Partial Exam on Search
(variant B)
Artificial Intelligence
Course code: 214030
May 30, 2012

Name and student number

Name: _____

Student number: _____

Introduction

This partial examination consists of multiple-choice questions. It is a closed book exam. You have 1 hours and 15 mins. At the end of the exam you must hand in this question paper and the answer form.
Each correct answer counts for 4 points.
Tips:

- Read each question carefully keeping the possible answers covered.
- Try to answer the question yourself, before you look at the answers you are given to choose from. Make a note of your first thoughts and calculations on a scribbling-paper (kladpapier).
- Beware of double negations (negatives) as these can be confusing.
- Do not stay on any one question too long. If you do not know the answer and have spent more than 10 minutes on the question, move on to the next question and come back to this one later.
- If you have any time over at the end, check your answers.
- Fill in your answers on this question form!

Good luck!

Multiple-choice questions

1. Consider the following statements about search:

   (i) Search is applicable (the found optimal solution is also an optimal solution when executing the action sequence) in a deterministic, static and fully observable environment.

   (ii) Search is applicable (the found optimal solution is also an optimal solution when executing the action sequence) in a non-deterministic, static and fully observable environment.

   Which of the above statements are true?

   (a) Both statements (i) and (ii) are false.

   (b) Only statement (i) is true.

   (c) Only statement (ii) is true.

   (d) Both statements (i) and (ii) are true.

2. Consider an A* search algorithm for which $g(n) = 0$. To which of the following search algorithms is this kind of A^* search equivalent?

   (a) Greedy best-first search

   (b) Depth-First Search

   (c) Breadth-First Search

   (d) None of the above.

3. Part of the description of a search problem are the state space, determining the vertices, and the set of possible actions, determining the edges; there is an edge from s to s' with label a, if there is an action a which leads from state s to state s'. These two together define the *search graph*. A cycle in the search graph is a vertex (state) s and a non-empty sequence of actions as such that if we start in s and execute the sequence of actions as then we will end up in s again. Consider the following statements:

   (i) If the Depth First Search Algorithm terminates on a given search problem then the corresponding search space contains no cycles.

   (ii) If the corresponding search space contains no cycles then the Depth First Search Algorithm terminates on the corresponding search problem.

   Which of the following claims is true?

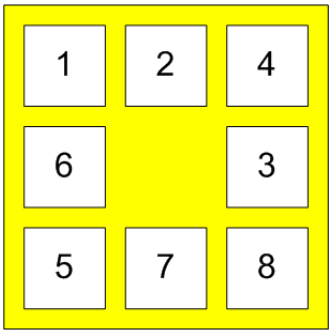
   (a) Both statements (i) and (ii) are false.

   (b) Only statement (ii) is true

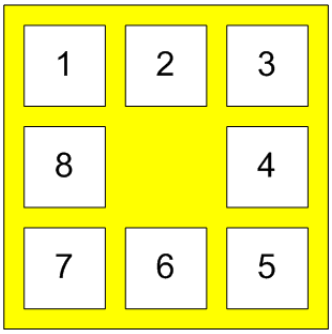
   (c) Only statement (i) is true

   (d) Both statements (i) and (ii) are true.

4. Consider the sliding puzzle below, with start and goal state as given.



Start state



Goal state

The legal actions are the sliding of a tile to a neighboring empty square. The cost of sliding a tile with number n to the empty square is n, so for instance in the above example the cost of sliding tile 2 to the empty square is 2.
A well known heuristic "cost to go" function h is the sum of the Manhattan distances of the tiles from their goal position. What is the h value of the initial state?

(a) 8

(b) 9

(c) 10

(d) 11

5. Assume that we apply A* search to the above sliding puzzle. Which node will be the **first** one that will be expanded after the initial node (node corresponding to the start state) of the search tree?

(a) The node corresponding to the state which arises from the initial state by moving tile 3 to the empty square.

(b) The node corresponding to the state which arises from the initial state by moving tile 7 to the empty square.

(c) The node corresponding to the state which arises from the initial state by moving tile 2 to the empty square.

(d) The node corresponding to the state which arises from the initial state by moving tile 6 to the empty square.

6. Once again consider the above sliding puzzle including the heuristic evaluation function h. h is called consistent if for every node n and every successor node n' of n generated by an action a the following holds:

$$h(n) \leq c(n, a, n') + h(n')$$

where $c(n, a, n')$ is the step cost of getting to n' from n by action a.
Now consider the following statements about h:

(i) h is admissible.

(ii) h is consistent.

Which of the above statements are true?

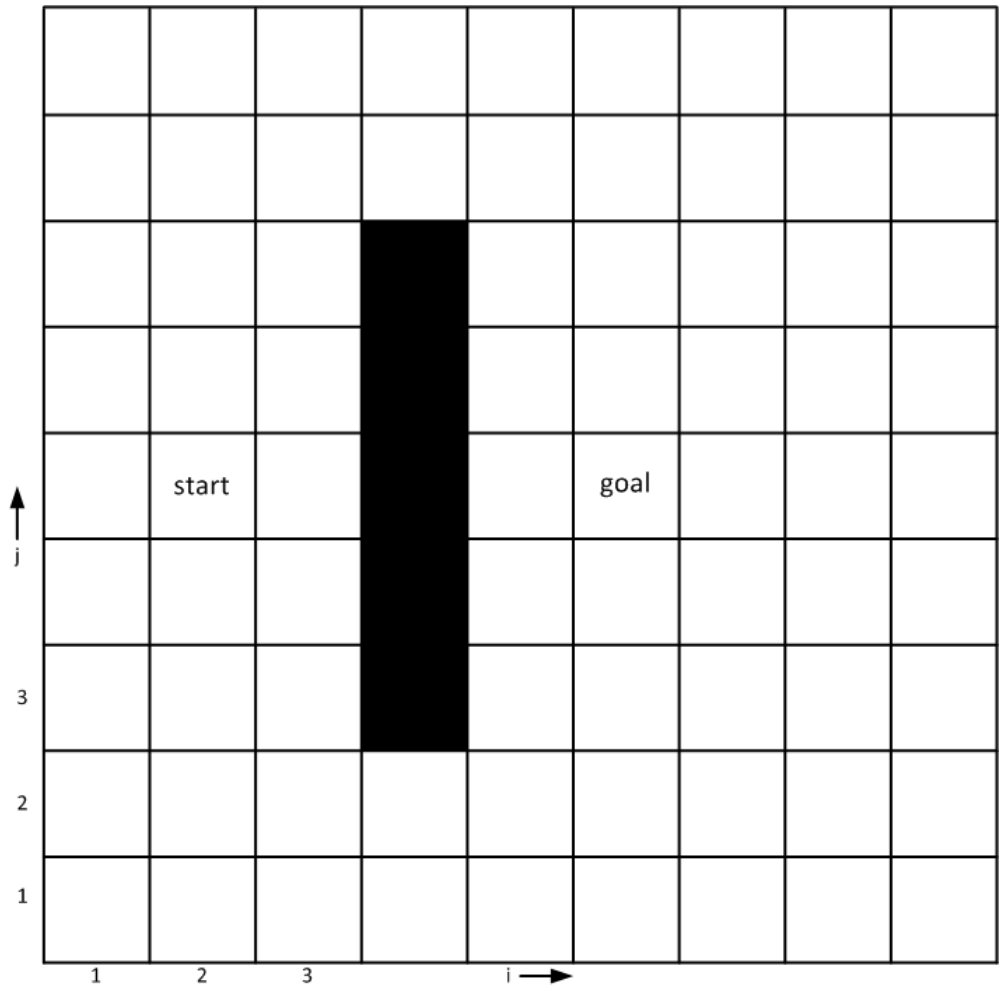
(a) Both hypothesis (i) and (ii) are true.

(b) Only hypothesis (ii) is true.

(c) Both hypothesis (i) and (ii) are false.

(d) Only hypothesis (i) is true.

7. Consider the following path finding problem in which an agent wants to go from the start cell $(2, 5)$ to the goal cell $(6, 5)$. The black cells with coordinates $(4, 3)$, $(4, 4)$, $(4, 5)$, $(4, 6)$ and $(4, 7)$ form a barrier which the agent cannot pass. Assume the agents applies greedy search. Which of the nodes will be in the `NewNode` list after 4 iterations of the search algorithm. **Zero or more answers could be correct: Mark them all!**



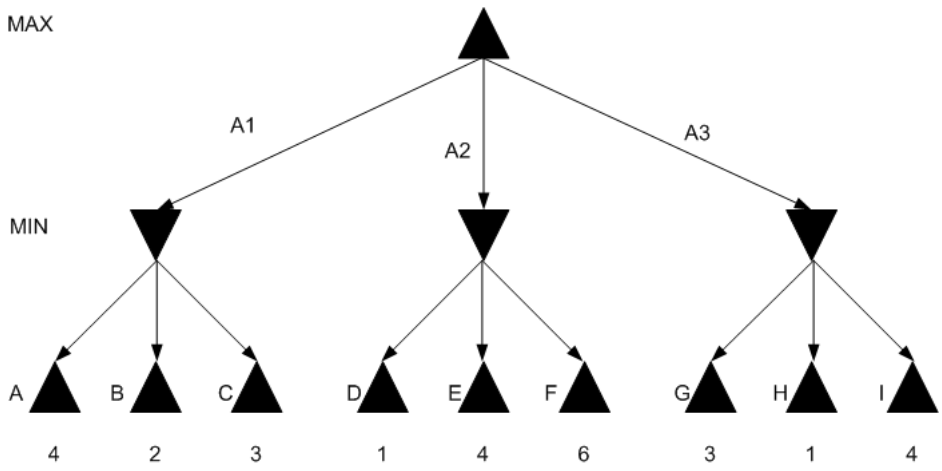
(a) node corresponding to cell (state) $(3, 7)$.

(b) node corresponding to cell (state) $(1, 5)$.

(c) node corresponding to cell (state) $(3, 5)$.

(d) node corresponding to cell (state) $(3, 6)$.

8. Consider the following part of a two-player game tree.



What will be the value of the top MAX node

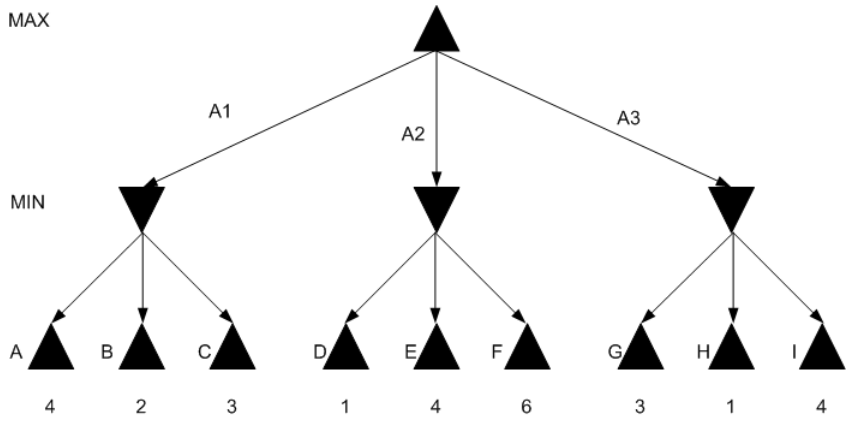
(a) 3

(b) 1

(c) 2

(d) 4

9. Once again consider the two-player game tree of question 8.



Assume one applies alpha-beta pruning. Which of the following collection of nodes will **all not** being explored?

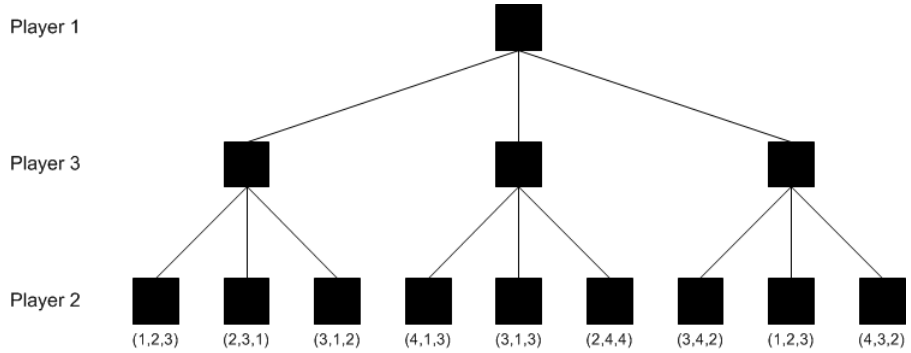
(a) $\{G, H, I\}$

(b) $\{F, H, I\}$

(c) $\{E, F, I\}$

(d) None of the above is correct.

10. Consider the following game tree for three players, player 1, 2 and 3.



At the lowest nodes the evaluation value of the relevant node is given (the value of the evaluation function) for each of the players. In the i position the evaluation value of the node for player i is given, $i = 1, 2, 3$. What will be the value for the top node?

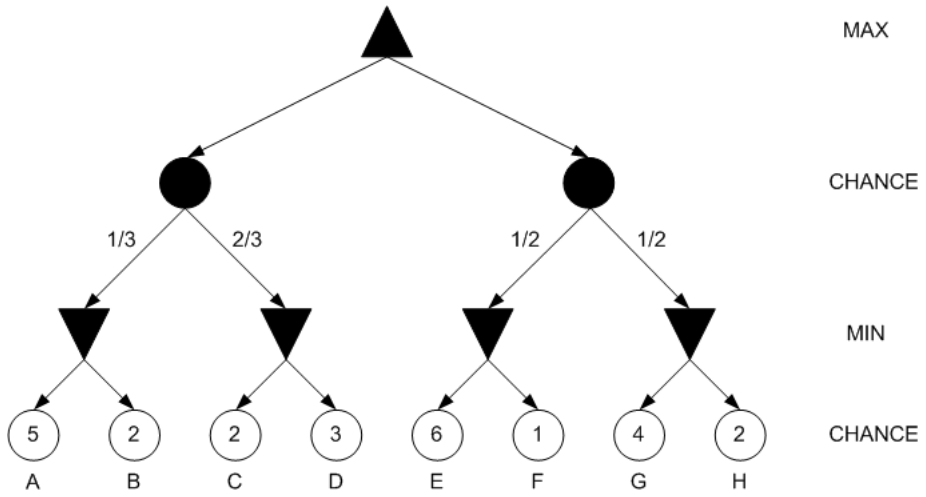
(a) (4,4,3)

(b) (2,4,4)

(c) (4,1,3)

(d) None of the above.

11. Consider the following two-player game tree in which the game has an element of chance, which is shown by the so-called probability nodes in the game tree.



What is the correct value for the top MAX-node if one applies the expectiminimax algorithm?

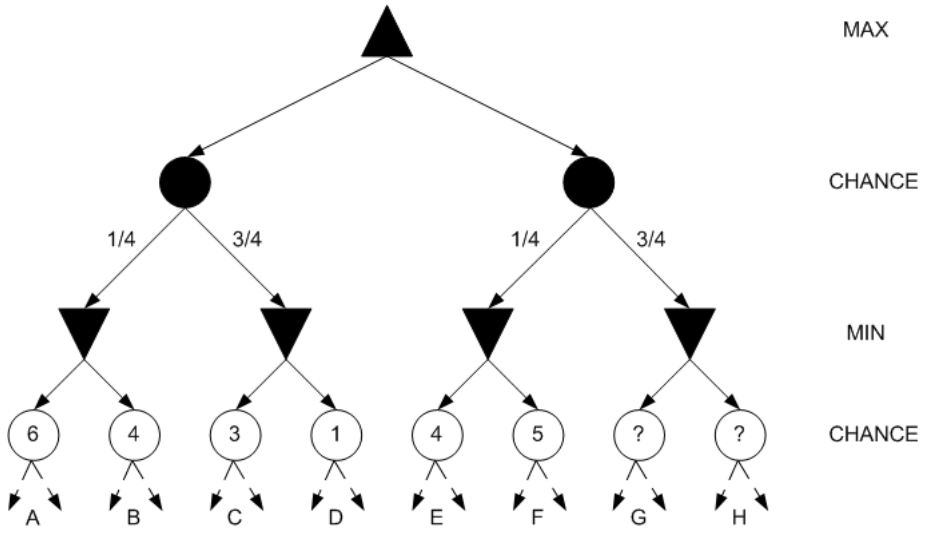
(a) 1

(b) 2

(c) 3

(d) 4

12. Consider the following game tree with an element of chance.



The letters under the bottom row of chance nodes are labels for the nodes just above the letter. One can also apply $\alpha - \beta$ pruning on this game tree. The numbers inside the chance nodes on the bottom row are the computed values of these chance nodes; ? indicates not computed yet. When is it **not** necessary to expand node H (to compute the value of node H)?

(a) If the value of node G is greater or equal to 1 then $\alpha - \beta$ pruning will **not** expand node H.

(b) $\alpha - \beta$ pruning will **never** expand node H.

(c) $\alpha - \beta$ pruning will **always** expand node H.

(d) If the value of node G is less than 1 then $\alpha - \beta$ pruning will **not** expand node H.