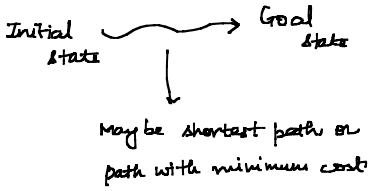
17/1/2022 AI.

Search through a State Space

I/p :- Set of states
Initial state
Goal states
Operators/ Actions [and costs]

O/p :- Path



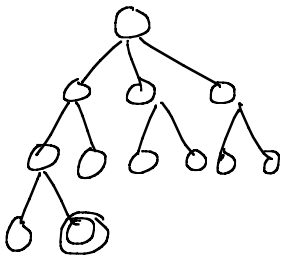
Search Algorithm

1. Let L be a list containing the initial state. (L = fringe)
2. Loop
   if L is empty return fail.
   Node ← Select (L)
   if Node is goal state then return Node (or path).
   else
   expand Node (Apply all feasible actions (operators) on Node)
   Merge all the newly generates Nodes in the list (fringe).
3. End

Search strategy

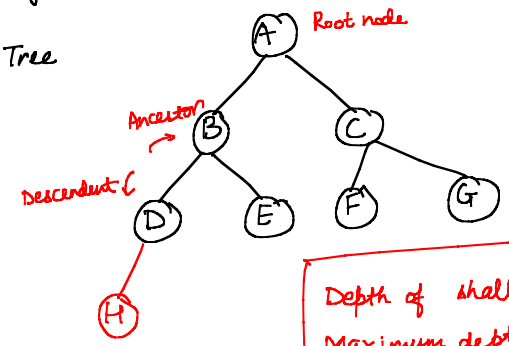
↳ completeness :- Is it guaranteed to find a solution if exists ?

↳ Optimality :- Does the solution has optimal/ minimum cost ?



↳ Complexity :- Time and space.

Search Tree



(b) Branching factor
(Maximum possible child nodes).

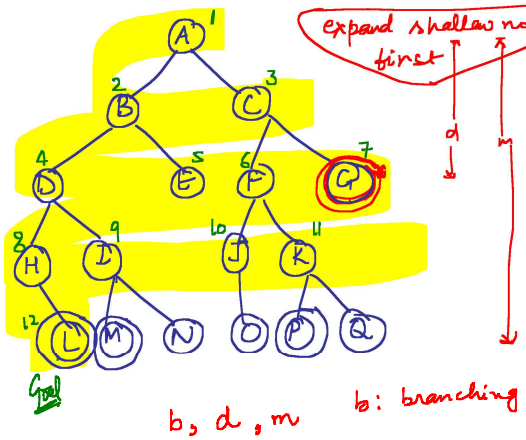
b = 2

Depth of shallowest goal node : d
Maximum depth of search tree : m

Breadth First Search

1. Let L be a list containing the initial state. (L = fringe)
2. Loop
   if L is empty return fail.
   Node ← Remove-first (fringe)
   if Node is goal state then return Node (or path).
   else
   Generate all child nodes and add them at back of fringe

3. End



expand shallow node first

BFS

Fringe

A B C D E F G H I J K L M N O P Q

d

m

1. Complete? Yes ✓

2. Optimal? Yes ✓

3. Time and space complexity.

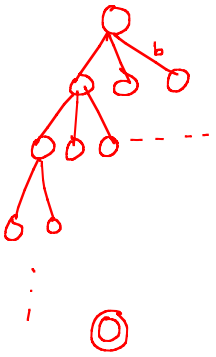
b, d, m

b: branching factor

d: depth of shallowest goal node.

m: max. depth of tree

Time complexity $= O(b^d)$



1

b

b^2

b^3

b^d

Time $= O(b^d)$

Space $= O(b^d)$

BFS :- complete
optimal.

Exponential time and space complexity. $O(b^d)$ b: branching factor
d: depth of shallowest goal node.

Advantage :- Find path of minimal length to goal.

Drs :- Exponential time in terms of depth of shallowest goal node.

Q. Lets consider a complete search tree of depth 12 where every node at depth 0 - - - 11 have 10 children and every node at depth 12 has 0 child.

How many nodes are there? $\simeq (10^{12})$

Assume If BFS expands 1000 nodes/sec and each node uses 100 Bytes of storage.

BFS will take 35 years to run in worst-case.

BFS will use 111 TB of storage.