COMPSCI 383 – Spring 2021

Homework 2 Primer

Due Monday, March 1st 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. Name three properties of a game that must be true in order to use “basic” (non-stochastic) Minimax. (Hint: there are at least seven.)

2. Based on your answer to (1), give an example of a game where basic Minimax is not applicable.

3. If at every game state there are b possible actions for each agent, and the maximum total number of moves in a single match is d, how many states will Minimax need to consider in order to compute the optimal move?

4. Briefly describe (1-2 sentences) the similarities and differences between the evaluation functions used for lookahead-limited adversarial search and the heuristic functions used in search algorithms like A*?

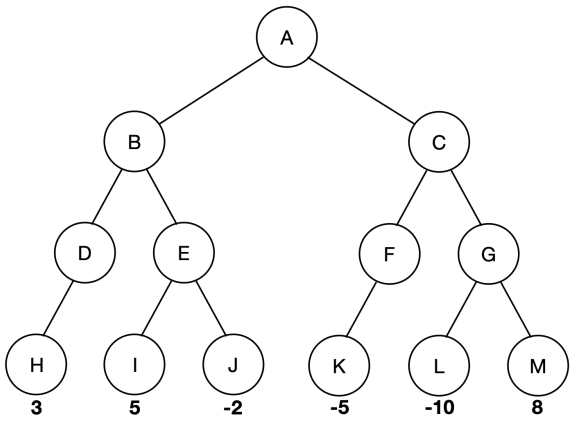
5. Given two evaluation functions used for lookahead-limited Minimax, how can we determine which one will perform better? How might we use the true utility function to determine this?

6. 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.

7. Consider agents A and B, which both use regular minimax. If agent A limits its search depth to d moves and agent B limits its search to d+1 moves, and they both use the same evaluation function, which agent will likely perform better? Explain your reasoning.

8. Consider Agent A, which uses regular minimax, and Agent B, which uses alpha-beta pruning. If both agents limit their search depth to d moves and use the same evaluation function, will one agent play better than the other? If so, which one? If not, why not?

9. 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) 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 in 1-2 sentences.

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

(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.