Midterm Exam
ARTIFICIAL INTELLIGENCE

Class: CS Honor 2010
Questions: 3 – Total mark: 10 – Time: 60 minutes
Open book

Question 1 (3 marks):
Consider the weighted graph in Figure 1, where A is the start node and F is the goal node, and the two following cost functions:
- \( g(n) \) = minimal sum of the weights of the edges of a path from the start node to node \( n \).
- \( h(n) \) = minimal number of the edges of a path from node \( n \) to the goal node.

In which order are the nodes visited using each of the following heuristic searching algorithms?
(a) Uniform Cost Search.
(b) Greedy Search.
(c) \( A^* \) Search.

Question 2 (3 marks):
Consider the 2-player game search tree of states with static heuristic values of the leaf nodes as shown in Figure 2. Suppose that, the smaller a heuristic value is, the better it is for the player who is going to make a move from the root node.
(a) According to the Minimax algorithm, which next state that player will choose?
(b) Using alpha-beta cut-off, which branches will be pruned in the search, assuming that the nodes are examined from left to right?

Question 3 (4 marks):
Consider a Blocks World that takes into account the block and robot arm positions. Assume that there are 2 positions on the table where a block can be placed, and the Start and Goal conditions are as in Figure 3. Initially, the robot arm is at position 1.
The robot can do one of the following actions in each step:
- Un-stacking a block $A$ from another block $B$; the robot arm must be currently at the same position as that of the two blocks.
- Stacking a block $A$ on another block $B$; the robot arm must be currently holding $A$ and at the same position as $B$'s one.
- Picking up a block from a position on the table; the robot arm must be currently at that position.
- Putting down a block to a position on the table; the robot arm must be currently at that position.
- Moving the empty robot arm from its current position to another position.
- Moving the robot arm holding a block from its current position to another position.

(a) Specify the Start and Goal conditions using predicate logic. (1 mark)
(b) Give specifications of the six actions described above with the precondition, add-list, and delete-list for each of them. (1.5 marks)
(c) Apply Goal Stack Planning, trace the steps followed to make a plan for the given Block World, showing the stack contents in each step. For not drawing too many stack images, you can group consecutive steps of obvious sub-goal satisfaction into one step. (1.5 marks)