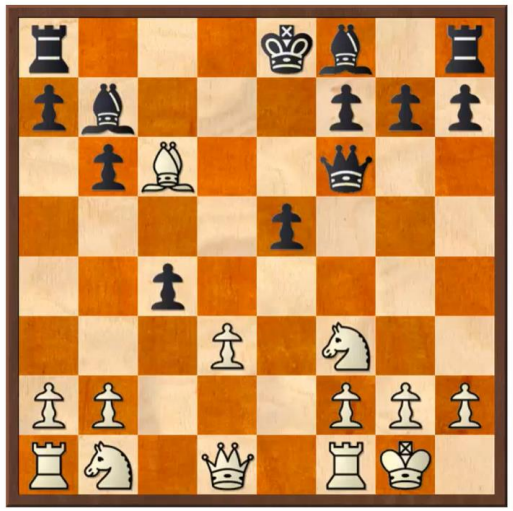
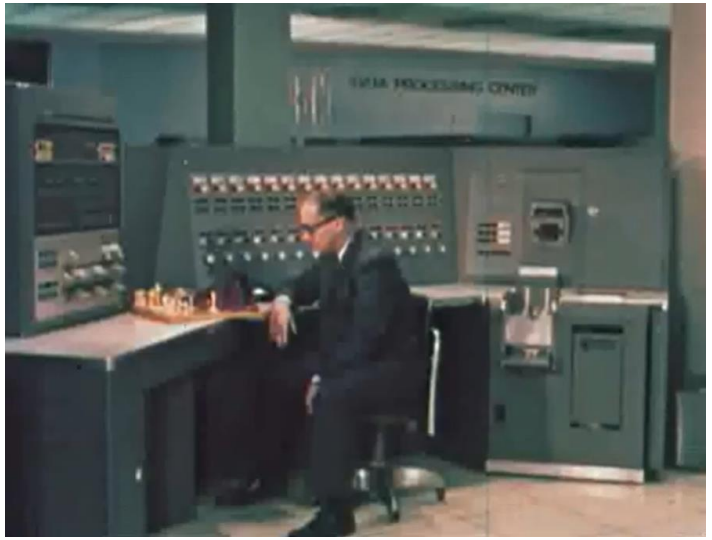
Search in Games

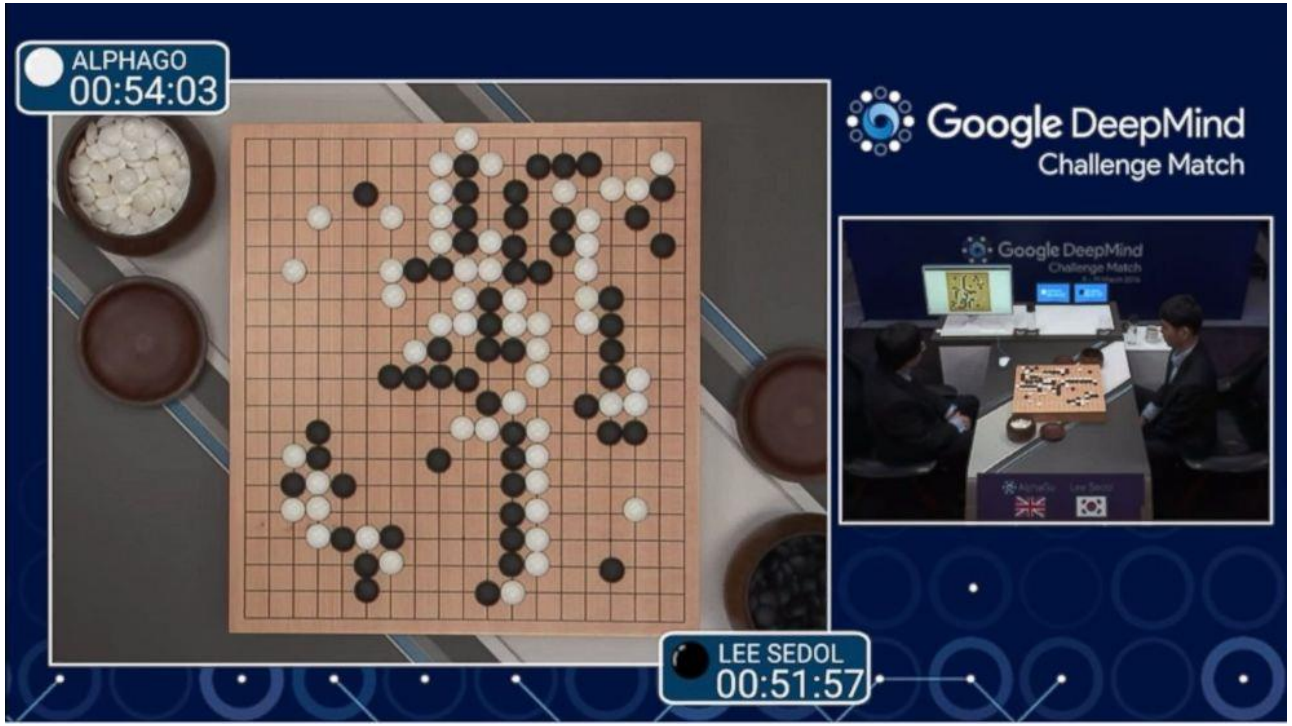
Chen-Yu Wei



Bernstein

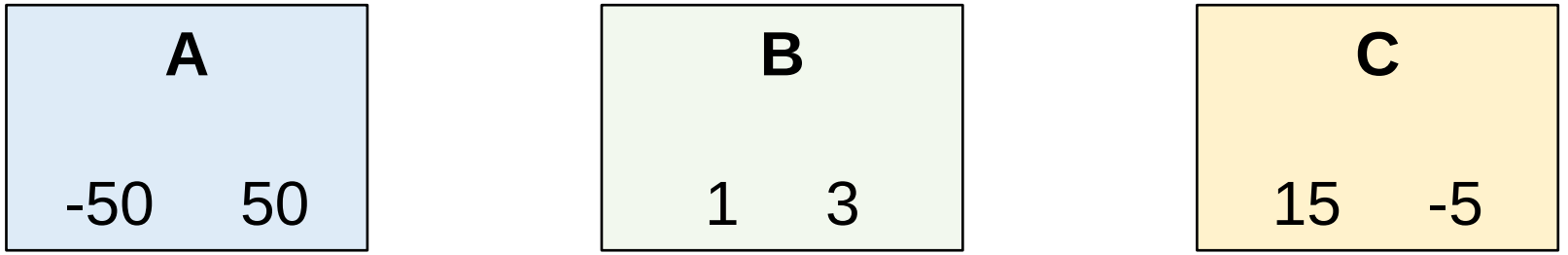
Computer





Turn-Based Two-Player Game

You choose one of the three bins. I choose a number from that bin. Your goal is to maximize the chosen number.



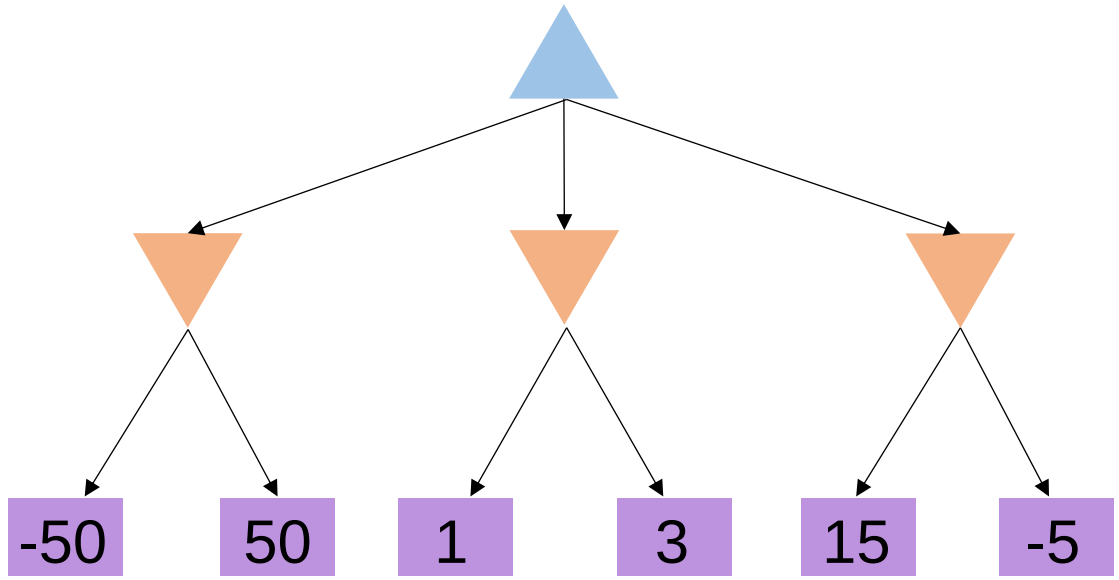
If I am

- adversarial
- random
- benign/cooperative

Turn-Based Two-Player Zero-Sum Games

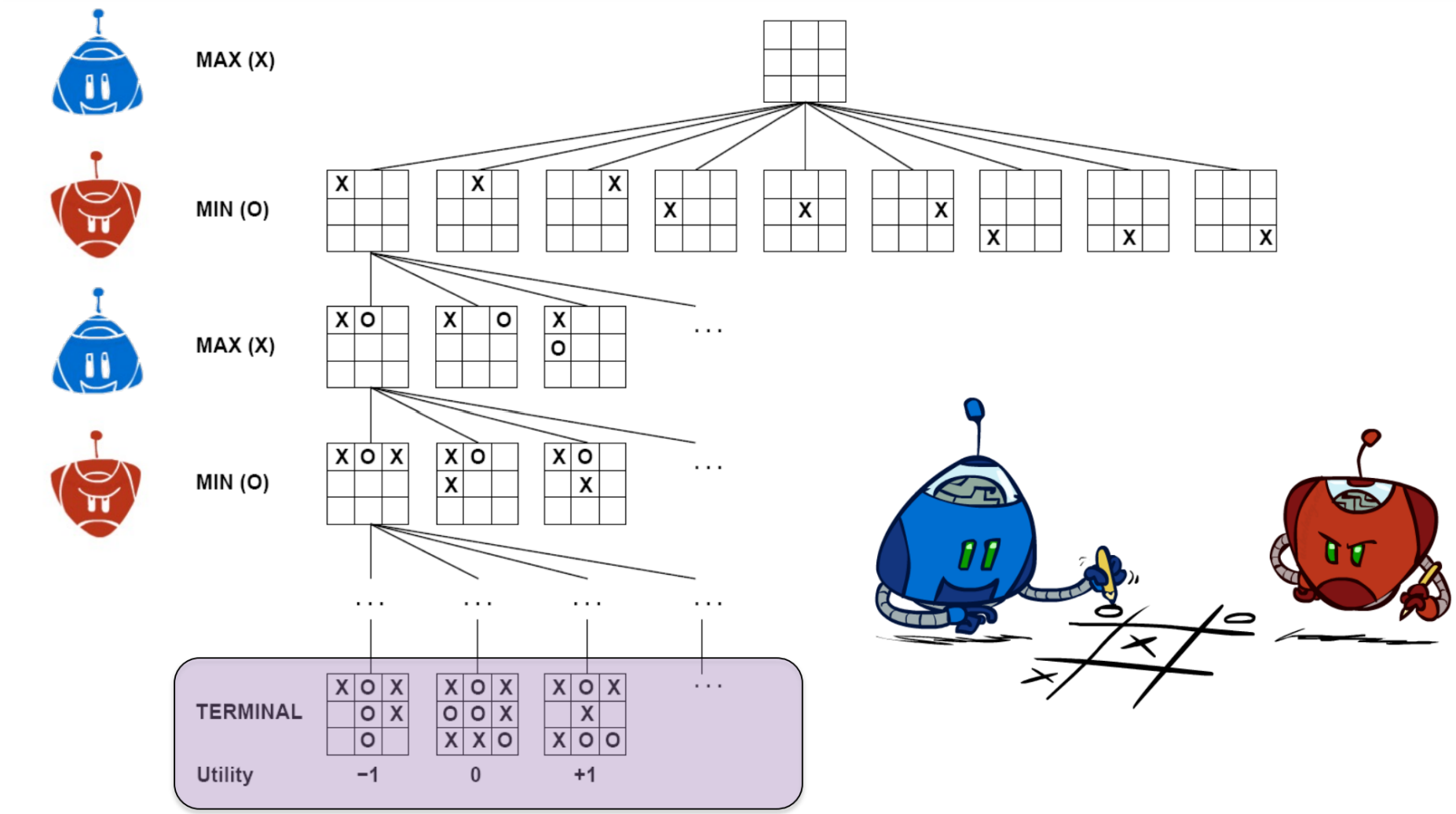
MAX

MIN

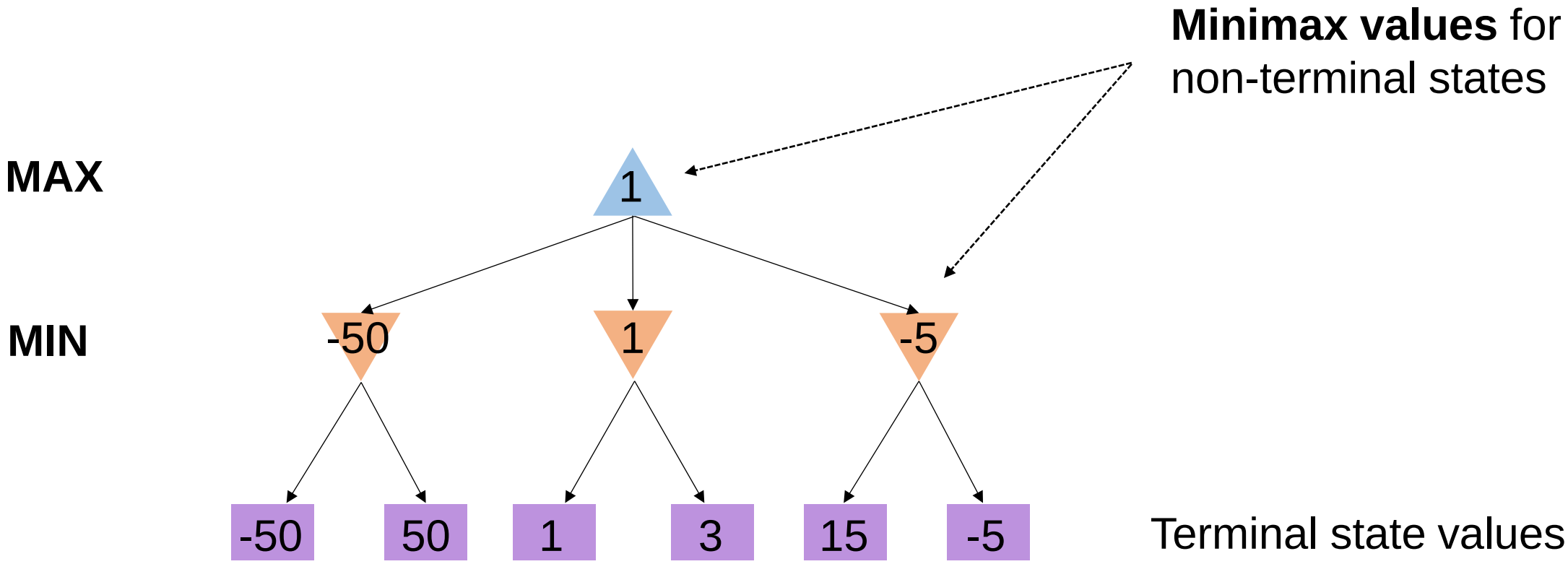


Terminal state values

Example: Tic-Tac-Toe

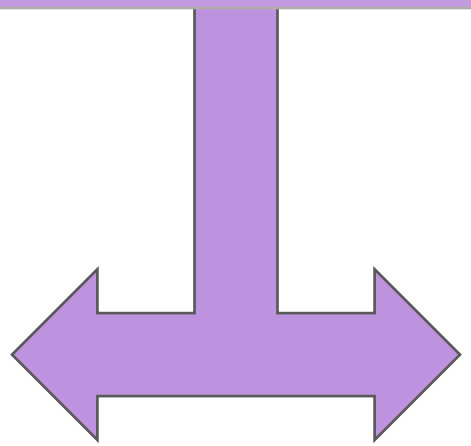


Turn-Based Two-Player Zero-Sum Games



Calculating Minimax Values

```
def value(state):
    if the state is a terminal state: return the state's utility
    if the next agent is MAX: return max-value(state)
    if the next agent is MIN: return min-value(state)
```



```
def max-value(state):
    initialize v = −∞
    for each successor of state:
        v = max(v, value(successor))
    return v
```

```
def min-value(state):
    initialize v = +∞
    for each successor of state:
        v = min(v, value(successor))
    return v
```

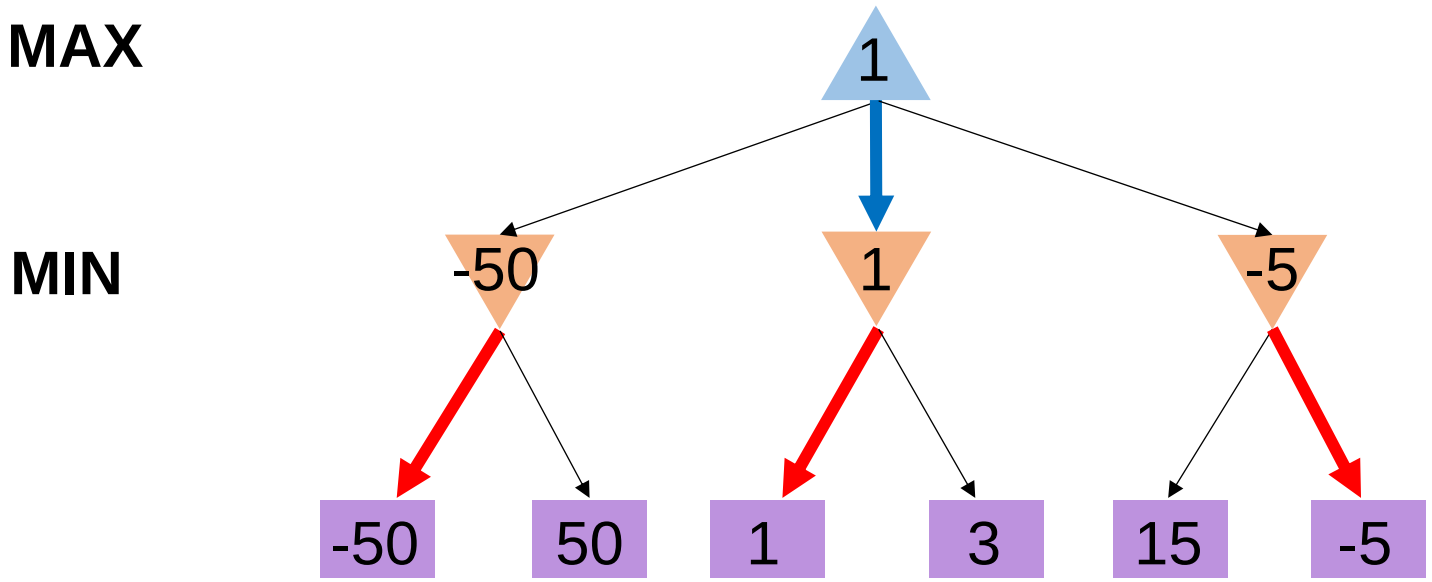
The Minimax Policy

"Policy" is mapping from state to action.

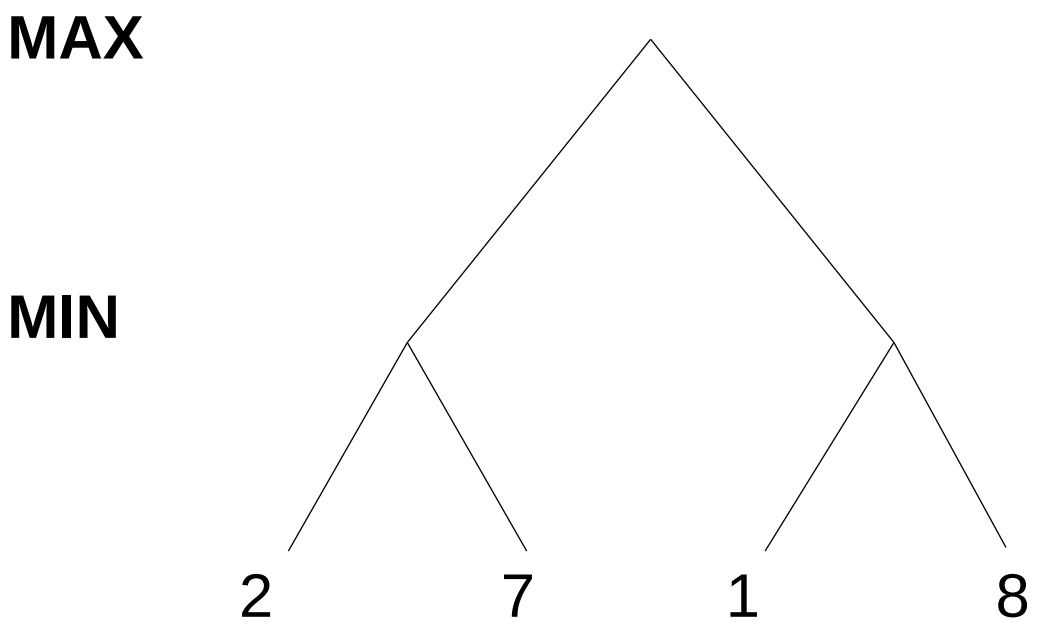
"Minimax policy" is the optimal policy against the most adversarial opponent.

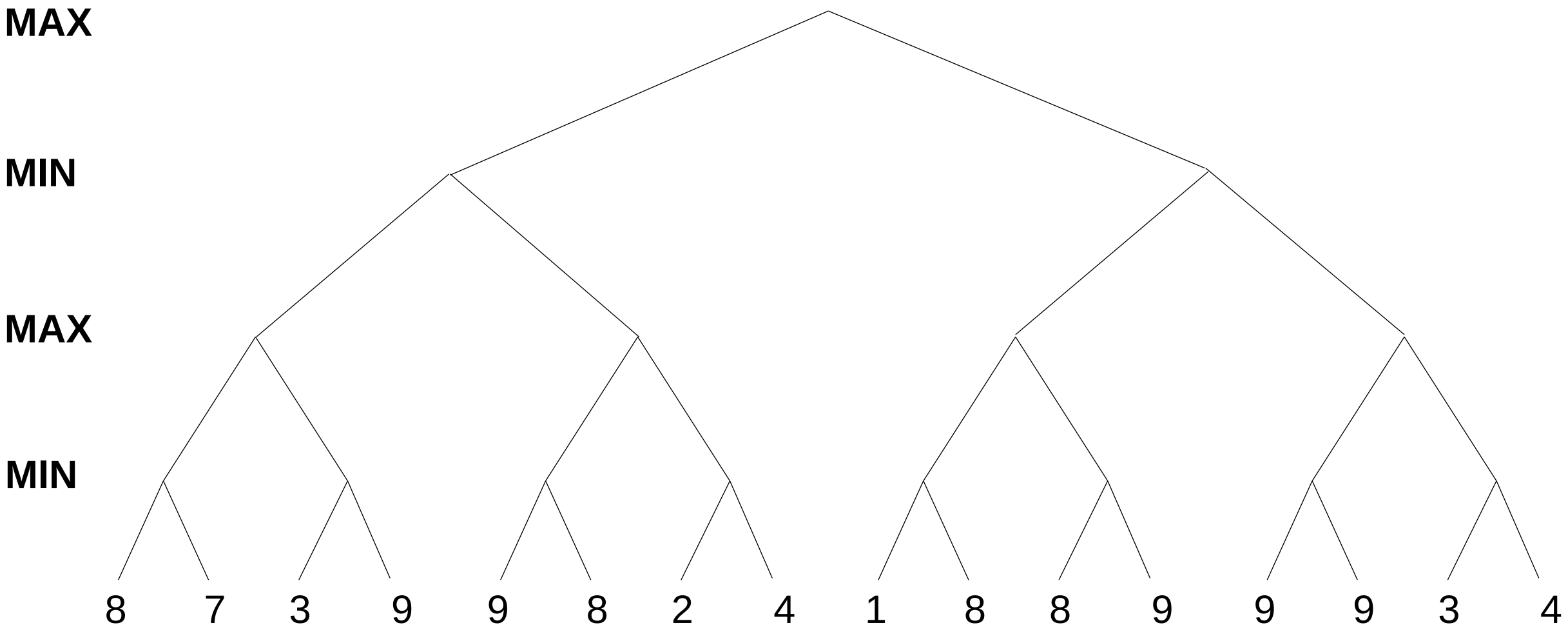
MAX's minimax policy

MIN's minimax policy



Alpha-Beta Pruning


MAX
MIN
2
7
1
8


MAX
MIN
MAX
MIN
8
7
3
9
9
8
2
4
1
8
8
9
9
9
3
4