

Department of Computer Science – UWO  
**CS346a — Artificial Intelligence**  
 SAMPLE MIDTERM EXAM

Two hours, close book/notes. Total mark: 60 (will scale down to 25).

1. AI and the Turing Test (10 points)

Can you think about some intelligent aspect of humans that the standard Turing Test does not cover? Try to improve the standard Turing Test to cover it.

2. A\* Search Algorithm (20 points)

The following graph represents a search space. The circles represent states, S is the initial state and the shaded circles represent the goal. Arrowed links represent operators; numbers on the links are their costs, and numbers in circles are values of a certain heuristic function of those states.

- a). Write down the order of nodes searched (expanded) each with the content of the queue in finding a solution using the A\* search algorithm ( $f = g + h$ ).
- b). Is the the above heuristic function admissible? Explain.

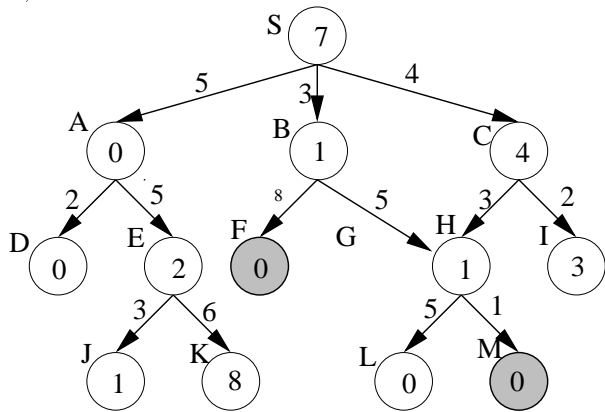


Figure 1: Figure for Q 2

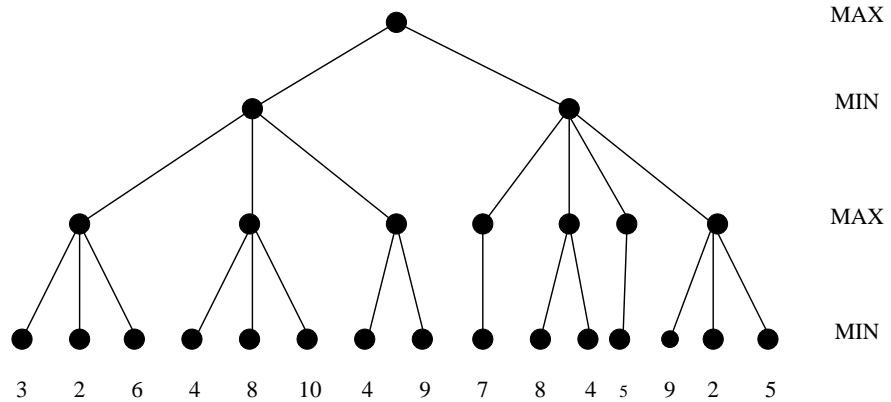


Figure for Q 4

3. Use Search to Solve Problems (15 points)

The following problem is given to elementary-school kids to solve: *?’s below represent the 9 different integer numbers from 1 to 9 and satisfy the three equations:  $? + ? = ?$ ,  $? - ? = ?$ ,  $? * ? = ?$ . What are these ?’s? How to formulate this problem as a search problem (state, operators, goal, constraints, etc.)? What heuristics would you use? How to apply iterative improvement algorithm (such as the hill-climbing) to solve it?*

4. (15 points) Game Tree and Alpha-beta Pruning

The figure shows an *underlying* game tree. Numbers on the leaves are the heuristic evaluation values of the board positions. 10 means MAX wins, 0 means MAX loses.

- a). Assume that the tree is searched in the left-to-right, depth-first order with alpha-beta pruning. What branches will be pruned?

- b). Which move should MAX take?

(Note: label the evaluation values of the nodes in the tree to show how you get your results. You can label on the exam sheet.)

- c). In what cases (give generalized examples) alpha-beta pruning does not save any search time, and in what cases it saves the most?