1st Midterm Exam

Thursday March 1
75 minutes – open book and notes
100 points plus 10 points extra credit

1. *15 points*
   Answer the following questions briefly but precisely:

   1. Can an agent that keeps no history of its percept sequence be rational? Please explain.
   2. Why is it better to design performance measures for an agent according to effects in the environment instead of behaviors of the agent?

2. *25 points*
   Consider the following problem: you are given a path of N white and black squares. The exact configuration of white and black squares and the length of the path vary with the instance of the problem you are given to solve. An example with N=18 might look like this:

   You start on the left-most square and the goal is to move off the right end of the path in the least number of moves. The rules for moving are:

   1. if you are on a white square, then you can move either 1 or 2 squares to the right;
   2. if you are on a black square, then you can move either 1 or 4 squares to the right.

   Answer the following questions. Explain briefly your reasoning:

   1. Describe how you would represent the state space, including the states, successor function, and goal test.
   2. Is the search space a tree or a graph?
   3. What is the branching factor?
   4. Propose a non trivial heuristic ($h = 0$ is not allowed) for the problem and specify if it is admissible and consistent.

3. *10 points*
   Answer the following questions on Uniform Cost search briefly but precisely:

   1. Is it possible for Uniform Cost to expand more nodes than Depth-First search? Feel free to use an example to support your answer.
   2. Does Uniform Cost search expand more nodes than A*? Why (or why not)?

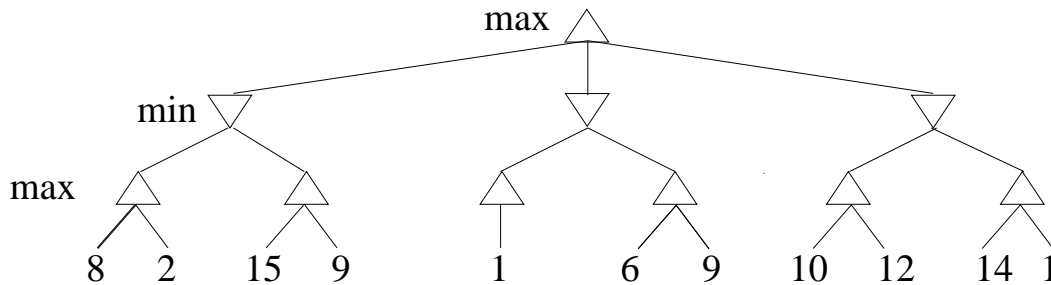TURN TO THE NEXT PAGE FOR MORE QUESTIONS

4. *25 points*

   Answer the following questions explaining your reasoning briefly but precisely.

   1. Why any node in OPEN with $f(n) < f^*(n)$ (the cost of the optimal solution path) will eventually be selected for expansion by A*?
   2. Is it true that all admissible heuristics are equal in the sense that A* will search the states in the same order no matter what the heuristic is?
   3. In what sense is IDA* preferable to A*?
   4. Is Breadth-First search complete if the state space has infinite depth but a finite branching factor?
   5. Does the fact that A* is "optimally efficient" mean that A* will never expand more nodes than any other algorithm?

5. *15 points*

   Show the backed-up values for the nodes in the following game tree and show the branches that are pruned by alpha-beta pruning. For each branch pruned, write down the condition that is used to do the pruning. Follow the convention used in the textbook to examine the branches in the tree from left to right.

6. *10 points*

   Suppose you decide to use the following strategy to evaluate a position in a two-player game: for each move the program plays against itself in a very large number of games making random moves until one side wins. The percentage of wins is used to evaluate the position. Is this a reasonable strategy or not? Explain your reasoning.

7. *10 points* EXTRA CREDIT

   1. You are given an admissible h function. Suppose you replace $h(n)$ with $\tilde{h}(n) = C \times h(n)$ where C is an arbitrary constant > 1. Is A* using $\tilde{h}(n)$ still guaranteed to find an optimal solution? Why (or why not)? Explain your reasoning.
   2. Suppose that instead you replace $h(n)$ with $\hat{h}(n) = C + h(n)$ Is A* using $\hat{h}(n)$ still guaranteed to find an optimal solution? Why (or why not)? Explain your reasoning.

YOU REACHED THE END OF THE EXAM