

Artificial Intelligence

- * AI - It is a branch of computer science by which we can create intelligent machines which can behave like human, think like human and able to make decisions.

Replicate human intelligence

Goals → solve knowledge intensive task

→ build machine that require human intelligence
• chess; driving cars

- * Advantages

High accuracy

High speed

Useful for risky areas

higher or public utility

Digital assistant

highest

- * Disadvantages - → cannot think out of box

→ no feeling, no emotion

→ increase dependency on machine.

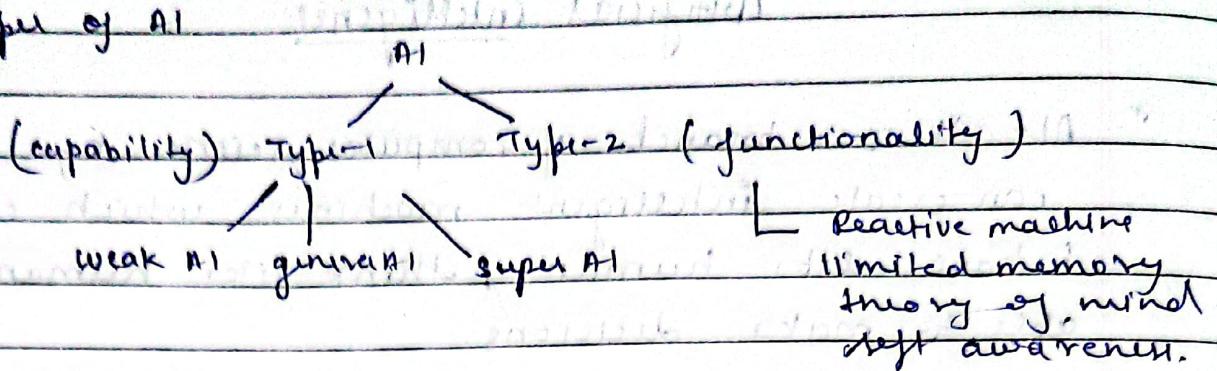
→ no creativity

- * Expert systems - An expert system uses knowledge of expert to create a program. The system answer question and solve problem with a clearly defined area of knowledge uses rule of logic.

Ex - Bank loan screening program.

- * Intelligent agents - intelligent agents are also called agent or bots with use of big data program they have gradually evolved into virtual assistant and chatbots. Agent can be anything that perceive environment through sensor and act on environment through actuators.

Type of AI



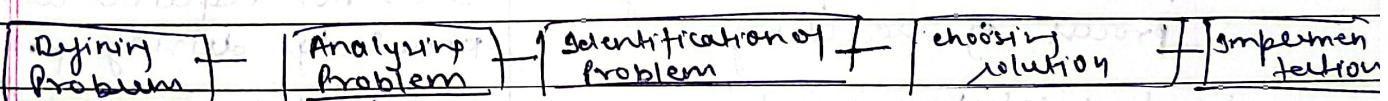
- **weak AI** - AI perform dedicated task with intelligence
 - cannot perform beyond its field.
 - trained for specific task. thus called weak.
 - Ex - chess playing, say driving cars.
- **general AI** - Perform intellectual task with efficiency
 - Smart system human like capability
 - No system under general AI
 - Under research.
- **Super AI** → end of intelligence where machine surpass humans
 - characteristics - ability to think, solve puzzle, play, learn, communicate its own.
 - Super AI is hypothetical concept
- **Reactive machines** - Basic AI
 - do not store memory / past experience
 - focus on current situation / future action
 - IBM's deep blue, google alpha go
- **limited memory** - can store past experience for short time
 - they store data for limited time
 - self driving car
- **Theory of mind** - They understand human emotion, people's belief, belief and interact socially.
 - Not developed, under research.
- **self awareness** - feature of AI, super intelligent machine will have own consciousness, sentiment and self-awareness.
 - smarter than human
 - do not exist, hypothetical

Application of AI

- 1) Astronomy - solve problem related to universe.
- 2) Healthcare - better and faster diagnosis
- building health facility
- 3) Gaming -
- 4) Finance - finance industry implementing automation, chatbot adaptive algorithm
- 5) Data Security - used for data safety and security
AES, A12 used to determine bug, cyber attack.
- 6) Social media - management of data, AI analyzes data to identify trends.
- 7) Travel & transport - AI is capable of doing work as suggesting flight, hotel, bus routes.
- 8) Automotive industry - self driving car, virtual assistant
- 9) Robotics -
- 10) Agriculture - crop monitoring, predictive analysis.
- 11) Education, E-commerce.

* Problem solving in AI - Problematic issue which comes across any system. A solution is needed to solve the problem.

Steps to solve problem -



most popular problem - chess, TSP, Tower of Hanoi, n-queen.

* Heuristic algorithm - algorithm which solve problem faster and efficient manner than traditional method by sacrificing optimality.

* Solution guaranteed algo - this algo has precise set of rules or procedure they do not depend on intuition or guess provide a solution. It contains sequence of step to an end point ex - sum of no.

heuristic	solution guaranteed
- based on intuition, guess, exploration	based on finite set
- yield sub-optimal result	yield optimal result
- can not be proven mathematically	can be proven
- do not yield same ans every time	give same answer.

- soft computing - group of computational techniques that are based on AI and natural selection provides cost-effective results to real life problems ex - ANN, genetic algo, fuzzy logic.

State space representation

Representation of problem in AI is done using state space representation.

State - contains all possible states.

state space search - in state space search a state space is formally represented as tuple s .

$$s = \{s, A, \text{Action}(s), \text{Result}(s,a), \text{Cost}(s,a)\}$$

S = set of all states

A = set of all actions

Action(a) - function that represents possible action in certain state

Result(s,a) - function that return state reached performing action a

Cost(s,a) - cost of performing action (a) in s state.

Informed search

- * use knowledge during process of searching
 - * find solution quicker.
 - * can be both complete / incomplete
 - * quicker
 - * implementation is shorter
- Ex - best first search, A* search.

Uninformed Search (blind)

- * do not require using any knowledge during process of finding solution slowly.
 - * always bound to complete.
 - * slow
 - * implementation is lengthy.
- Ex - BFS, DFS

Production system - Production system is based on set of rules about behaviour. These rules are basic representation found in expert systems, automated planning. If in computer program typically provide some form of AI which contains set of rules about behaviour, also includes mechanism to follow those rules. The system respond to world.

↳ component

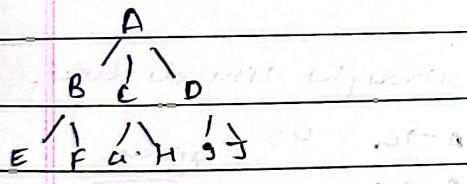
- global DB. →
- production rule →
- control system - choose which rule to apply.

→ feature - simple, modular, modifiable, knowledge.

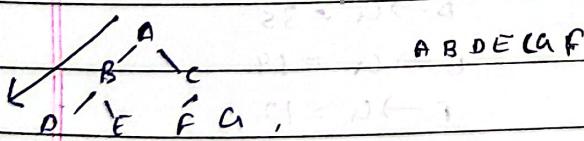
↳ classes -

- monotonic → rule never prevents another rule.
- Non-monotonic / solve ignorable problem
- Partially commutative → Application of sequence transform state X to Y
- commutative → useful for problem in which changes occur but can be reversed. order of operation not critical.

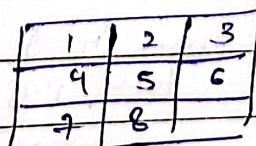
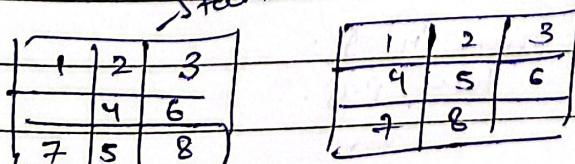
↳ BPS - uninformed, FIFO (Q), levels by level, optimal, $O(V+E)$ $O(b^d)$



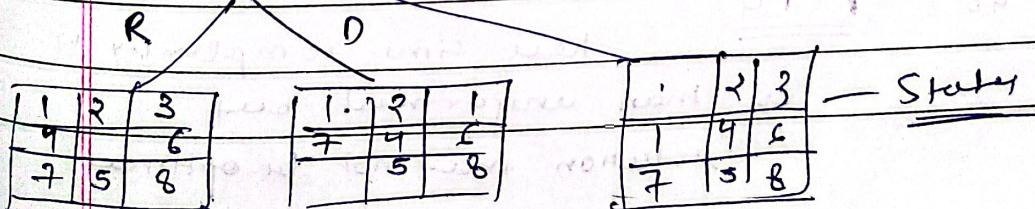
↳ DPS - uninformed, stack, depth, optimal, $O(V+E)$ $O(b^d)$



- 8 Puzzle Problem



up, down, left, right



time = $O(b^d)$ depth.
branching factor.

Date Page

Heuristic - technique to solve problem quickly using some

information, example of informed search.

→ give good solution / not optimal

euclidean dist, manhattan dist.

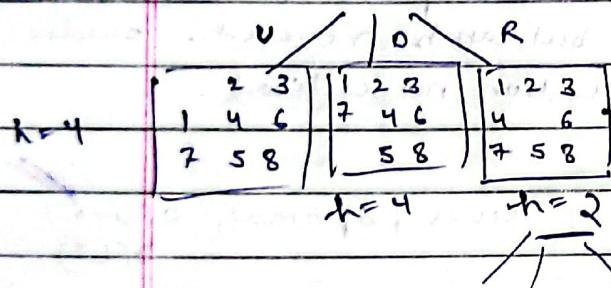
Start

8-puzzle

	1	2	3		1	2	3
	4		6		4	5	6
	7	5	8		7	8	

heuristic $h = \text{count of misplaced tiles}$.

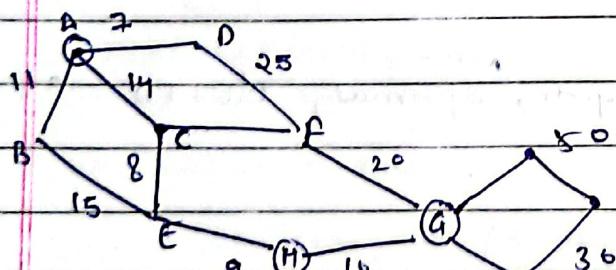
$h = 3$



again calculate heuristic
and move to min. heuristic
val. path.

Best First Search - informed search.

straight line distance.



$A \rightarrow u = 46$ given.

$B \rightarrow u = 32$

$C \rightarrow u = 25$

$D \rightarrow u = 35$

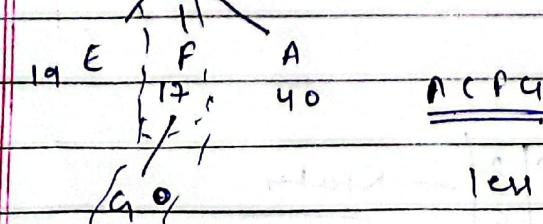
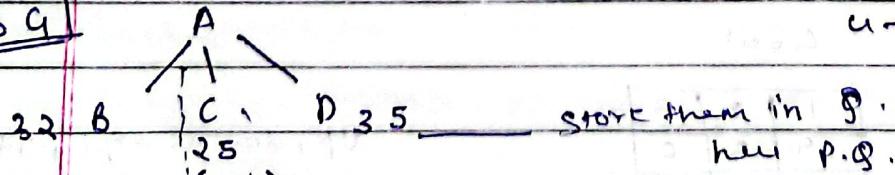
$E \rightarrow u = 19$

$F \rightarrow u = 12$

$H \rightarrow u = 10$

$u \rightarrow u = 0$

A to G

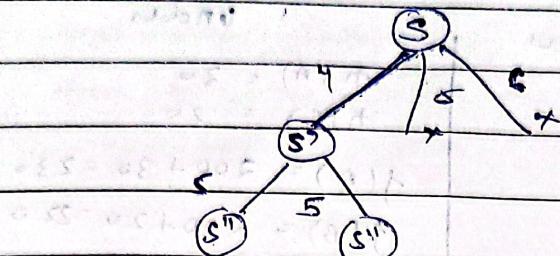


here time complexity is

less than uniformed but

solution may not be optimal.

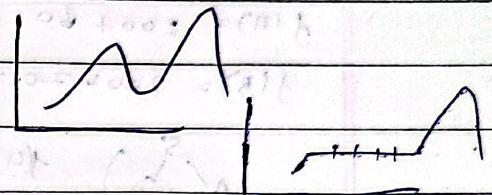
Hill climbing algorithm - It is local search algo, greedy algo and do not backtrack based on heuristic. Only explores best path.



Problem - local maximum

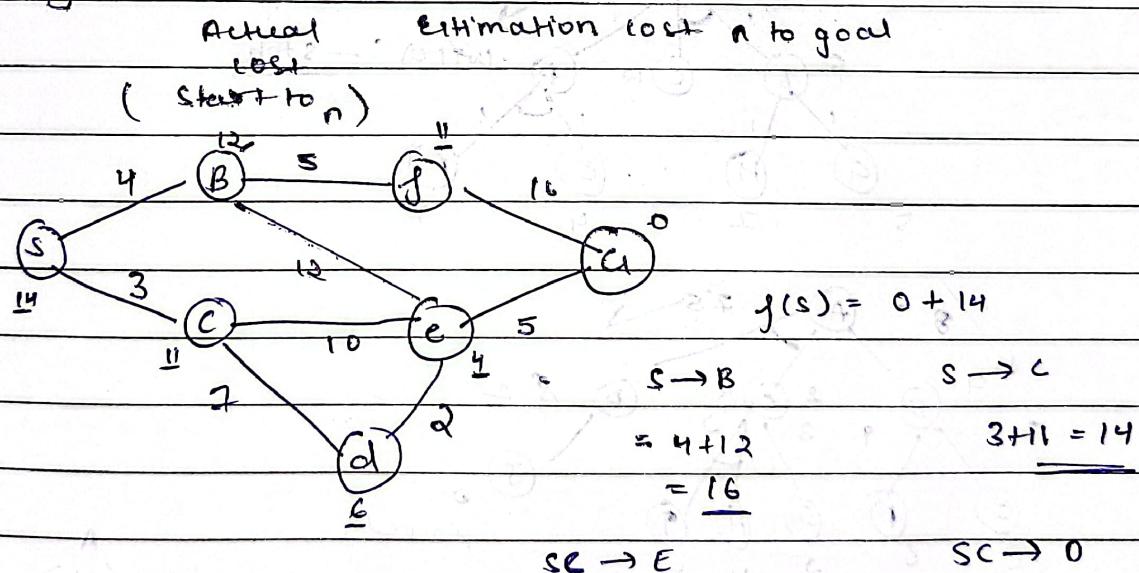
Plateau / flat maximum

Ridge, (single direction)



→ A* algorithm - informed searching
admissible

Time - $O(b^d)$



$SB \rightarrow F$

$$S + 4 + 11 = 20$$

$SB \rightarrow C$

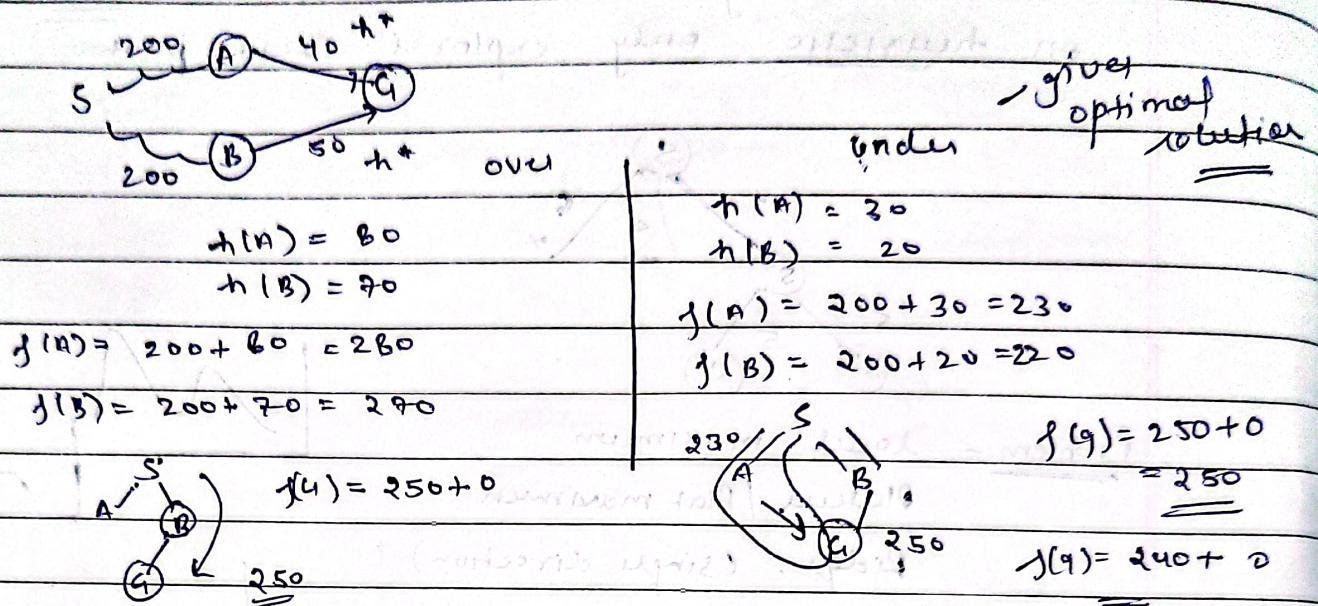
$$4 + 12 + 6 = 20$$

$SC \rightarrow e$

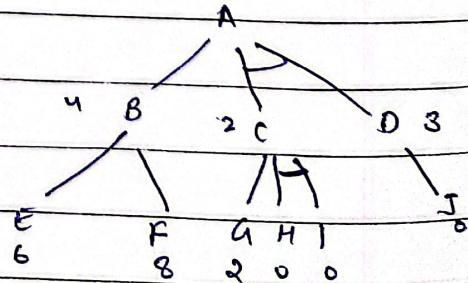
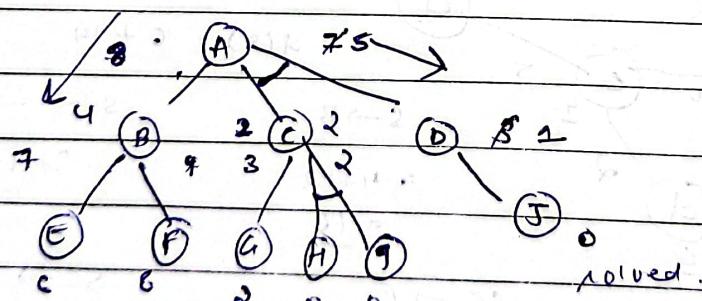
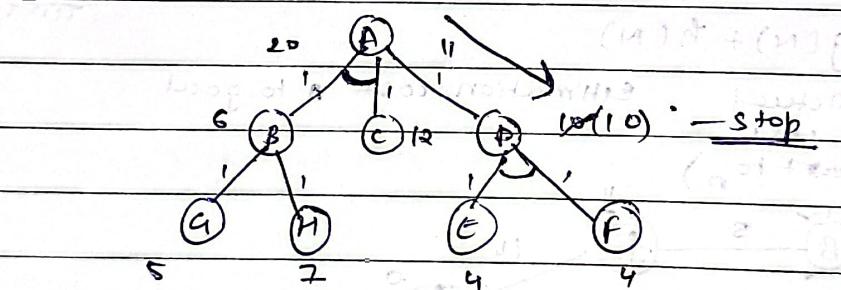
$$3 + 7 + 2 + 4 = 16$$

$SC \rightarrow G$

$$12 + 5 + 6 = 23$$

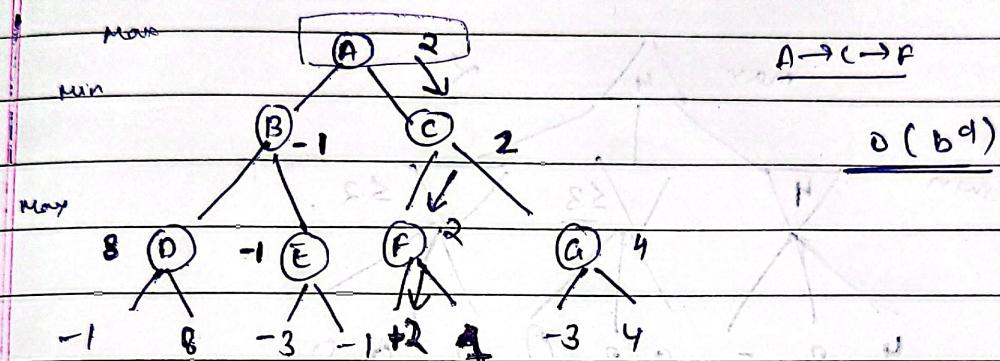
sachet cost $h(n) \leq h^*(n)$ underestimation $h(n) \geq h^*(n)$ overestimation.

→ AND/OR (AND/OR) - do not explore all the solutions paths. once it gets solution ...

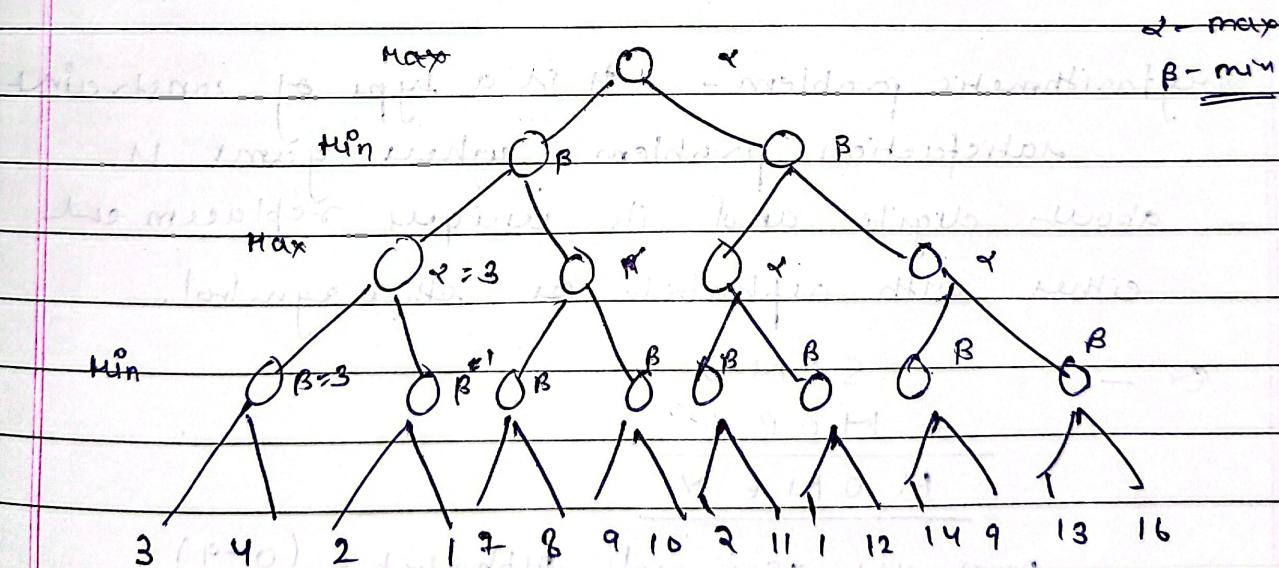


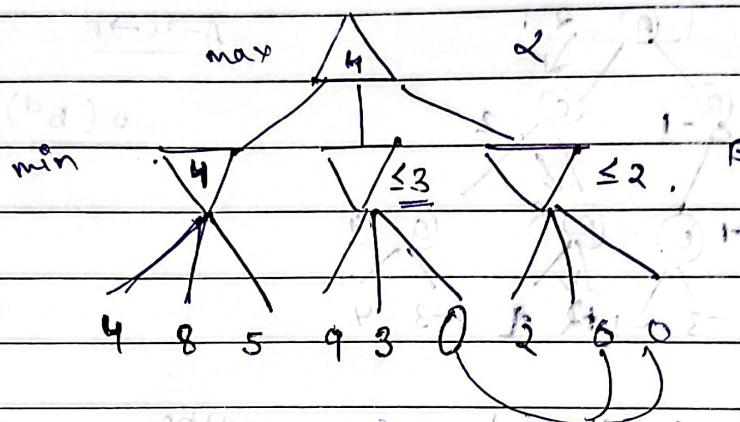
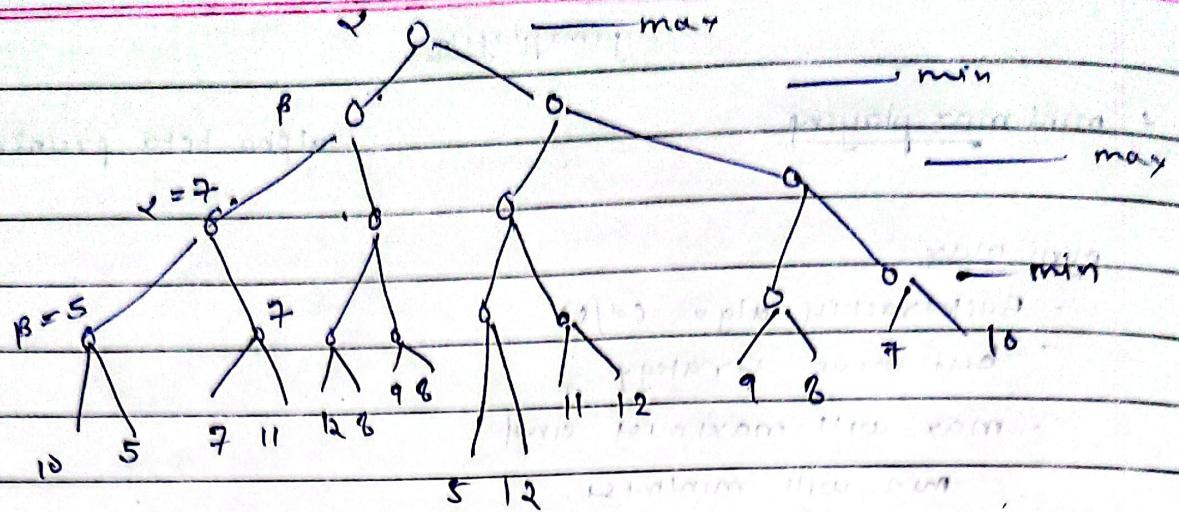
game playing* mini-max playingalpha-beta pruningmini-max

- Backtracking algo (cyc)
- best move strategy.
- max will maximise and
min will minimise.



- α - β pruning cutting down some paths, reduced search.





Cryptarithmetic problem - It is a type of constraint satisfaction problem where game is about digits and its unique replacement either with alphabet or other symbol.

$$\begin{array}{r} \text{SEND} \\ + \text{MORE} \\ \hline \text{MONEY} \end{array}$$

Digits are assigned Alphabet = (0-9)