CSE 412A Spring 2022 Introduction to Artificial Intelligence — Exercise 5

- You have approximately as many minutes as there are points.
- Mark your answers ON THE EXERCISE ITSELF. If you are not sure of your answer you may wish to provide a *brief* explanation. All short answer sections can be successfully answered in a few sentences AT MOST.
- For True/False questions, please *circle* your answer.

First name	
Last name	
WUSTL ID	

For staff use only:

Q1.	Adversarial Search	/20
	Total	/20

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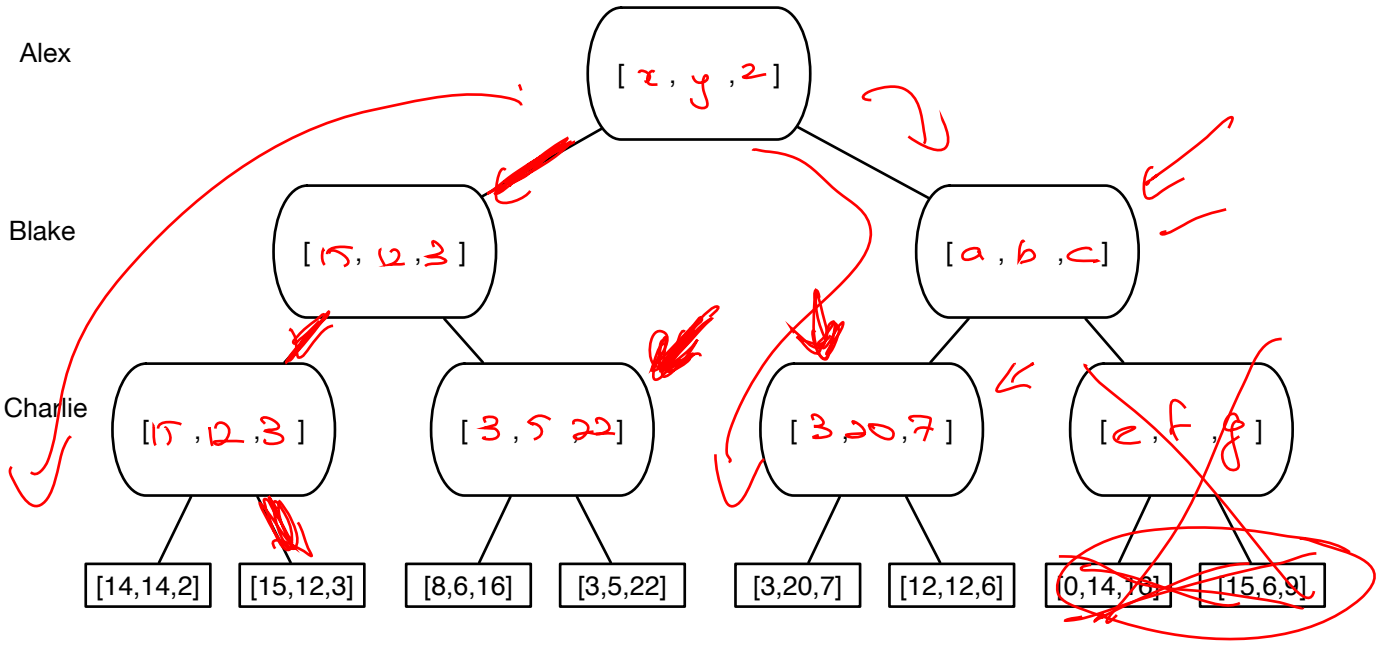
Q1. [20 pts] Adversarial Search

Alex, Blake, and Charlie are three friends who are trying to decide how to strategically divide the 30 Halloween candies that they have collected. They finally decided to use a candy shuffler, which takes in a set number of candies and groups them into three batches, one for each player. The candy shuffler has three levers (with either "up" or "down" position), and the three levers combined determine how the candies are distributed among the three players.

After putting their 30 cookies into the shuffler, Alex will pull the first lever, followed by Blake who will pull the second lever, and finally Charlie will pull the last lever. The utility triples (= outcomes) after all three levers are pulled are shown in the game tree below, where left branches correspond to "up" positions and right branches correspond to "down" positions. For example, if all three players pulled their levers to the "up" positions, then the utility triple is $[14, 14, 2]$, which means that Alex gets 14 candies, Blake gets 14 candies, and Charlie gets 2 candies.

Assume all players want to maximize their own number of candies. Further, no candies are lost in the process. So, the sum of candies of all three players must equal 30.

(a) [7 pts] Fill in the utility triples in all the nodes in the game tree below.



(b) [3 pts] What is the optimal action of each player? Highlight the corresponding branch in the game tree above.

(c) [5 pts] Assuming that you expand nodes on the left before nodes on the right, is it possible to prune parts of the game tree while still guaranteeing that the optimal utility triple is propagated to the root and the optimal actions are found for all players?
If yes, cross out all the nodes that are pruned and explain why those nodes are pruned.
If not, explain why pruning is not possible.

$x = \max(15, a) \Rightarrow x = 15$
$b = \max(20, f) \Rightarrow b \geq 20$
$a + b + c = 30 \quad a \leq 10$

(d) Each question is worth 1 point. Leaving a question blank is worth 0 points. **Answering a question incorrectly is worth −1 point.** This gives you an expected value of 0 for random guessing.

(i) [1 pt] [*true* or *false*] With identical tie-breaking strategies, minimax search is guaranteed to return the exact same solution as alpha-beta search.

(ii) [1 pt] [*true* or *false*] When playing against a random agent, minimax will compute an optimal solution.

(iii) [1 pt] [*true* or *false*] Minimax is a natural choice for modeling poker.

(iv) [1 pt] [*true* or *false*] An evaluation function for expectimax must always return positive values.

(v) [1 pt] [*true* or *false*] Expectimax solutions are guaranteed to always perform better on average (i.e., it gets a higher utility when playing the same game a very large number of times) than minimax solutions.