

CS 331: Artificial Intelligence

Alpha-Beta Practice

ALPHA-BETA Pseudocode

function ALPHA-BETA-SEARCH(*state*) **returns** an action
inputs: *state*, current state in game
 $v \leftarrow \text{MAX-VALUE}(\text{state}, -\infty, +\infty)$
return the *action* in SUCCESSORS(*state*) with value *v*

function MAX-VALUE(*state*, α , β) **returns** a utility value
inputs: *state*, current state in game
 α , the value of the best alternative for MAX along the path to *state*
 β , 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*
 $\alpha \leftarrow \text{MAX}(\alpha, v)$
return *v*

ALPHA-BETA Pseudocode

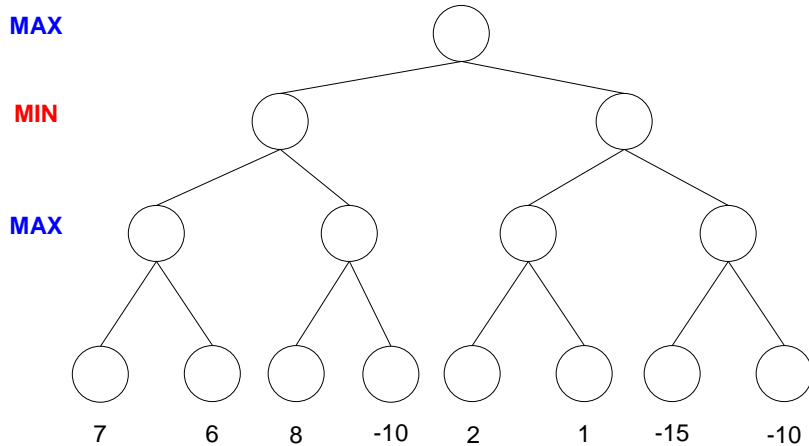
```

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  $v$ 
     $\beta \leftarrow \text{MIN}(\beta, v)$ 
  return  $v$ 

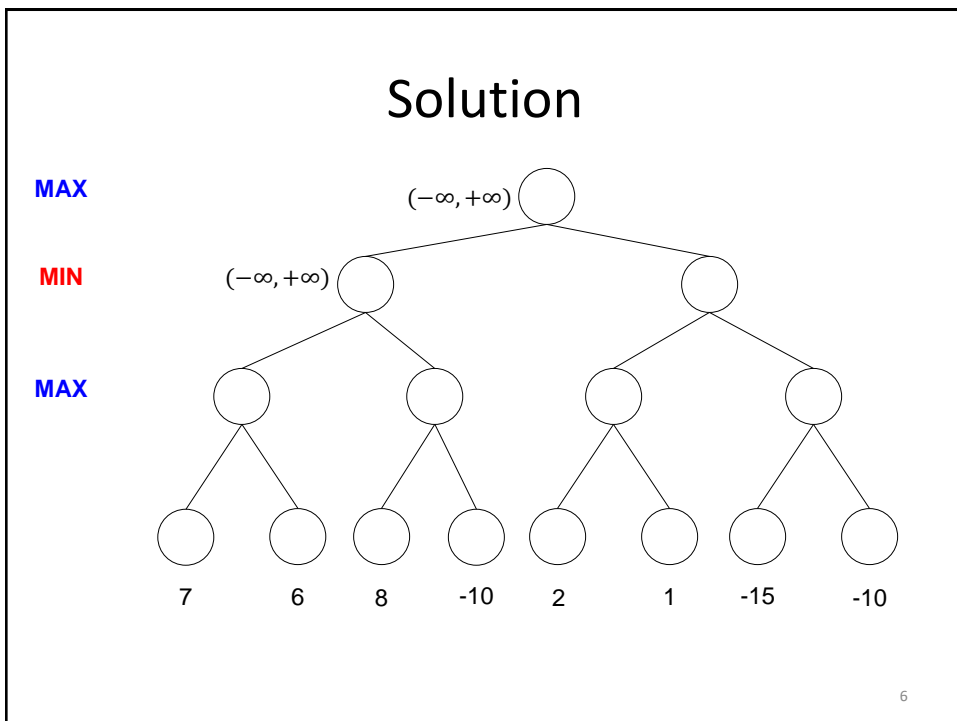
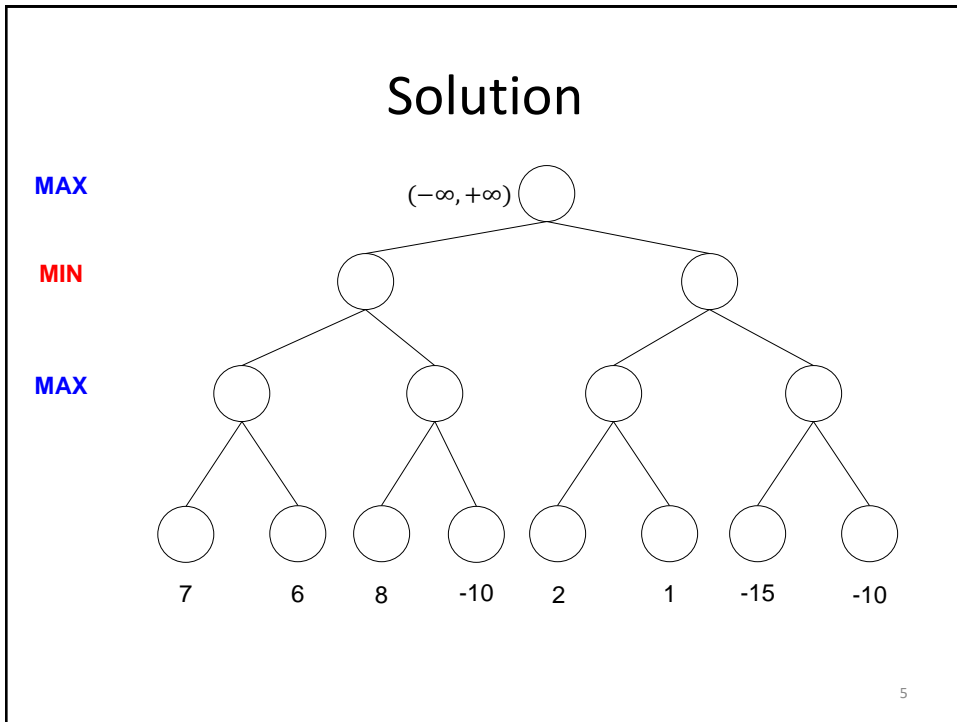
```

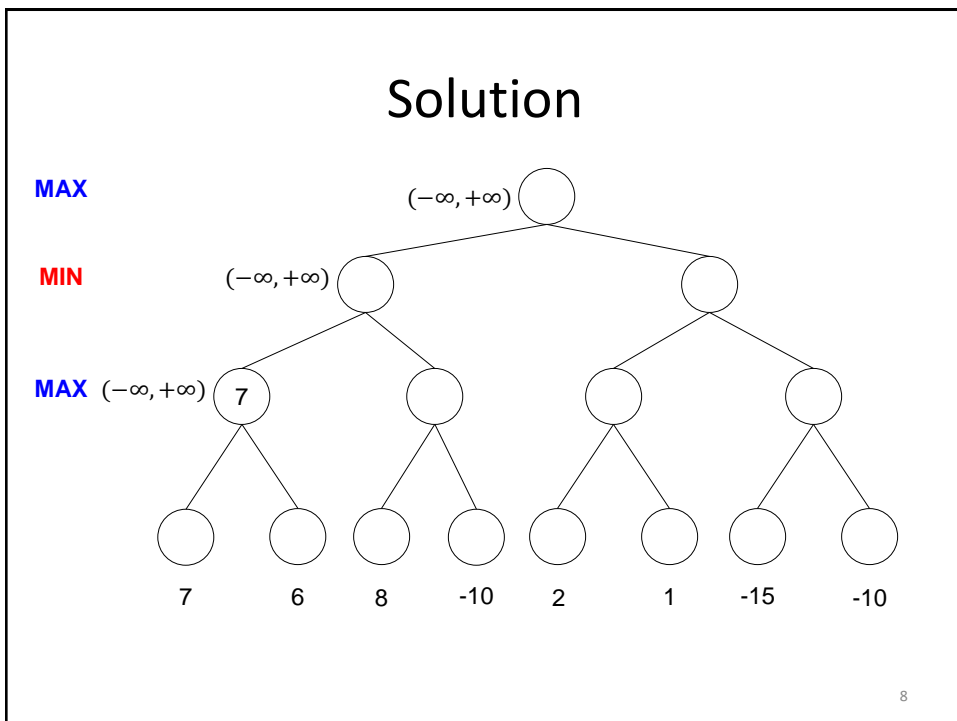
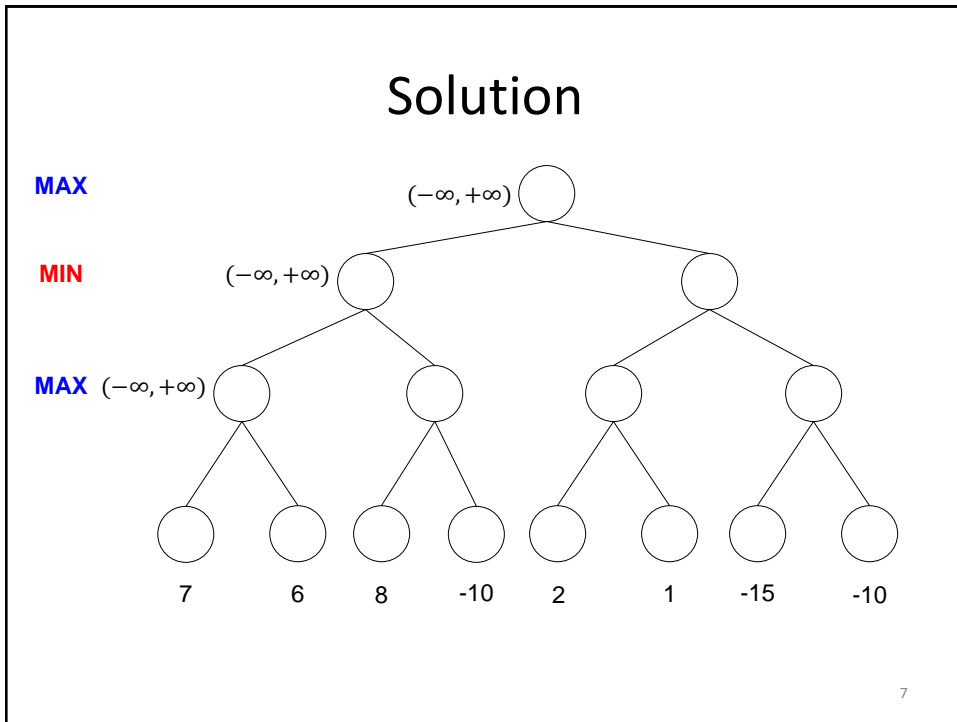
3

Run Alpha-Beta Pruning

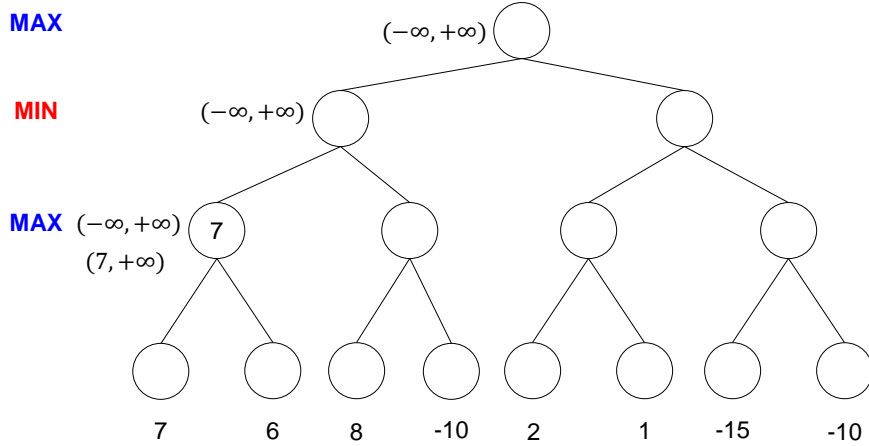


4



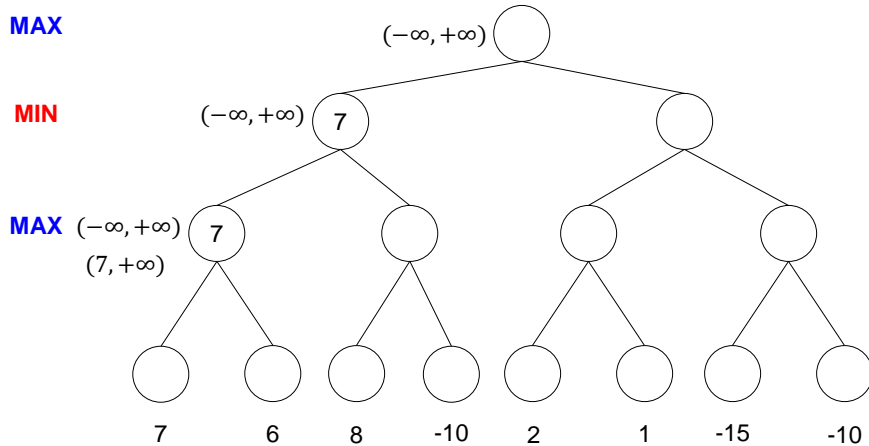


Solution



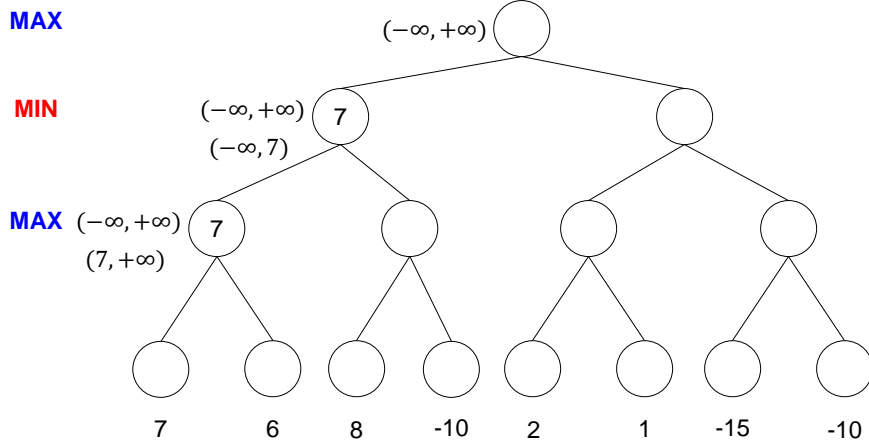
9

Solution



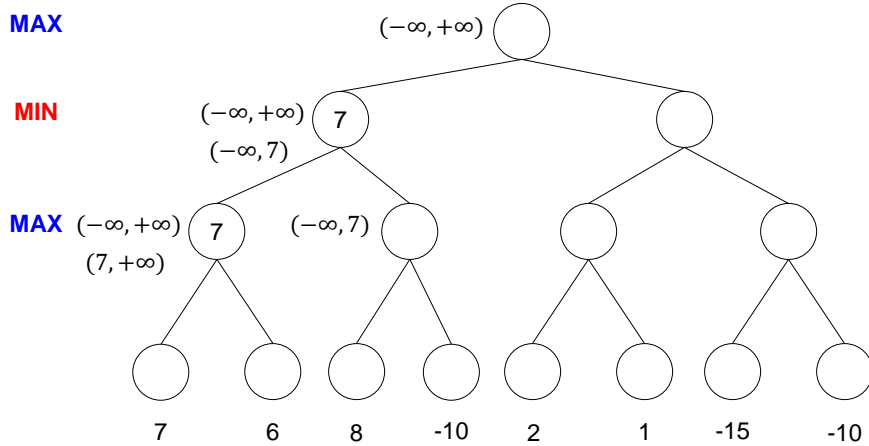
10

Solution

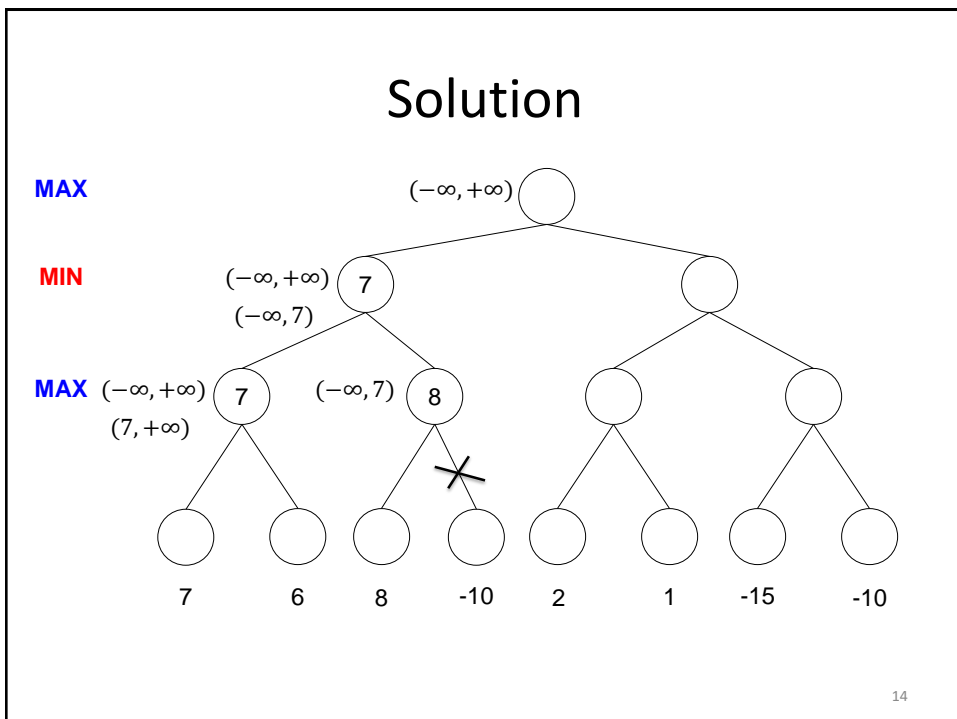
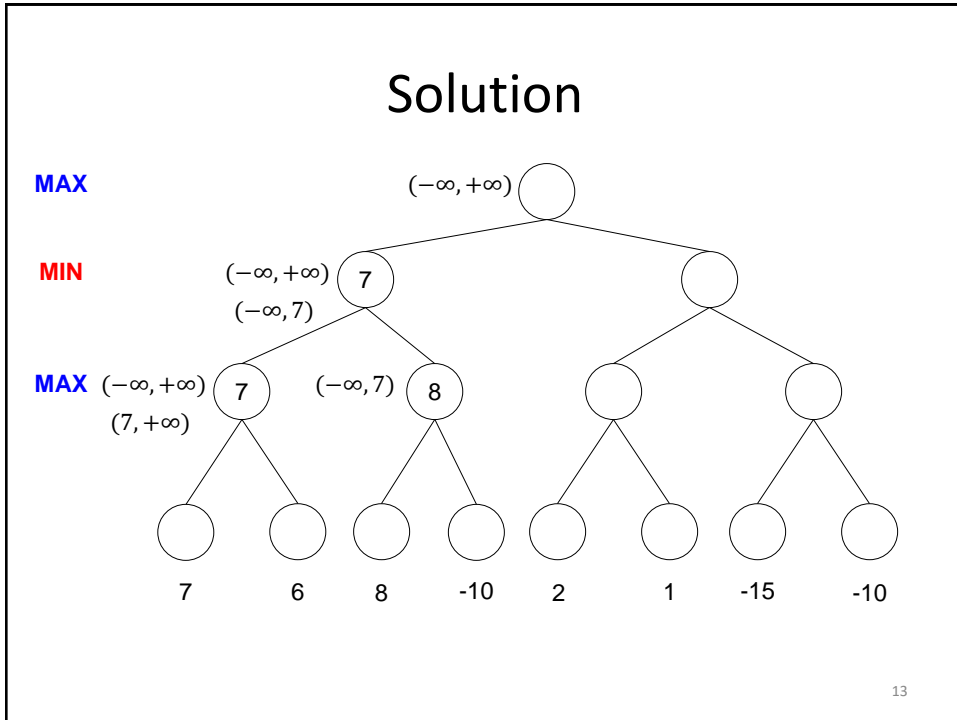


11

Solution



12



Solution

MAX

$(-\infty, +\infty)$ 7

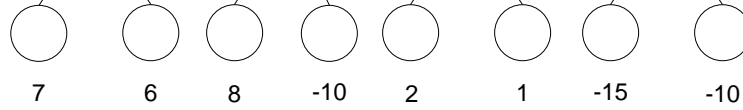
MIN

$(-\infty, +\infty)$ 7
 $(-\infty, 7)$

MAX

$(-\infty, +\infty)$ 7
 $(7, +\infty)$

$(-\infty, 7)$ 8



15

Solution

MAX

$(-\infty, +\infty)$ 7
 $(7, +\infty)$

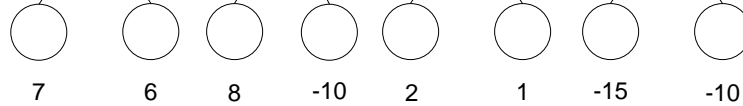
MIN

$(-\infty, +\infty)$ 7
 $(-\infty, 7)$

MAX

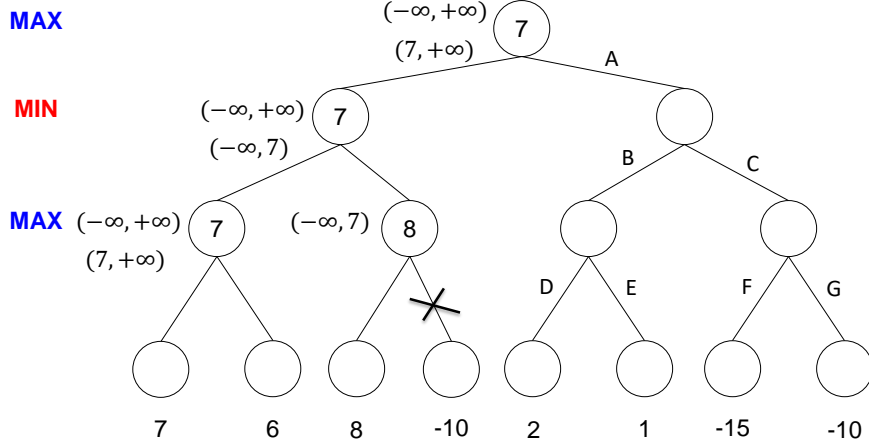
$(-\infty, +\infty)$ 7
 $(7, +\infty)$

$(-\infty, 7)$ 8



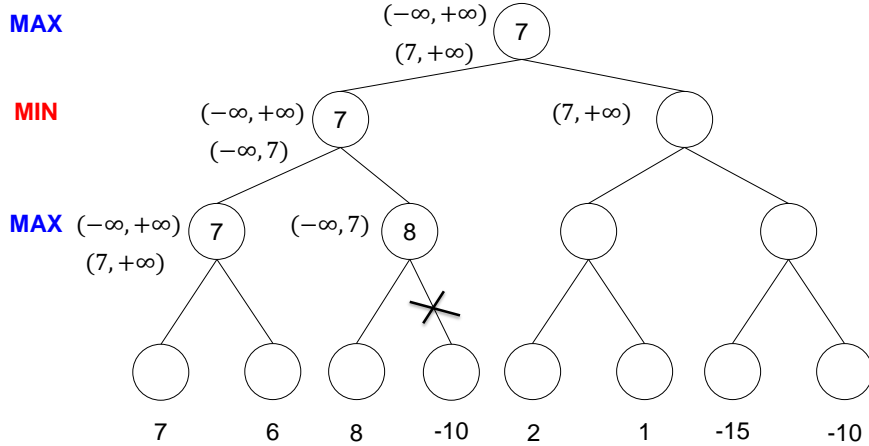
16

Solution



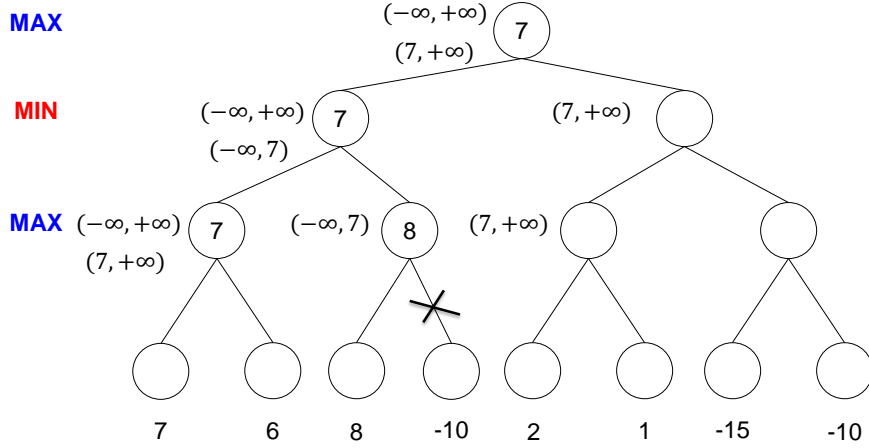
17

Solution



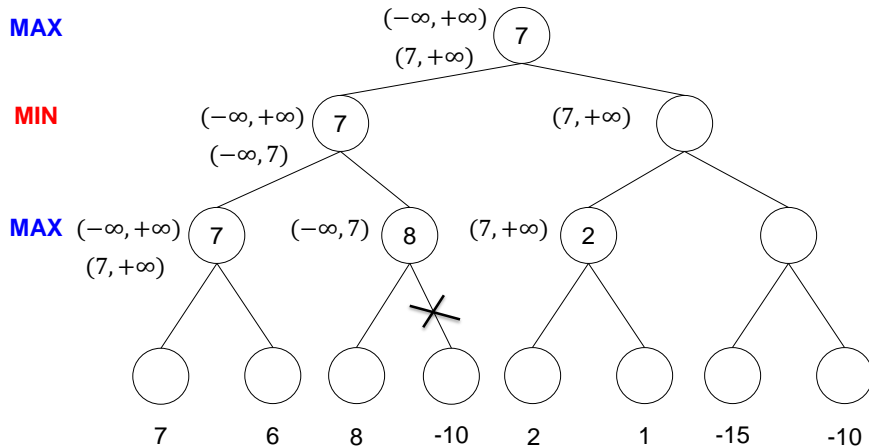
18

Solution



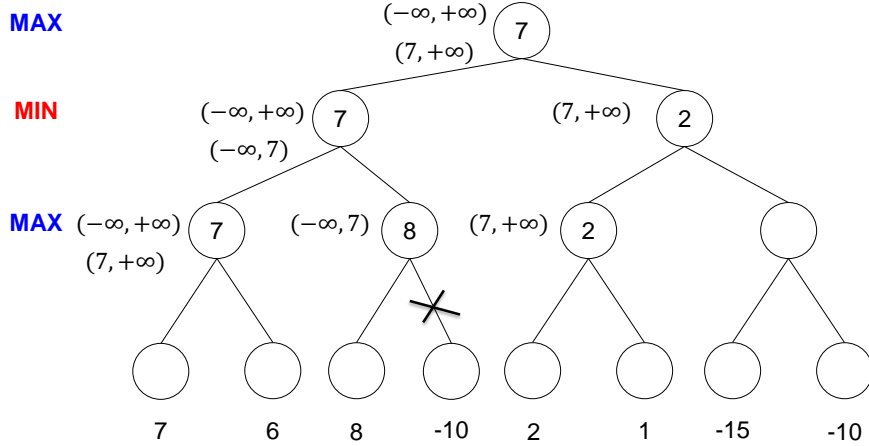
19

Solution



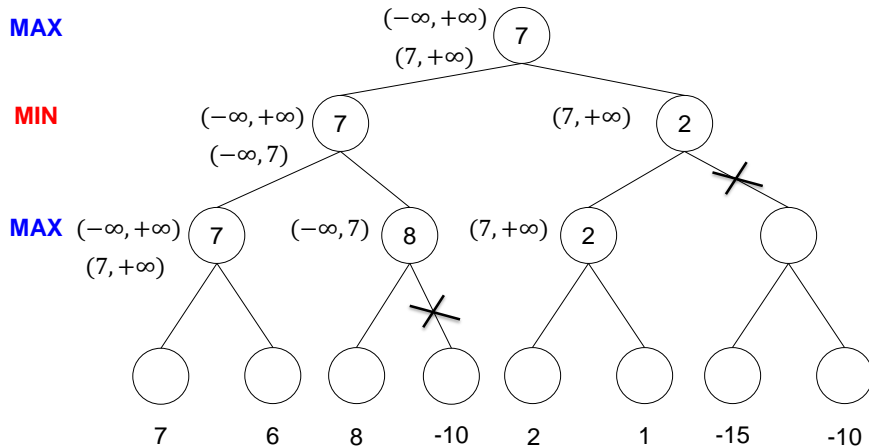
20

Solution



21

Solution



22