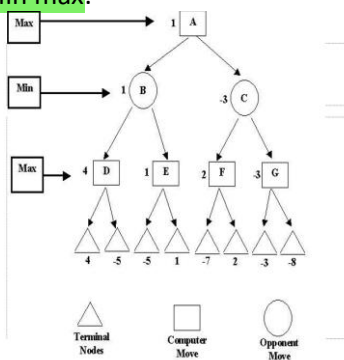


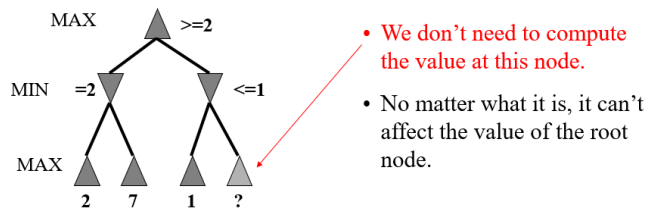
<p>Pros: When very large spaces, BFS is not used</p> <p>Solve hard problems with minimal initial structure</p> <p>Min max:</p>  <p>Backtracking algo – DFS Optimal Complete Time complexity: $O(b^m)$ Space complexity: $O(bm)$ b-legal moves m-depth</p>	<p>Example:</p> <ul style="list-style-type: none"> - Chess - Checkers - Go - Bridge - Nim - Tic-tac-toe - Othello <p>Agents 2 types:</p> <p>Competitive Cooperative</p>	<p>Characteristics:</p> <ul style="list-style-type: none"> - 2 person game (multiagent environments) - Alternate moves (one after another) - Zero sum - Perfect information - No chance involved <p>Game tree: a tree where the nodes are game states and the edges are moves</p>	<p>How to play: Consider all the legal moves you can make.</p> <p>Compute the new position resulting from each move.</p> <p>Evaluate each resulting position and determine which is best.</p> <p>Make that move.</p> <p>Wait for your opponent to move and repeat.</p>	<p>Evaluation function:</p> <p>$f(n) \gg 0$: position n good for me and bad for you</p> <p>$f(n) \ll 0$: position n bad for me and good for you</p> <p>$f(n)$ near 0: neutral position</p> <p>$f(n) = +\text{infinity}$: win for me</p> <p>$f(n) = -\text{infinity}$: win for you</p>
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Alpha beta pruning: improve performance of minmax.

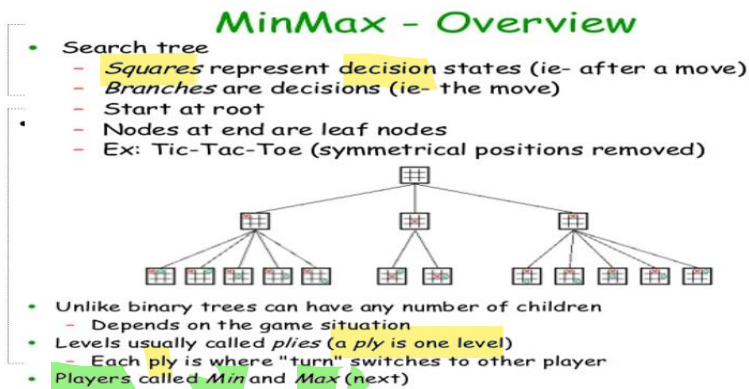
Gives **same value** of the **root** node **as minmax** algo, but needs **less or equal computation**.

DFS algo follow, time complexity: $O(b^{m/2})$

- **Worst case**: no pruning, examining b^d leaf nodes, where each node has b children and a d-ply search is performed
- **Best case**: examine only $(2b)^{d/2}$ leaf nodes.
- **Best case** is when each player's best move is the first alternative generated



- At each **MAX** node n , **$\alpha(n)$** = maximum value found so far, start at **-infinity** and only **increase**
- At each **MIN** node n , **$\beta(n)$** = minimum value found so far, start at **+infinity** and only **decrease**.



Extra:

- 1) **Zero sum**: one's loss is other's gain.
- 2) **Perfect Information**: both players have access to complete information about the state of the game.
- 3) **No chance**: players have full control over their moves and the outcome of the game is solely **determined by their strategic decisions and actions**.
- 4) **Evaluation function / static evaluator**: evaluate the "goodness" of a game position.
- 5) **Heuristic evaluation function**: approximate the true utility of a state without doing a complete search. Ex: pruning
- 6) **Alpha cutoff**: stop searching below MIN node n if **$\beta(n) \leq \alpha(i)$** for some MAX node ancestor i of n .
- 7) **Beta cutoff**: stop searching below MAX node n if **$\beta(i) \leq \alpha(n)$** for some MIN node ancestor i of n .
- 8) **Pruning**: ignore portions of the search tree that **make no difference to the final choice**
- 9) **Metareasoning**: It involves the ability to monitor, evaluate, and control one's own cognitive activities to improve problem-solving, decision-making, and learning.