Foundations of Artificial Intelligence

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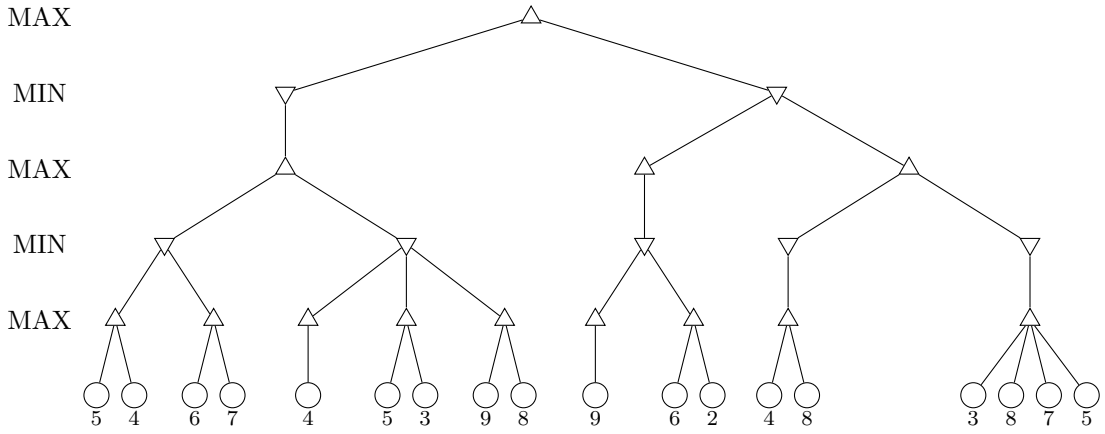
Exercise Sheet 12

Due: May 20, 2020

Important: For submission, consult the rules at the end of the exercise. Non-adherence to the rules will lead to your submission not being corrected.

Exercise 12.1 (2+4 marks)

Consider the following game tree:

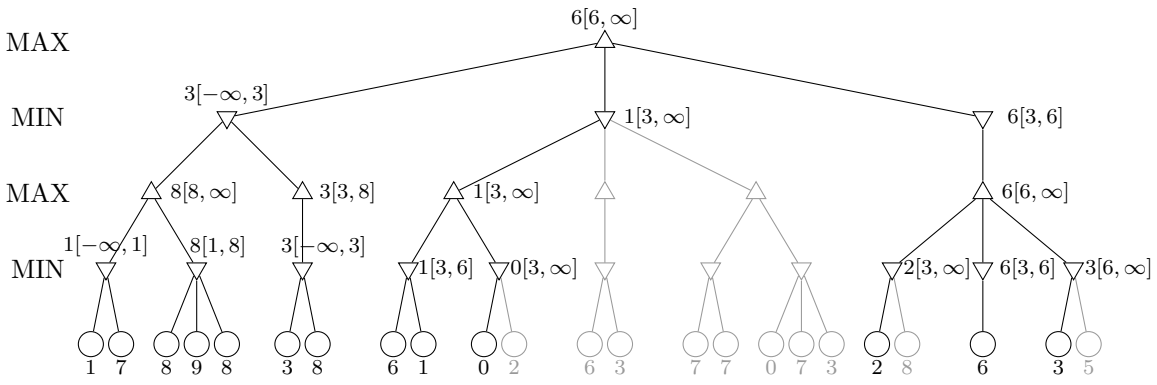


(a) Use the minimax algorithm to annotate the game tree. Successor nodes should be considered from left to right. According to the values computed by the minimax algorithm, what is a possible playout of the game tree?

(b) Use alpha-beta search for the game tree. As for part a), successor nodes should be considered from left to right. Annotate all considered nodes with the returned value as well as the (last) alpha and beta values, and show which parts of the tree can be pruned (e.g., by drawing cut lines through edges which lead to subtrees that do not need to be considered). How many nodes does alpha-beta search need to consider? Discuss the difference compared to part (a).

Exercise 12.2 (3 marks)

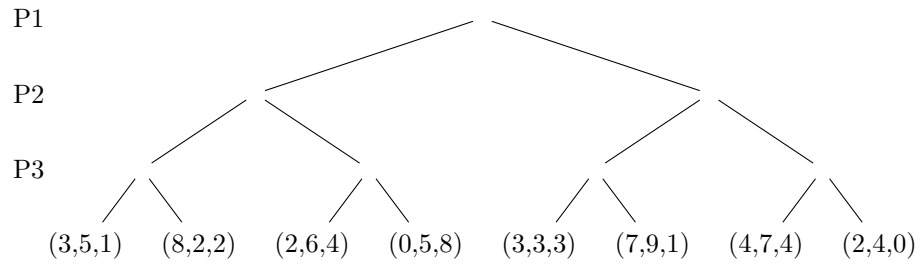
Consider the following alpha-beta search:



Reorder the game tree (without altering the game) such that alpha-beta search prunes the maximum possible amount of nodes. Draw the reordered game tree and again annotate all considered nodes with the returned value as well as the (last) alpha and beta values, and show which parts of the tree can be pruned (e.g., by drawing cut lines through edges which lead to subtrees that do not need to be considered). How many nodes does alpha-beta search need to consider? How does this compare to alpha-beta search with the original order?

Exercise 12.3 (3 marks)

Consider an extension of the concept of game trees to three players, where the game is not necessarily zero-sum. We assume that there are no alliances allowed between any players. The players are now called P1, P2, and P3. In contrast to two player zero-sum games, the evaluation of a position now is a triple (u_1, u_2, u_3), where u_i is the utility for player i. All players aim to maximize their own utility, and the utility of the two other players is irrelevant for each player. Annotate all inner nodes of the following game tree with triples (u_1, u_2, u_3) containing the utility for each player under the assumption that all players play perfect. Mark the best moves.



Submission rules:

- Upload a single PDF file (ending .pdf). If you want to submit handwritten parts, include their scans in the single PDF. Put the names of all group members on top of the first page. Use page numbers or put your names on each page. Make sure your PDF has size A4 (fits the page size if printed on A4).
- Only upload one submission per group. Do not upload several versions, i.e., if you need to resubmit, use the same file name again so that the previous submission is overwritten.