COMPSCI 383 – Fall 2022

Homework 2 Primer

Due Wednesday, October 12th at 11:59pm ET

You are encouraged to discuss the assignment in general with your classmates, and may optionally collaborate with one other student. If you choose to do so, you must indicate with whom you worked. Multiple teams (or non-partnered students) submitting the same solutions will be considered plagiarism.

Understanding Adversarial Search Basics

This assignment is intended to help you build some intuition for how adversarial search strategies work, what assumptions they make, what computational limits they encounter, and what types of things we can or cannot guarantee about their behavior.

Grading

We will grade your answers based on whether they demonstrate an understanding of the concepts in each question. Some questions have more than one correct answer. We will award partial credit for answers that show partial understanding.

What to Submit

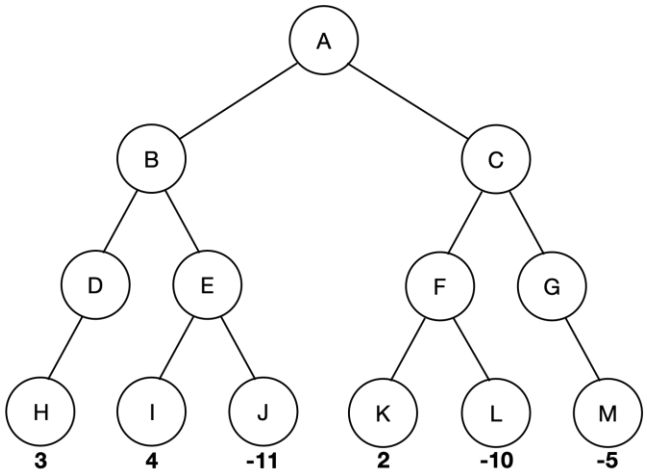
You should submit a file named `homework2primer.pdf`, containing your answers to the questions. You can record your answers on this document (preferred) or create your own.

Questions

1. If at every game state there are b possible actions for each agent, and the maximum total number of moves in a single game is d, how many states will Minimax need to consider in order to compute the optimal move assuming no pruning? You can give an exact answer or provide a Big-O approximation.
   The amount of states that Minimax will need to consider to compute the optimal move is about b^d moves.

2. What would the above quantity be for a Connect-383 game played with m rows and n columns? Write your answer in terms of m and n rather than b and d.

3. The game tree on the right shows the state space for a two-player game. The numbers below the leaf nodes show the utility values of the terminal states. At starting state A, it is Player 1's turn (the MAX player).



(a) What is the Minimax value of state A?

(b) Assume that the states are explored in a depth-first, left-to-right fashion, which states (if any) will not be explored by the Minimax algorithm using alpha-beta pruning (with no lookahead limit)? Briefly explain your answer.

(c) What is the Minimax value of state A if pruning is used as in (b)?

(d) The table below shows some of the values obtained from two evaluation functions $\mathbf{e_1}$ and $\mathbf{e_2}$. Which is the better function for Player 1 to use in order to win the game if

evaluating the state space with a depth limit of 2? Explain your answer. (1-2 sentences)

x	$e_1(x)$	$e_2(x)$
D	4	2
E	-2	-2
F	1	2
G	-3	1

(e) In general, given two evaluation functions used for lookahead-limited Minimax, how can we determine which one will perform better? How might we use the true utility function to determine this? (1-2 sentences)

(f) If the maximum and minimum possible scores in a game are 100 and -100, respectively, what is the largest possible range of the evaluation function? Explain why allowing the evaluation function to take values outside of this range might hurt the performance of minimax. (1-2 sentences)