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MATH. - NATURWISS. FAKULTÄT
FACHBEREICH INFORMATIK
KOGNITIVE SYSTEME · PROF. A. ZELL

Artificial Intelligence

Assignment 7

Assignment due by: 17.12.2021

Question 1 Minimax (3+1+2=6 points)

Two players, MAX and MIN, are playing a game against each other with a pile of six wooden matchsticks. Each time a player removes one or two matchsticks from the pile. The game ends when a player loses $i.e.$ the player can not remove the matchsticks.

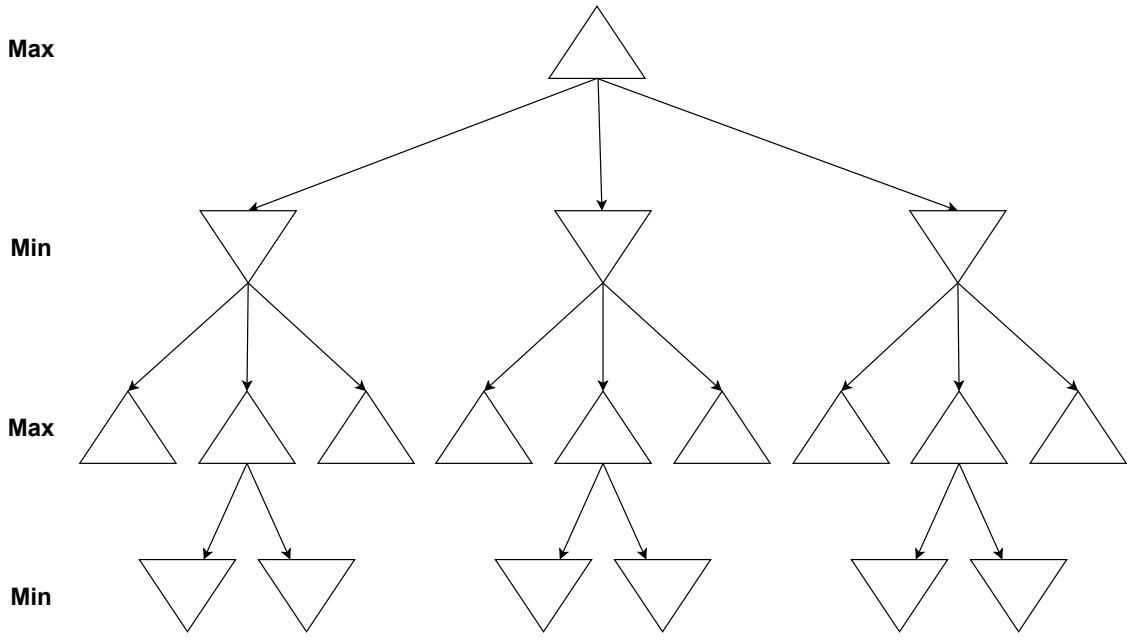
(a) Build the entire search tree for the game when MAX plays first.

(b) For each leaf node, enter a $+1$ if player MAX wins or a -1 if player MIN wins.

(c) Propagate the Minimax values up the tree and see which player wins.

Question 2 Alpha-beta pruning I (2+3+3=7 points)

Consider the following search tree:



(a) Distribute integers from 1 to 12 on the leaves of the tree so that alpha-beta pruning does not prune a single leaf. Explain the choice of your distribution.

(b) Distribute integers from 1 to 12 on the leaves of the tree so that alpha-beta pruning prunes exactly 6 leaves. Explain the choice of your distribution.

(c) How many leaf nodes at most can you prune of a full binary tree having a total number of 15 nodes? Draw an example of such a tree with integers $1...8$ as leaf node values.

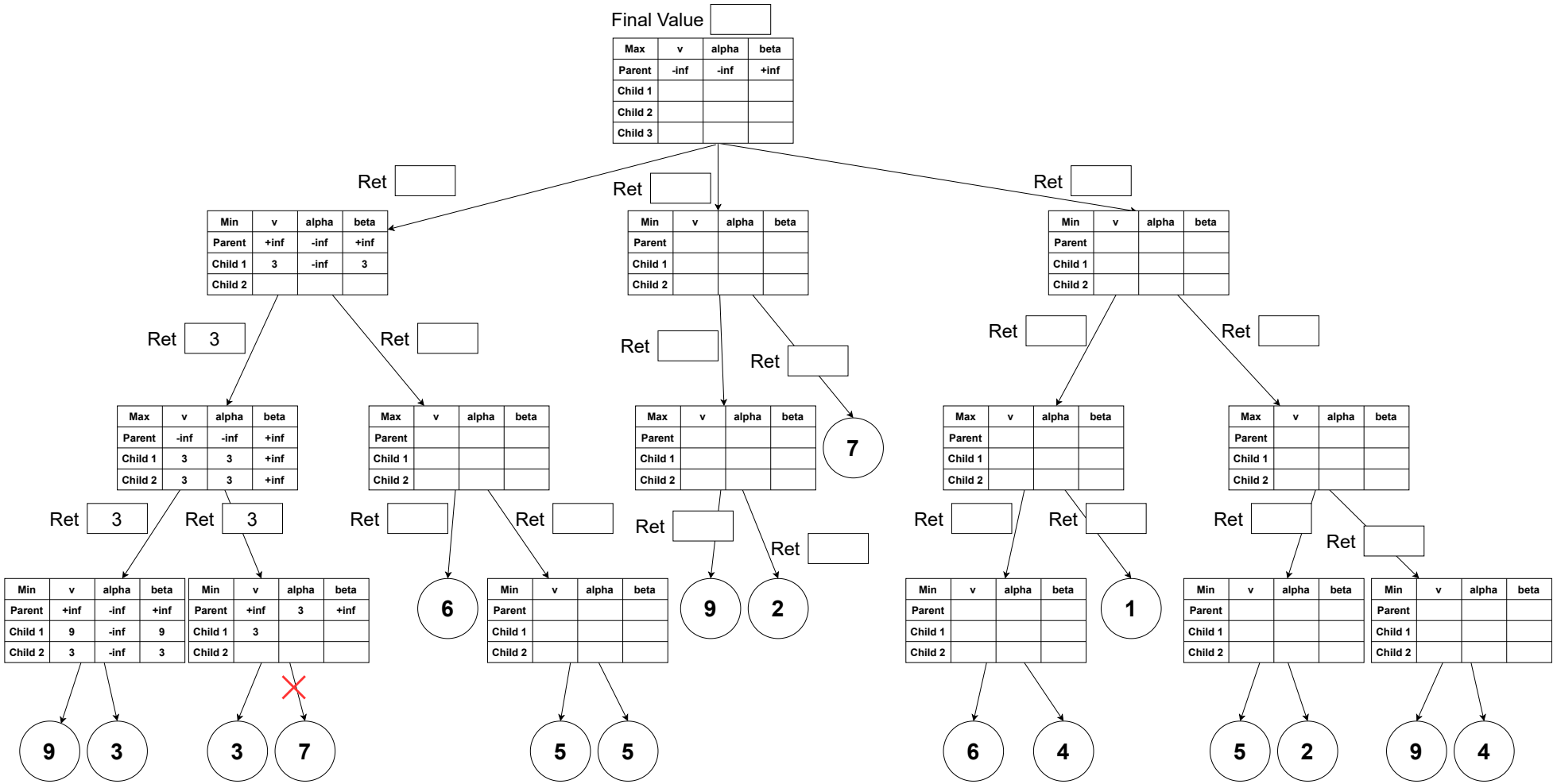
Question 3 Alpha-beta pruning II (2+5=7 points)

The search tree, shown on next page, is the representation of a game, where MAX should make a move. Therefore:

(a) Write down the minimax values for each node. Which path should MAX choose?

(b) Apply the alpha-beta pruning algorithm to fill in the information on each node. You should identify when and which values (v, α, β) should be written down. Which parts of the tree do get pruned?
Notes:

- Ret: returned value.
- X: pruned section.


Final Value
Max v alpha beta
Parent -inf -inf +inf
Child 1
Child 2
Child 3
Ret
Min v alpha beta
Parent +inf -inf +inf
Child 1 3 -inf 3
Child 2
Ret 3
Max v alpha beta
Parent -inf -inf +inf
Child 1 3 3 +inf
Child 2 3 3 +inf
Ret 3
Ret 3
Min v alpha beta
Parent +inf -inf +inf
Child 1 9 -inf 9
Child 2 3 -inf 3
9
3
Min v alpha beta
Parent +inf 3 +inf
Child 1 3
Child 2
3
7
6
Min v alpha beta
Parent
Child 1
Child 2
5
5
7
9
2
1
6
4
5
2
9
4