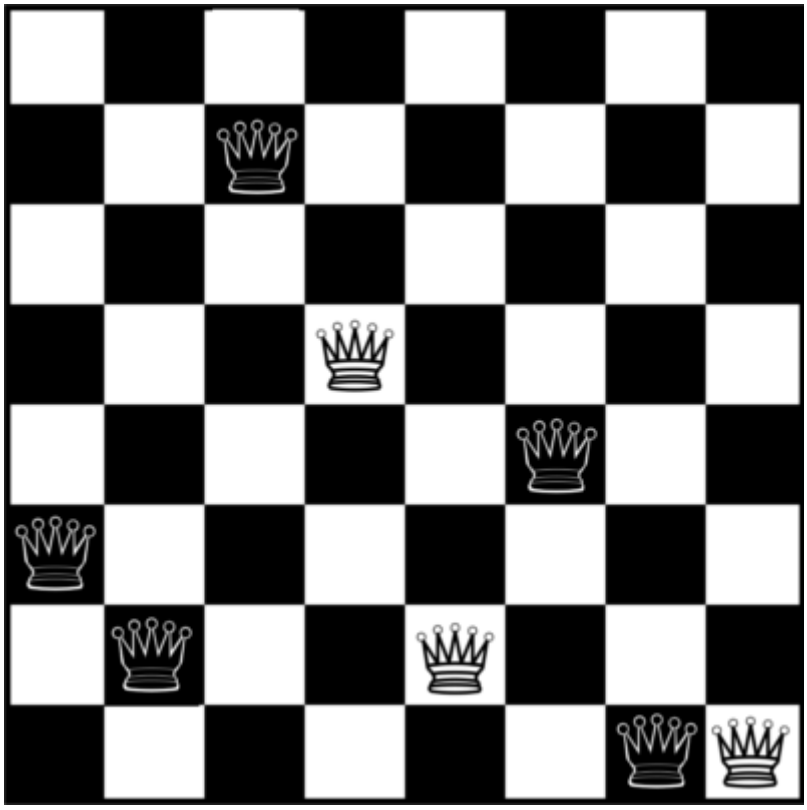
Midterm

Part 5 of 5 - Genetic Algorithms

In the 8-Queens problem, there are 8 queens on a board, one per column. The goal of the problem is to find a board position in which no queen is attacking any other queen (no queen can move to the location of any other queen). We can represent the state of a board as a string of 8 integers, with each number representing the row position of the queen in the corresponding column. We can calculate a fitness function for this problem by counting the number of unique pairs of queens that do not have lines of attack on each other, including paths obstructed by other queens (the best fitness function score would be 28). For example, the board state given in (example.png) would be encoded as 3275241 and would have a score of 23 according to our metric.

Attachments



Question 31 of 33 0.0 Points

Out of the following boards, we want to cull the 3 with the lowest fitness scores. Select the three to be culled:

- [x] A. 32583211
- [ ] B. 58647561
- [ ] C. 35712864
- [ ] D. 38647511
- [x] E. 53176462
- [x] F. 77854568

Question 32 of 33 0.0 Points

Which, if any, of the following is not a valid recombination of the most fit of the three boards above assuming no random mutations happen?

- [ ] A. 38647561
- [x] B. 27176412

- [x] C. 77176462
- [x] D. 38647211
- [x] E. 53172864
- [x] F. 58583211
- [ ] G. None of the above

Question 33 of 33

0.0 Points

Bonus: If there are any solutions that have a fitness score of 28 available from the recombination of any pair of the 3 most fit boards from section 1 of this question, please write its encoding out below:

(Maximum number of characters: 60000)

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No, I don't think there are any solutions that are a recombination of the 3 most fit boards from section 1.

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