DOMS Page No.
Date / /

U-3 (Adversarial Search & Games in AI)

* Adversarial Search

- problem environment is multiagent, competative when agent's goal are in conflict.
- known as games.
- Mathematical game theory → economic view of any multiagent environment as a game
-

* Game –

def^n

- sort of conflict in which n individuals or groups (known as players) participate.
- game theory → games of strategy
- John Von Neumann → father of game theory → 1923.
- game theory → decision-makers (players) → cope with other decision maker (players) → diff purpose in mind.
- players determine own strategies & goals of opponent.
- games → integral attribute of human beings.
- computers → mimic people → able to play games.

Game playing → close relation to intelligence & well-defined states and rules.

DOMS Page No.
Date / /

* Applⁿ of Game Theory -

- wideranging
- Von Neunmann & Magenstern indicated → utility of game theory

- economic models
- social sciences
- epidemiologists
- military strategists

limitation → could be inaccurate
→ computationally expensive
→ sensitive to gains
→ & difficult to adapt

* Game

→ atleast two players
→ solitaire → not considered a game by game theory.
→ choosing from set of specificed alternatives → move.
→ games in which all moves of all players are known to everyone → games of perfect information. * defⁿ

Board games → perfect info.
Card games → not perfect info.

*defⁿ
→ every instance of game must end.
→ payoff → value associated with each player's final situation.

* Terms in Game Theory -

- rules → stipulates the condⁿ under which game begins.
- strategy → list of optimal choices for each player at every stage of a given game
- move → game progresses from one stage to another, beginning with an initial state.
- Minimax → the least good of all good outcomes.
- Maximin → the least bad of all bad outcomes.

* Characteristics of Game play -

→ unpredictable opponent
→ opponent introduces uncertainty / wants to win.
→ Time limit.

* Types of Games :-

i) Based on chance.

1) Deterministic (not involving chance)

eg - chess, checkers, Tic-tac-toe

2) Non-deterministic (can involve chance)

eg - Backgammon, Monopoly

ii) Based on information.

1) Perfect Information. (all moves of all players are known to everyone.)

eg - chess, Checker, tic-tac-toe.

2) Imperfect Information (all moves are not known to everyone)

eg - Bridge, Poker, Scrabble

iii) General zero - sum games.

→ choose strategies simultaneously (neither knowing what other player).

→ eg → chess → one person will lose & one will win.

→ win (+1) & lose (-1) = 0.

iv) Constant - sum game.

→ algebric sum of outcoms → constant.

→ not necessarily zero.

→ strategically equivalent to zero-sum games.

v) Non - zero - sum game -

→ algebric sum → outcomes are not constant.

→ sum of payoffs → not same for all outcomes.

- negative sum game (competitive) - nobody wins, everybody loses. (war or a strike)
- positive sum game (co-operative) - one goal, contri together. (eg - educational game, building block or science exhibit)

vi) N- person game -

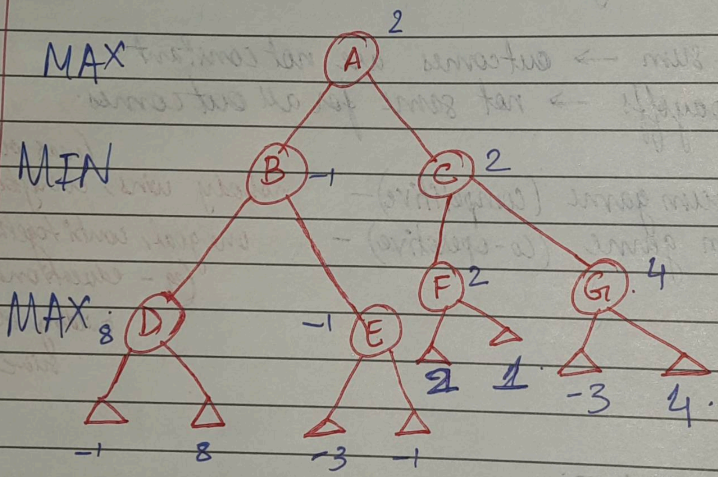
→ more than 2 players.

→ analysis → more complex than zero-sum games.

→ conflicts of interest are less obvious.

✱ Min-Max Algorithm

- → Backtracking algorithm.
- → Best move strategy used.
- → max will try to maximize its utility (Best move)
- → min will try to minimize utility (worst move)
- → minmax decision from current state.
- → used as searching technique in game problem.
- → complete depth-first exploration of game.
- → Time complexity → $O(b^d)$ → b - branching factor
  d - depth of graph.



✱ Properties → • complete sol^n for finite tree.
• optimal strategy → optimal opponent.

✱ Disadv → • explores whole search space
• huge search game spaces → lot of time.
• exact solution is completely infeasible.

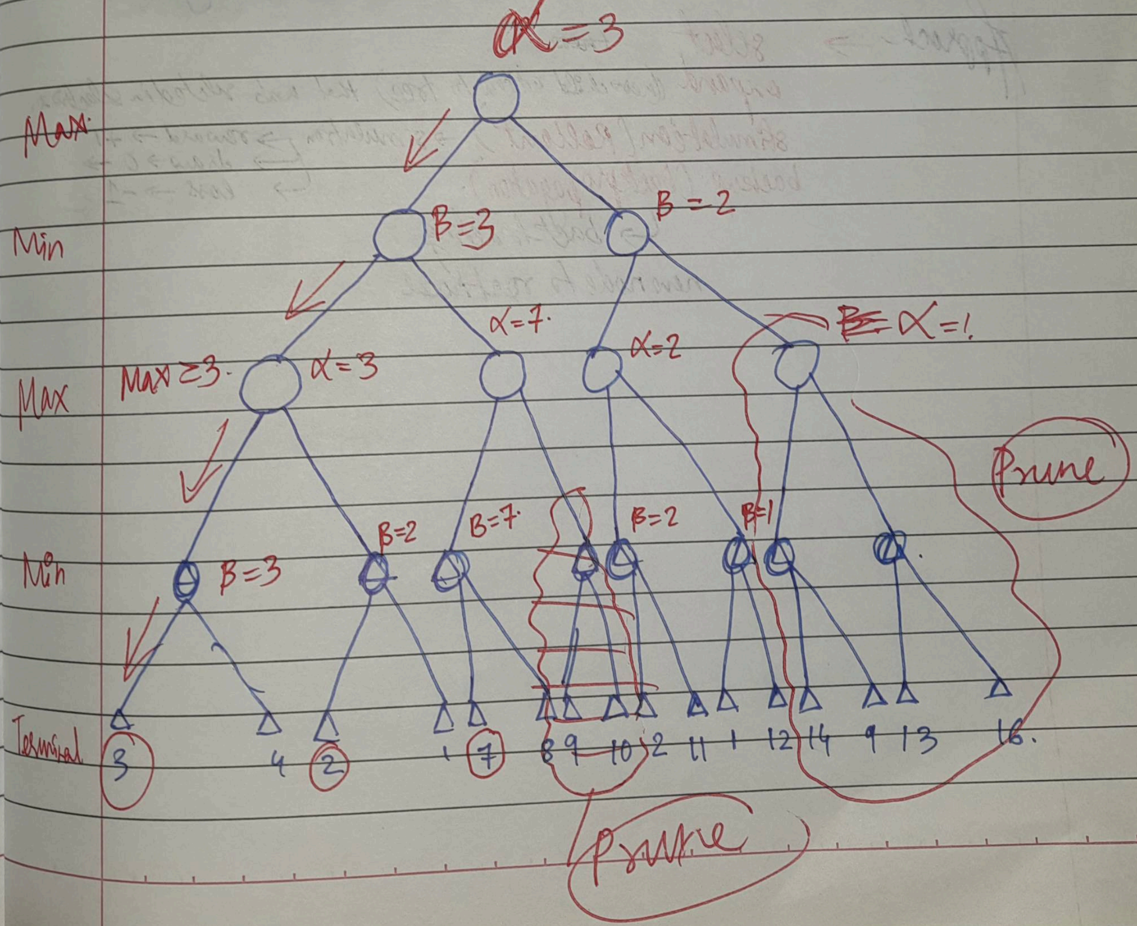
Alpha Beta Pruning (α-β)

→ cutoff search by exploring less no. of nodes.
max → α min → β

→ Search tree

→ Advantags → reduce amt of time (search)
→ improve accuracy
→ simple algrithm to implement

→ Disadvantags → difficult to implement correctly.
→ less efficient in some case, such as when gametree → sparse.



Monte Carle Tree Search - (MCTS)

→ probablistic & heuristic driven search.
→ works on repeatedly simulating g game from given state.
→ each simulation → playout → estimate value of each state.
→ Advantage → explore large gametrees
→ use to play games that are complex (Brute force search)
→ learn from experience → updating
→ estimates of value of states → result of playouts
→ reliability issue.
→ disadvantages → slow to converge (large no. of possible moves)
→ sensative → choice of parameter.
→ difficult to adapt → changes in game.

Approach → select ~~term~~.
expand (new child added to tree) that was selected in selection.
simulation (Rollout) → simulation → reward → +1
→ draw → 0 →
→ loss → -1
backup. (backpropagation).
→ backtracking
new node to root node

DOMS Page No.
Date / /

Constrain Satisfaction Problem.

→ consists of 3 components V, D, C.

variables → $\{N, NW, NE, M, MW, ME, S, SE\}$

Domains → $D = \{red, green, blue\}$

Constraints → Adjacent regions must have diff color

→ finding sol^n that meets the constraints.

→ V is set of variables $\{V_1\ V_2 — V_n\}$
→ D is set of domains $\{D_1, D_2\ D_3 — D_n)$ one for each variable
→ C → set of constrains that specify allowable combination of values.

$Ci = (scope, rel)$ $\{C_1 C_2 C_3\}$.

→ scope is set of variable that participate in constraint.
→ rel is ~~set~~ relation that defines values that variable to take.

→ Properties in CSPs
- specific partial info
- non-directional
- declarative.
- additive
- independent.