CS444

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Minimax!

1: **procedure** MINIMAX(N)
2:    **Inputs**
3:      N a node in a game tree
4:    **Output**
5:      The value for node N
6:    **if** N is a leaf node **then**
7:      **return** value of N
8:    **else if** N is a MAX node **then**
9:      $v \leftarrow -\infty$
10:      **for all** children C of N **do**
11:        $v \leftarrow \max(v, Minimax(C))$
12:      **return** v
13:    **else**
14:      $v \leftarrow \infty$
15:      **for all** children C of N **do**
16:        $v \leftarrow \min(v, Minimax(C))$
17:      **return** v

Alpha Beta Pruning

1: **procedure** Max-Value(N, α, β)
2:     **Inputs**
3:        N a node in a game tree
4:        α value of best known option for Max
5:        β value of best known option for Min
6:     **Output**
7:        The value for node N
8:     $v \leftarrow -\infty$
9:     **for all** children C of N **do**
10:        $v \leftarrow \max(v, \text{Min-Value}(C, \alpha, \beta))$
11:        **if** $v \geq \beta$ **then**   ▷ *Min will not allow this outcome!*
12:           **return** v
13:        $\alpha \leftarrow \max(\alpha, v)$
14:     **return** v

(This is slightly different from the formulation in our book...)

Alpha Beta Pruning

1: **procedure** MIN-VALUE(N, α, β)
2:     **Inputs**
3:         N a node in a game tree
4:         α value of best known option for Max
5:         β value of best known option for Min
6:     **Output**
7:         The value for node N
8:     $v \leftarrow \infty$
9:     **for all** children C of N **do**
10:         $v \leftarrow \min(v, \text{Max-Value}(C, \alpha, \beta))$
11:         **if** $v \leq \alpha$ **then**   ▷ *Max will not allow this outcome!*
12:             **return** v
13:         $\beta \leftarrow \min(\beta, v)$
14:     **return** v

(This is slightly different from the formulation in our book...)

Status of Games

Three main categories:

- "Solved"
  - tic-tac-toe
  - Checkers
- Best computer player is better than the best human player
  - Chess
  - Othello
  - Go (as of March 2016)
  - Some versions of poker (?)
- Best human players are better than the best computer players
  - Some versions of poker (?)