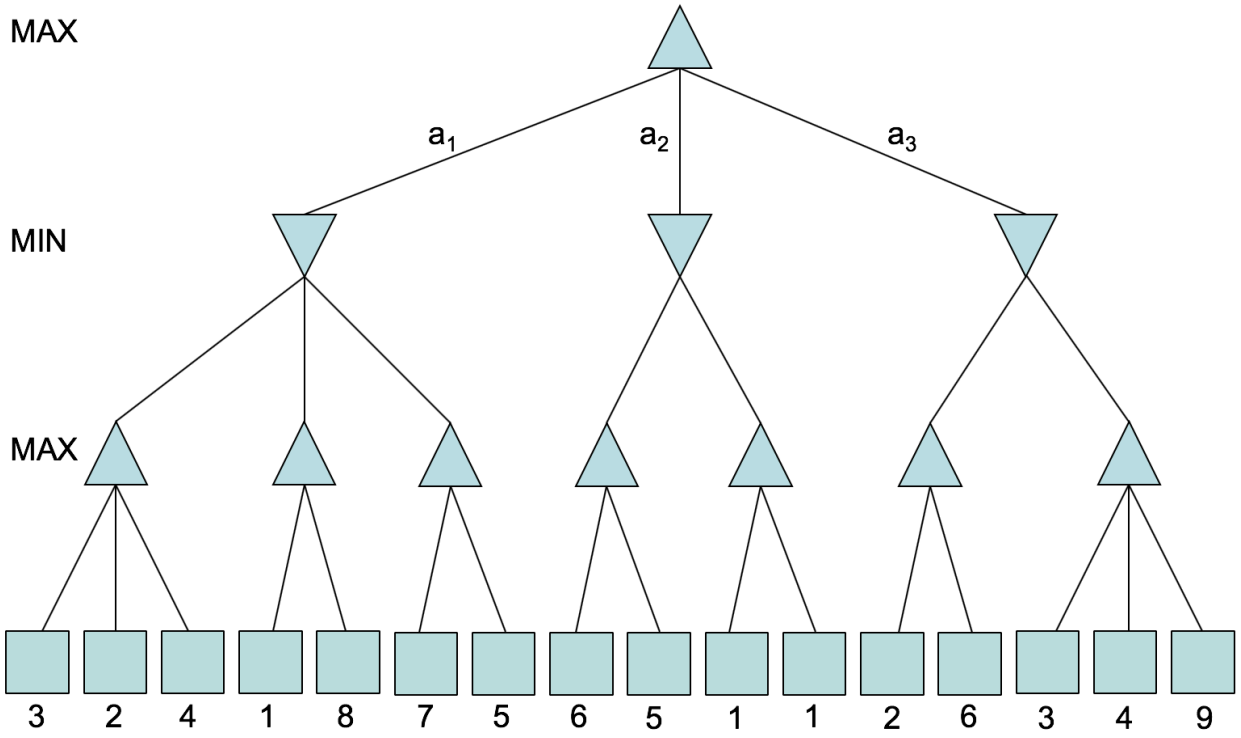
Washington State University
School of Electrical Engineering and Computer Science
Fall 2018

CptS 440/540 Artificial Intelligence
Homework 4 Solution
Due: September 20, 2018 (11:59pm)

General Instructions: Put your answers to the following problems into a PDF document and submit as an attachment under Content → Homework 4 for the course CptS 440 Pullman (all sections of CptS 440 and 540 are merged under the CptS 440 Pullman section) on the Blackboard Learn system by the above deadline. Note that you may submit multiple times, but we will only grade the most recent entry submitted before the above deadline.

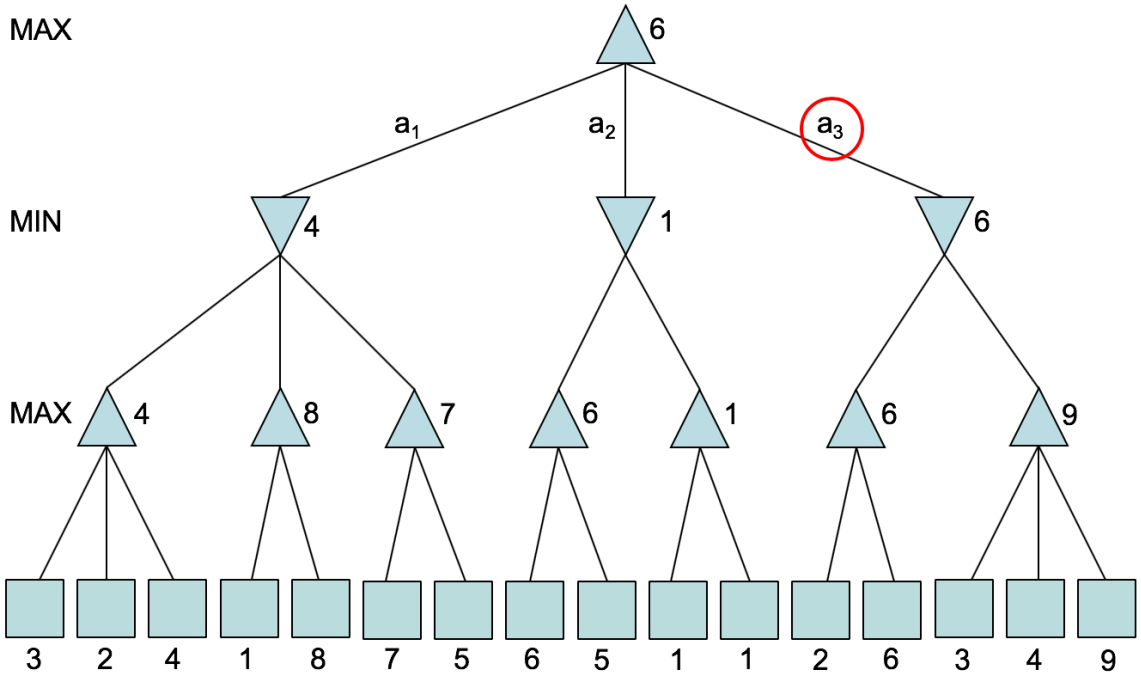
1. Consider the following game tree. Upward-pointing triangles are MAX nodes, downward-pointing triangles are MIN nodes, and squares are terminal nodes. Put an "X" over each node that is pruned, i.e., not evaluated (including all nodes in a pruned subtree). Put the final value next to all other nodes. Finally, indicate which action MAX should take: a_1, a_2 or a_3.



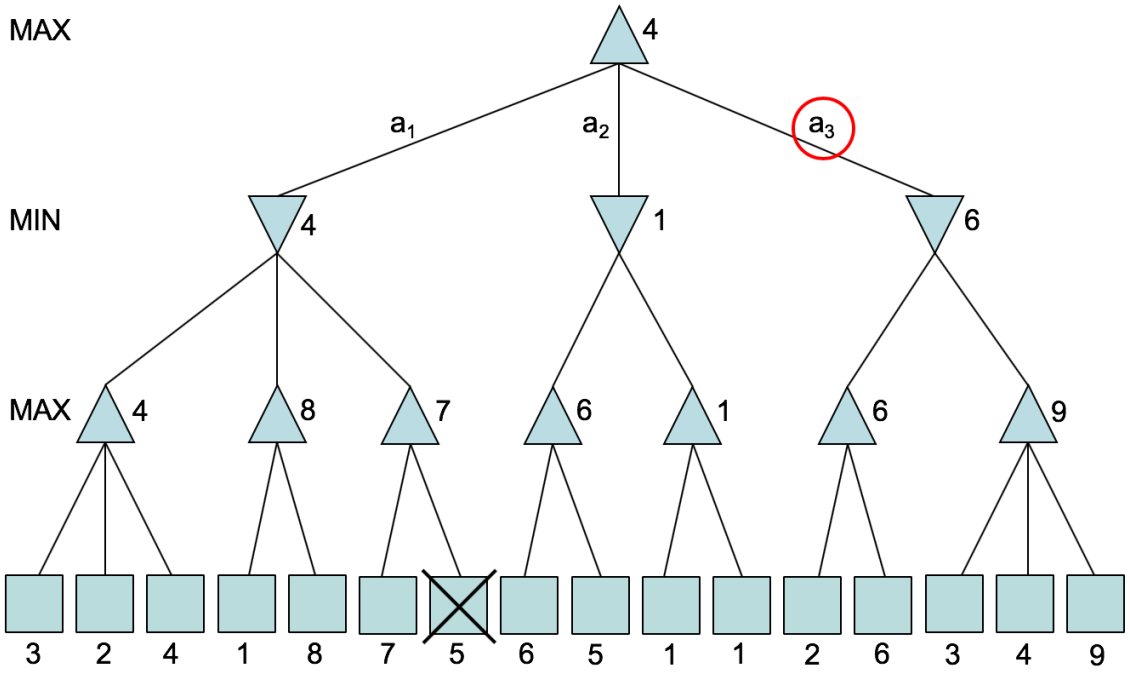
a. Perform Minimax-Decision search on the above tree. Put the final value next to each node in the tree. Finally, indicate which action MAX should take: a_1, a_2 or a_3.
b. Perform Alpha-Beta-Search on the above tree (don't reuse your tree from part (a)). Put an "X" over each node (internal or terminal) that is pruned, i.e., not evaluated (including all nodes in a pruned subtree). Put the final value next to all other nodes. Finally, indicate which action MAX should take: a_1, a_2 or a_3.
c. *CPTS 540 Students Only*: The sequence of utility values on the terminal nodes, from left to right, is: 3,2,4,1,8,7,5,6,5,1,1,2,6,9,3,4. Using these same sixteen utility values, how would you rearrange them on the terminal nodes in order for Alpha-Beta-Search to prune the maximum number of nodes in the tree?

Solution:

a. MAX should take action a_3.



b. The Alpha-Beta-Search prunes one node. MAX's best action is still a_3.



c. The order leading to the most pruning is to assign one of the first three leaf nodes the value of 7, and then the fourth and sixth leaf nodes should get the values of 8 and 9 (or 9 and 8). Since the top-most MAX will then have a choice (a_1) leading to a value of 7, then anytime MIN has a choice less than 7, there is no reason to continue searching in MIN's subtree. Since the remaining utility values (represented by v) are all less than 7, they can be assigned in any order among the v's in the figure below. This arrangement leads to pruning nine total nodes during Alpha-Beta-Search.