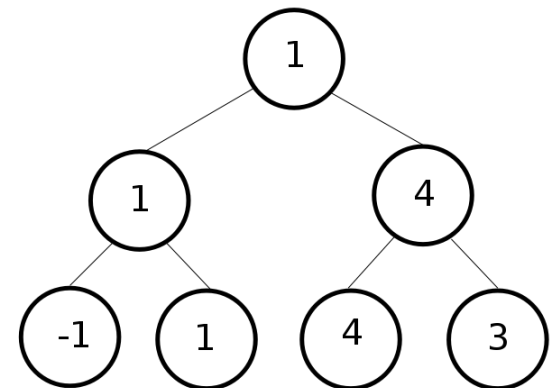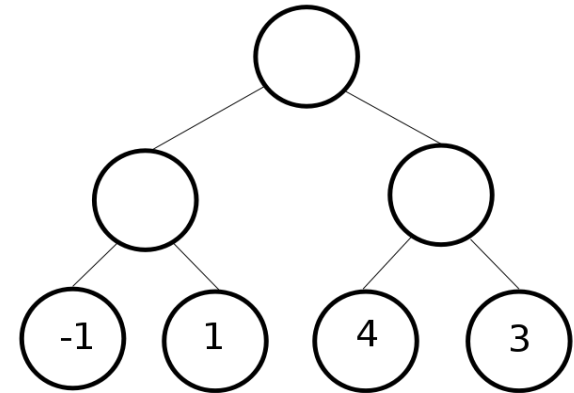# Minimax

Gwylim Ashley

Game tree

•Minimax can be applied to two player, non-random games where players alternate

•It is possible to construct a tree representing possible moves and resulting states

•Selecting the best move for each player in each state, it is possible to determine the worst possible outcome for a player using an optimal strategy

Example - Nim

Rules

- There are a number of heaps of objects
- A player must remove one or more objects from a heap on their turn
- If they can not, they lose

Solution

- Xor the number of objects in each heap, if 0, then this is a losing position, otherwise, it is a winning position
- A losing position is one in which it is only possible to move to a winning position
- A winning position is one in which it is possible to move to a losing position
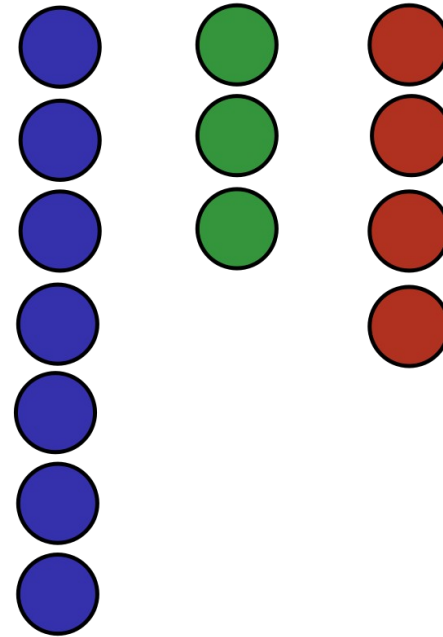
111
011
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DP Example - Ioiwari

Game is played on a circular board with 7 holes around the edge and 20 beads distributed in the holes. Each player has a bank representing their score

On their turn, a player takes the beads from a hole, and for each other hole in a clockwise direction:

1.If one bead in his hand, and the hole has 1-4 beads, put them and the one in his hand into the bank

2.If one bead in his hand, and the hole has 0 or 5 beads, put the one in his hand into the opponents bank

3.Otherwise if the hole has 5 beads, one is placed into his bank

4.Or if the hole has less than 5, one bead from his hand is placed into the current hole

There are only 6^7 possible arrangements of beads, so the game can be solved by memoization
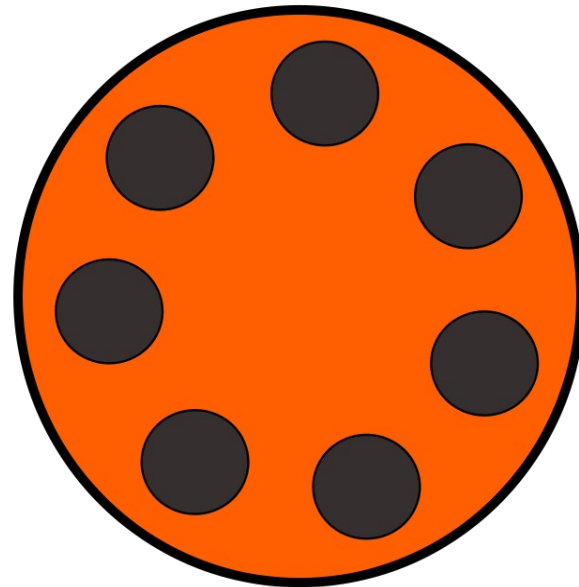
Alpha-Beta pruning

•If one branch is guaranteed to be worse than another, it can be discarded
•This is possible due to the fact that there are two players