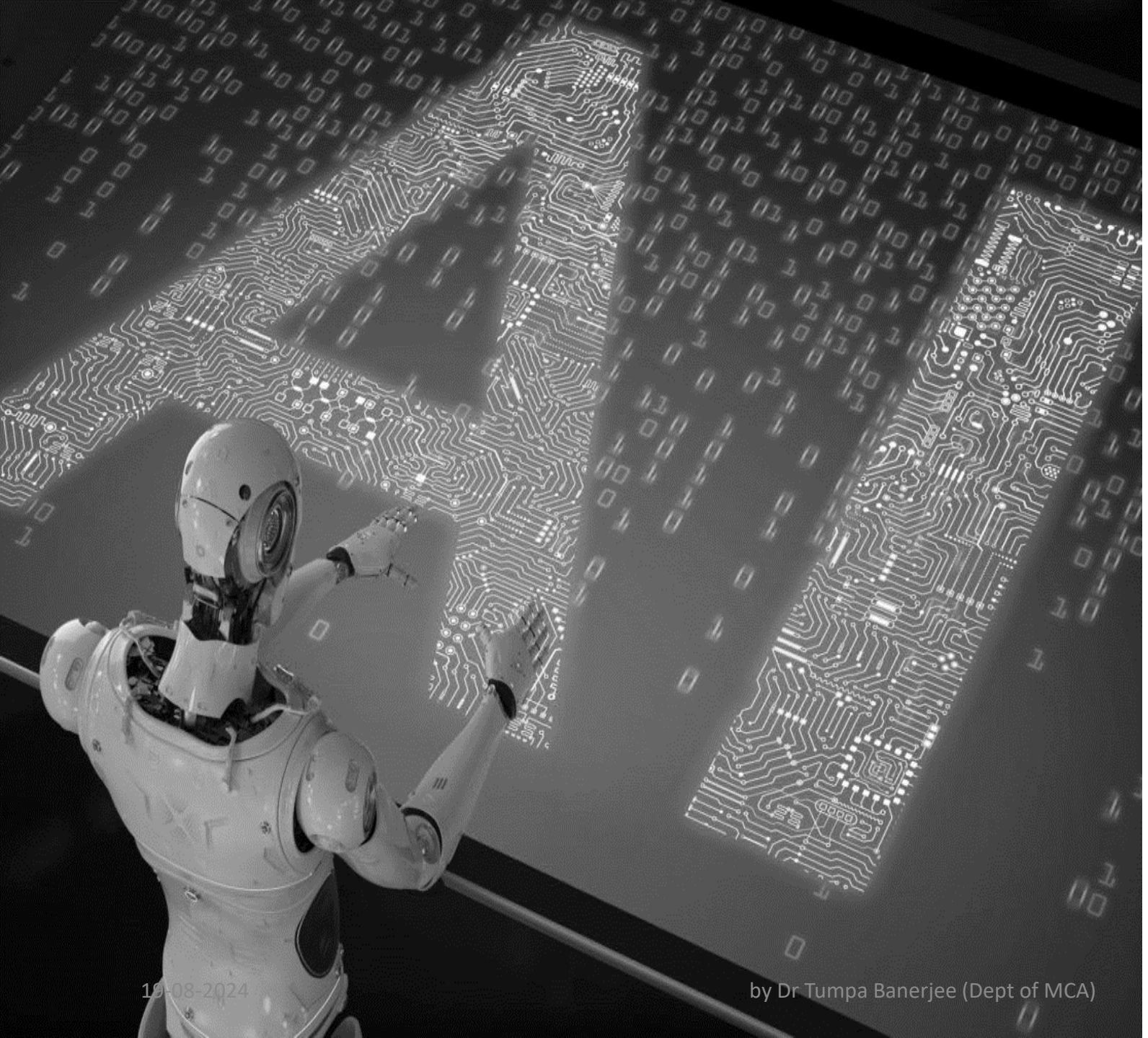


TECHNO INDIA SILIGURI INSTITUTE OF TECHNOLOGY
A Satyam Roychowdhury Initiative

Best First Search, Greedy Search, A* Search

Informed Search

Informed Search

- Systematically explore the state space and find the goal.
- Find the solution by systematically generating new states and testing them against goal.
- These strategies are incredibly inefficient in most cases.
- It use the specific knowledge of the problem.
- Core concept of such algorithm is heuristic function.

Best First Search

- Uniform Search Cost is a special case of the best first search.
- A cost function f(n) is applied to each node.
- The nodes are put in OPEN in the order of their f values.
- The nodes with smaller f(n) values are expanded earlier.

Best First Search

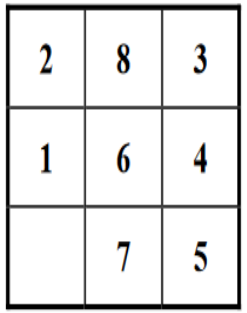
Let *fringe* be a priority queue containing the initial state
Loop
    if *fringe* is empty return failure
    Node ← remove-first (fringe)
                if Node is a goal
                    then return the path from initial state to Node
        else generate all successors of Node, and
          put the newly generated nodes into fringe
          according to their f values
End Loop

Heuristic Function

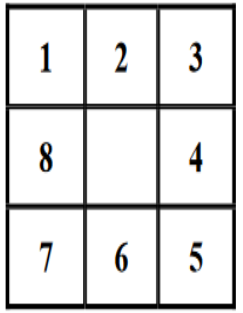
- Heuristic means “Rule of Thumb”
- “Heuristics are criteria, methods or principles for deciding which among several alternative courses of action promises to be the most effective in order to achieve some goal”-Judea Pearl
- h(n)= estimated cost of the cheapest path from node n to a goal node.

Example 1: We want a path from Kolkata to Guwahati
Heuristic for Guwahati may be straight-line distance between Kolkata and Guwahati
h(Kolkata) = euclideanDistance(Kolkata, Guwahati)

Example 2: 8-puzzle: Misplaced Tiles Heuristics is the number of tiles out of place.



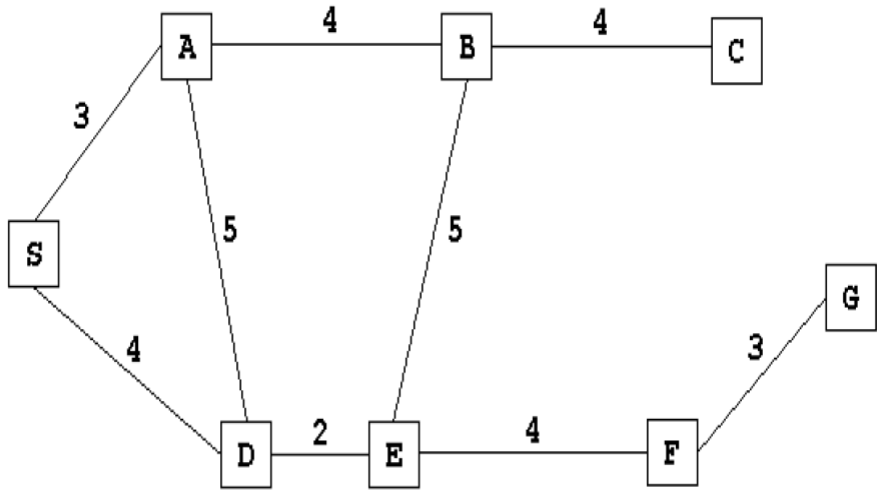
Initial State

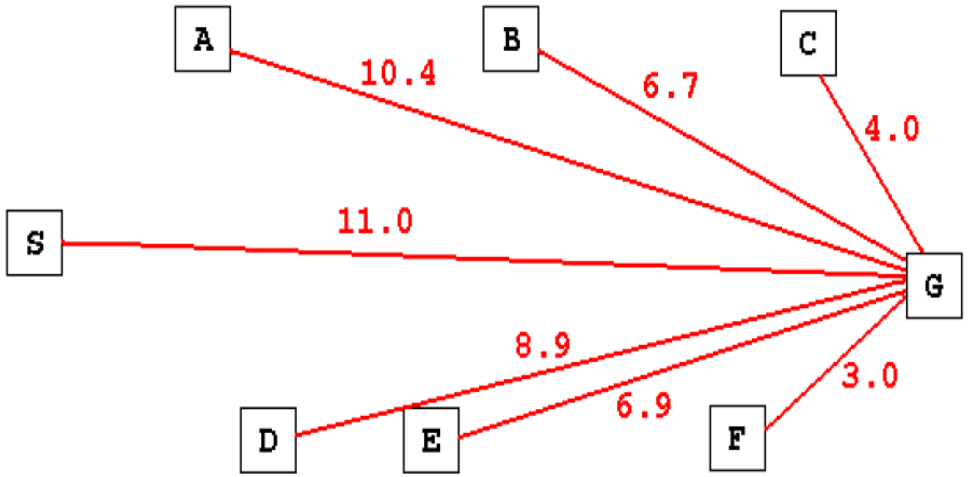


Goal state

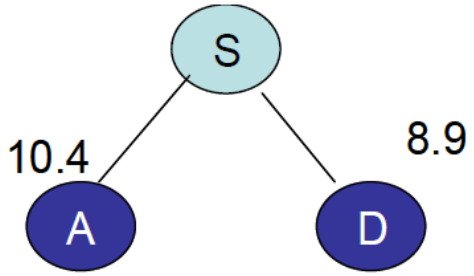
Greedy Search

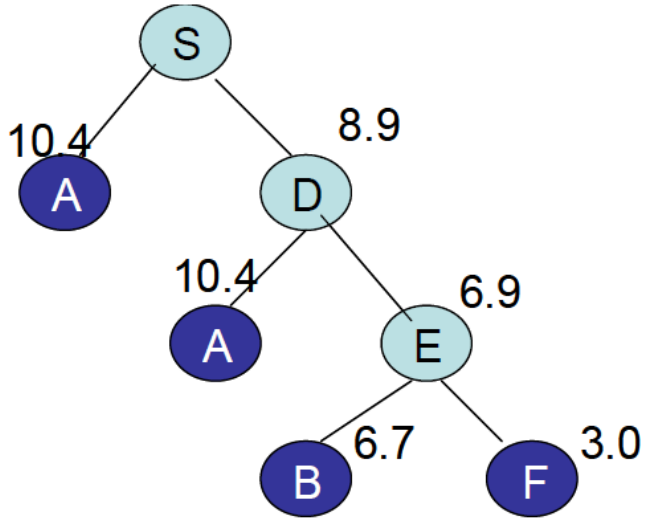
- Expand the node with smallest estimated cost to reach the goal.
- H(n) estimates the distance remaining to the goal.

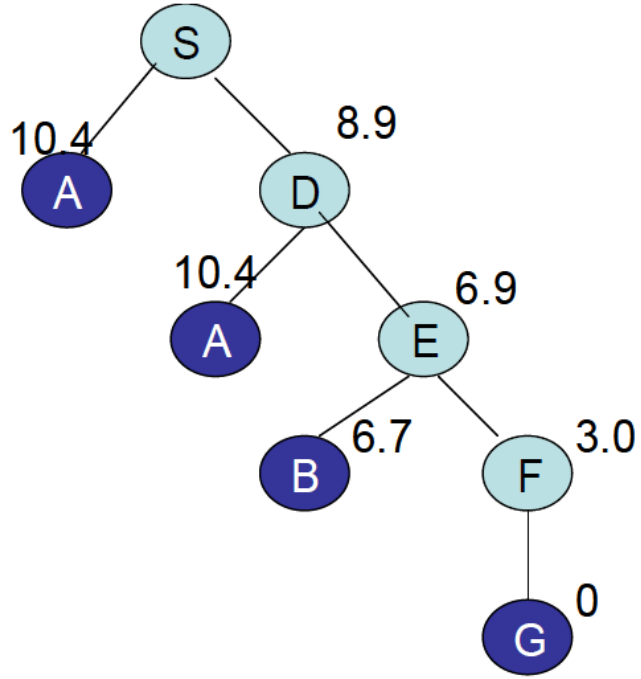


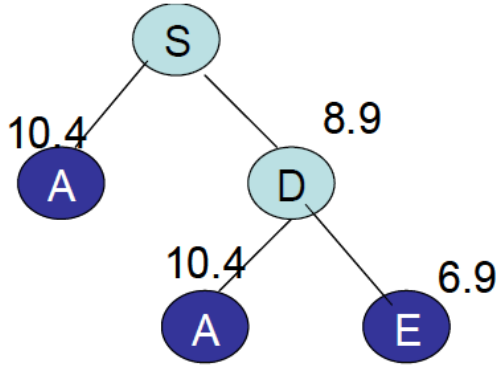


Greedy Search









A* Search

- Algorithm is given by Hart, Nilsson & Rafael in 1968
- A* is best search algorithm with f(n)=g(n)+h(n) , g(n) is sum of edge cost from start to n and h(n) is the estimate of lowest cost path from n to goal.
- f(n)=actual distance so far + estimated distance remaining
- h(n) is said to be admissible if it underestimates the cost of any solution that can be reached from n.
- If C*(n) is the cost of the cheapest solution path from n to a goal node and h(n) is admissible then h(n)<=C*(n)
- If h(n) is admissible then the search will find an optimal solution.

A* Algorithm

OPEN= nodes on frontier CLOSED= expanded nodes

OPEN={s,nil}

While OPEN is not empty

remove from OPEN the node <n,p> with minimum f(n)

place <n,p> on closed

if n is a goal node,

return success(path p)

for each edge connecting n & m with cost c

if <m,q> is on CLOSED and {p|e} is cheaper than q

then remove n from CLOSED

put <m,{p|e}> on OPEN

else if <m,q> is on OPEN and {p|e} is cheaper than q

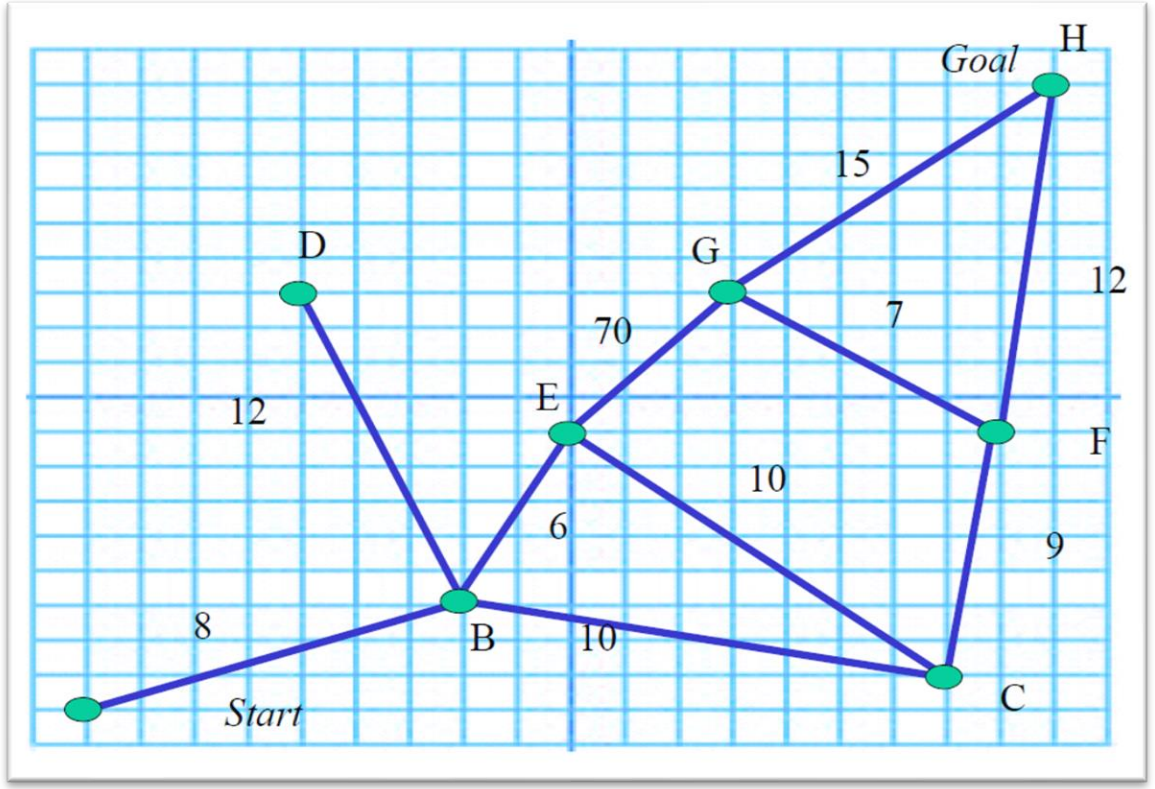
then replace q with {p|e}

else if m is not in OPEN

then put <m,{p|e}> on OPEN

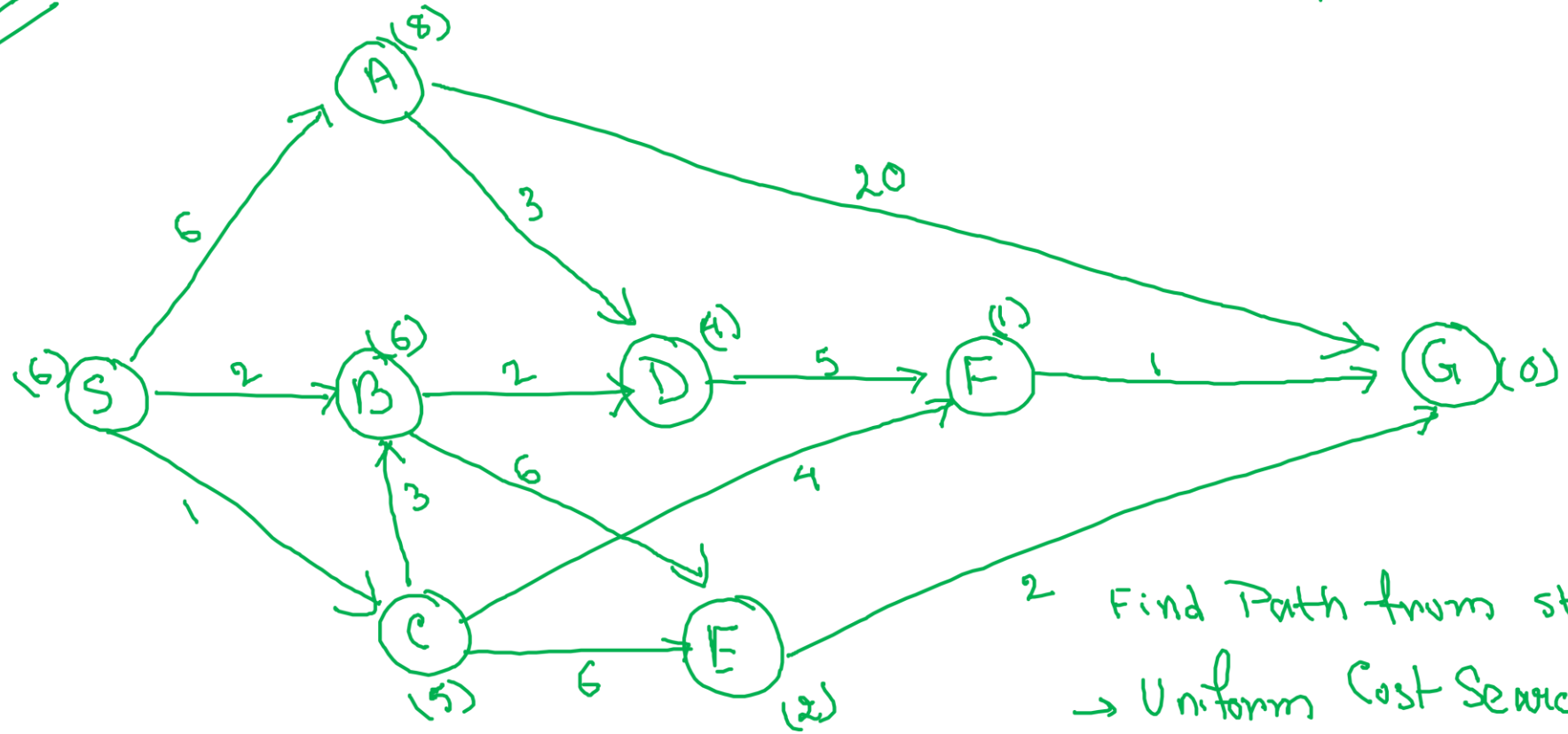
A* Algorithm

Steps	Fringe	Node expanded	Comments
1	A		
2	B(26.6)	A	
3	E(27.5), C(35.1), D(35.2)	B	
4	C(35.1), D(35.2), ~~C(41.2)~~ G(92.5)	E	C is not inserted as there is another C with lower cost.
5	D(35.2), F(37), G(92.5)	C	
6	F(37), G(92.5)	D	
7	H(39), G(42.5)	F	G is replaced with a lower cost node
8	G(42.5)	H	Goal test successful.



2016

A — B



Find Path from start (s) to Goal (G)

→ Uniform Cost Search

→ A* Search.

2018

Find path from start (S) to Goal (G) using

(a) Uniform cost search

(b) A* search