

# The $\alpha$ - $\beta$ algorithm

**function** ALPHA-BETA-SEARCH(*state*) *returns an action*

**inputs:** *state*, current state in game

$v \leftarrow \text{MAX-VALUE}(state, -\infty, +\infty)$

**return** the *action* in SUCCESSORS(*state*) with value  $v$

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**function** MAX-VALUE(*state*,  $\alpha$ ,  $\beta$ ) *returns a utility value*

**inputs:** *state*, current state in game

$\alpha$ , the value of the best alternative for MAX along the path to *state*

$\beta$ , the value of the best alternative for MIN along the path to *state*

**if** TERMINAL-TEST(*state*) **then return** UTILITY(*state*)

$v \leftarrow -\infty$

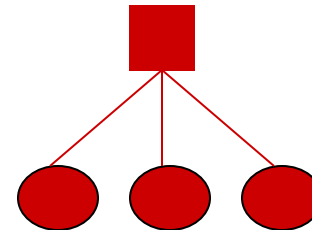
**for**  $a, s$  in SUCCESSORS(*state*) **do**

$v \leftarrow \text{MAX}(v, \text{MIN-VALUE}(s, \alpha, \beta))$

**if**  $v \geq \beta$  **then return**  $v$  **cutoff**

$\alpha \leftarrow \text{MAX}(\alpha, v)$

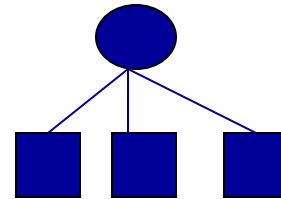
**return**  $v$



# The $\alpha$ - $\beta$ algorithm

```
function MIN-VALUE(state,  $\alpha$ ,  $\beta$ ) returns a utility value
  inputs: state, current state in game
          $\alpha$ , the value of the best alternative for MAX along the path to state
          $\beta$ , the value of the best alternative for MIN along the path to state

  if TERMINAL-TEST(state) then return UTILITY(state)
   $v \leftarrow +\infty$ 
  for  $a, s$  in SUCCESSORS(state) do
     $v \leftarrow \text{MIN}(v, \text{MAX-VALUE}(s, \alpha, \beta))$ 
    if  $v \leq \alpha$  then return  $v$       cutoff
     $\beta \leftarrow \text{MIN}(\beta, v)$ 
  return  $v$ 
```



Should  $\alpha$  and  $\beta$  be passed by value or reference?  
ie. Should a lower  $\alpha$  affect an upper one?

# Alpha-Beta Pruning Example

