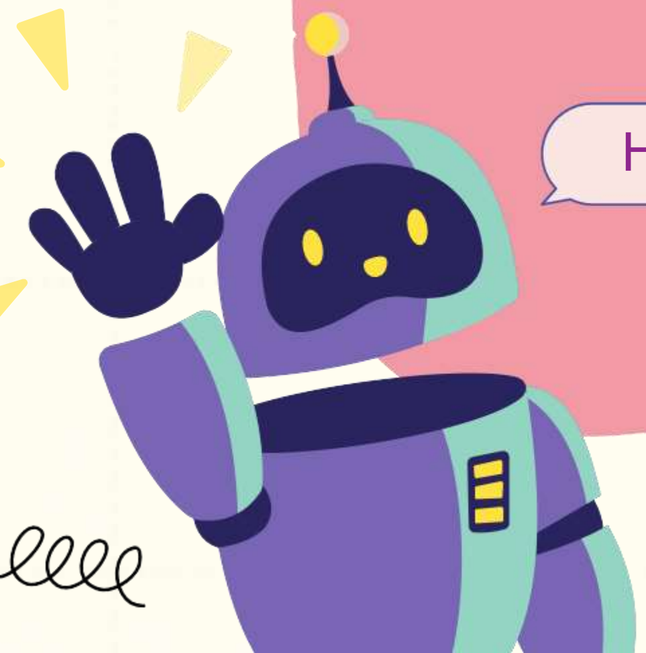
Sorting Algorithms

Of Artificial Intelligence



cONTeNTS

Harshini

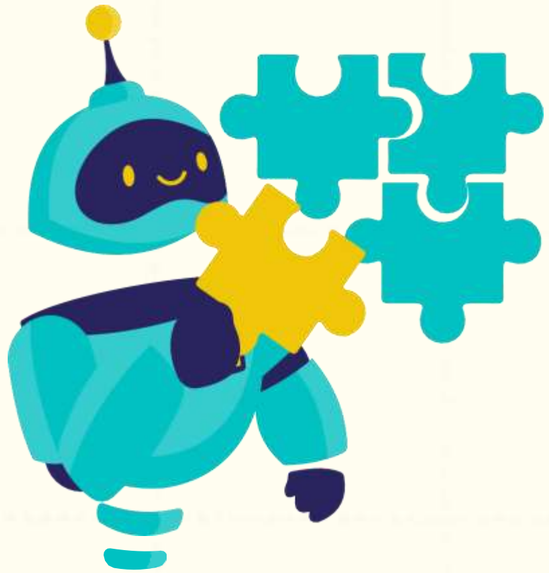
What Is Sorting Algorithm?

A sorting algorithm is a method used to arrange elements in a list or array in a specific order, typically ascending or descending

Types:

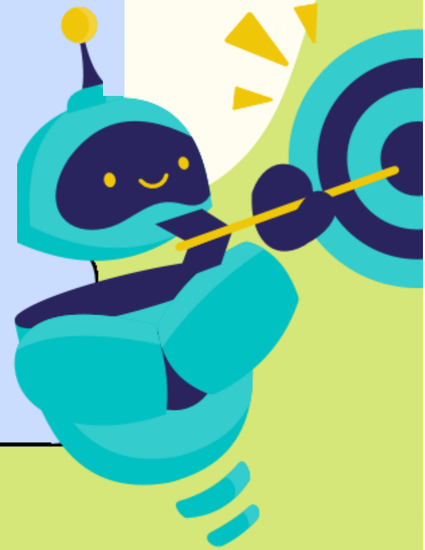
- Uninformed Search: Does not have additional information (e.g., Linear Search, Binary Search).
- Informed Search: Utilizes heuristics to find data more efficiently (e.g., A* Search, Greedy Search).

Why Is It Necessary?



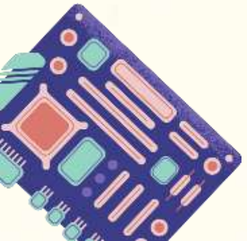
- **Data Retrieval:**
  Efficiently access and retrieve information from large datasets.
- **Performance:**
  Optimize the speed of data searches, enhancing overall system performance.
- **Scalability:**
  Enable systems to handle increasing amounts of data without compromising efficiency.

UNINFORMED SEARCH



BEADTH FIRST SEARCH:

Breadth First Search (BFS) is a fundamental graph traversal algorithm .It begins with a node(Parent node) and then first traverses all its adjacent. Once all the adjacent are visited ,then their adjacent are traversed.



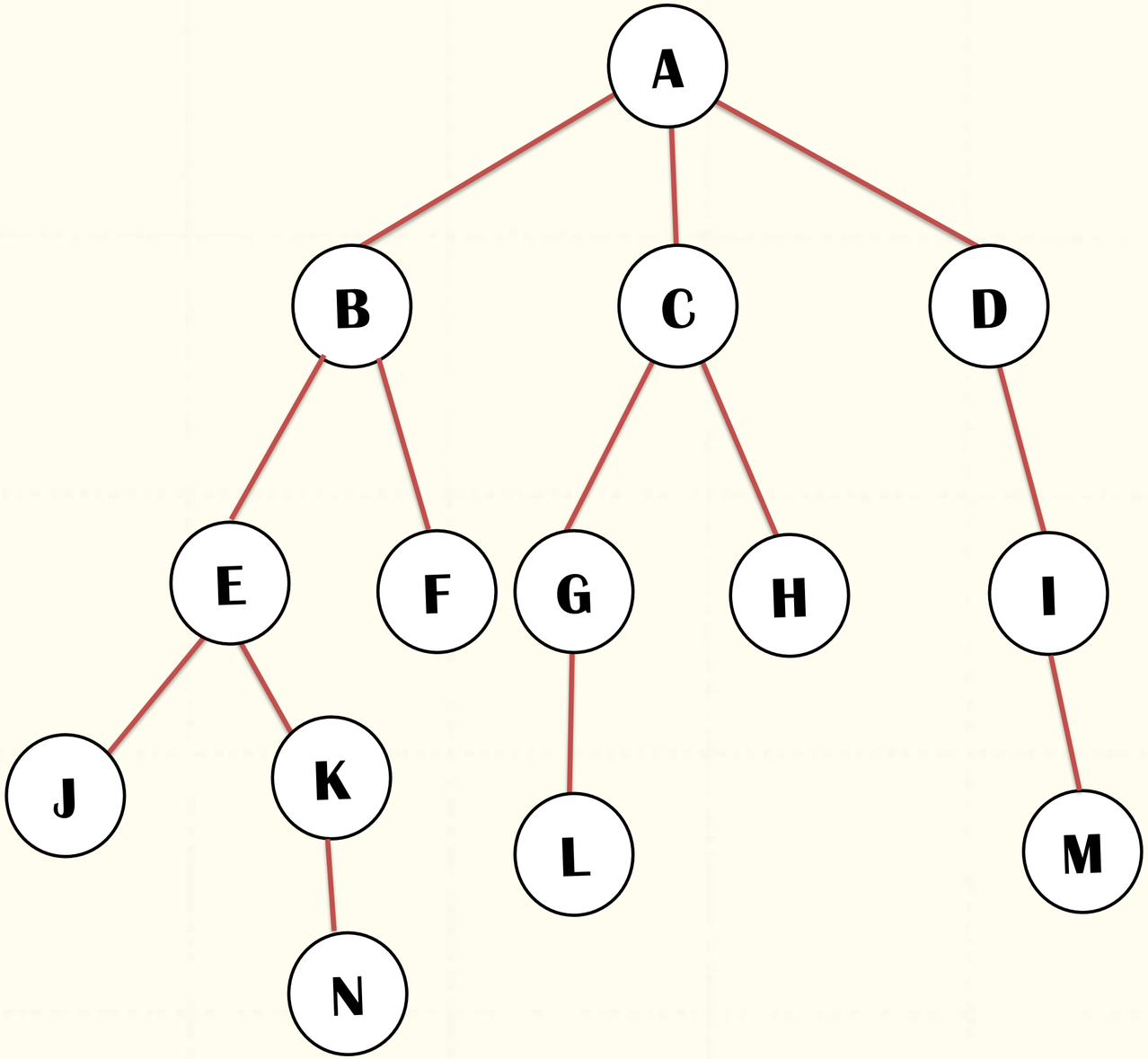
PROPERTIES

- **Uninformed Search**
- **Uses queue format (FIFO)**
- **Time complexity formula:-**

  i. For AI :- $o(b^d)$.
  ii. For Data structure:- o(V+E).

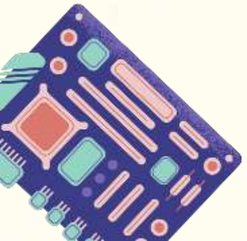
EXAMPLE

Traverse from A → N



DEPTH FIRST SEARCH:

DEPTH First Search (DFS) is an algorithm for traversing or searching tree or graph data structures. The algorithm starts at the root node and explores as far as possible along each branch before backtracking. It is more time consuming than BFS. There are chances in getting trapped in a loop.

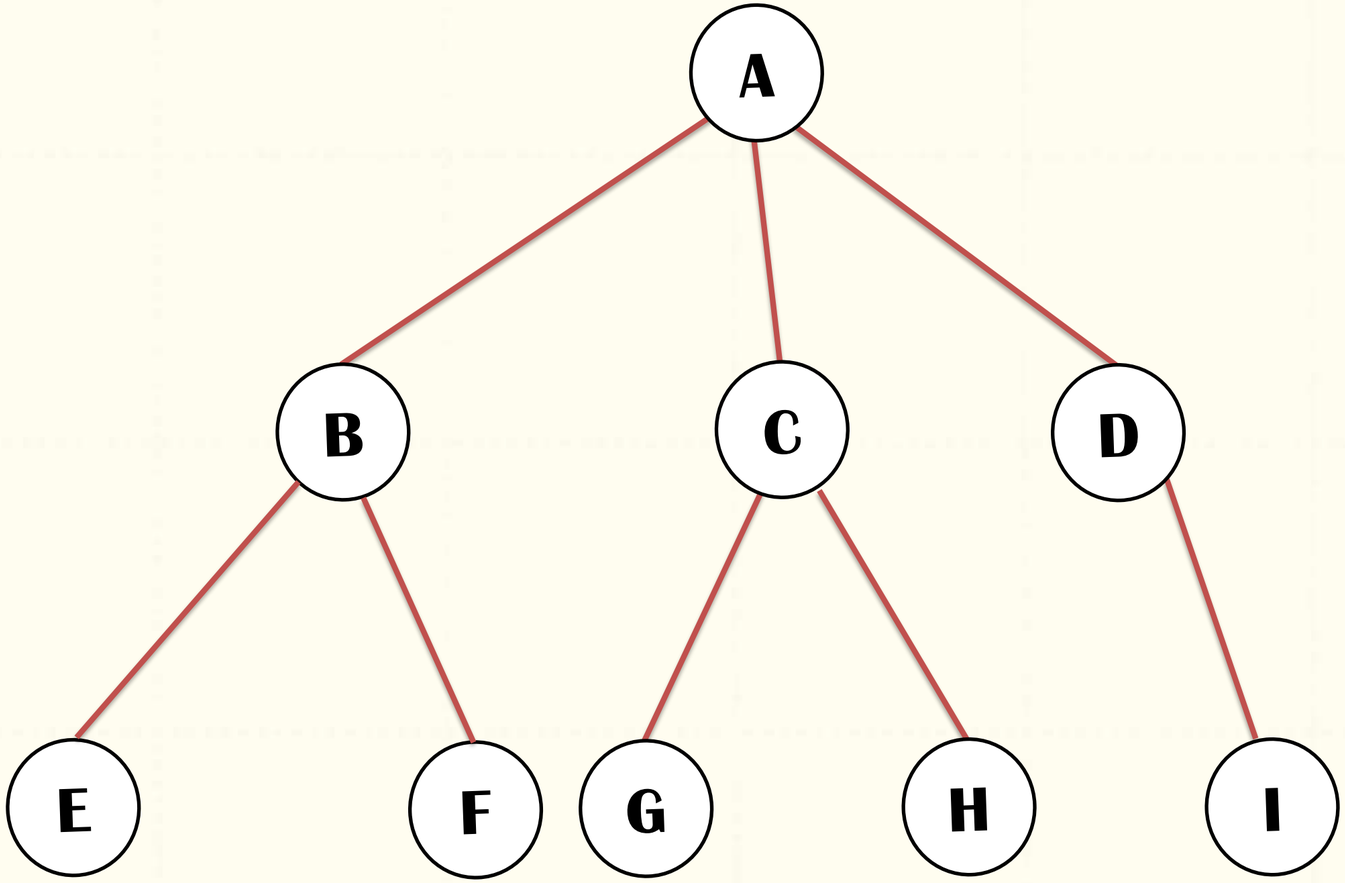


PROPERTIES

- **Uninformed Search**
- **Uses stack format(LIFO)**
- **Time complexity formula:-**
  i. For AI :- $o(b^d)$.
  ii. For Data structure:- o(V+E).

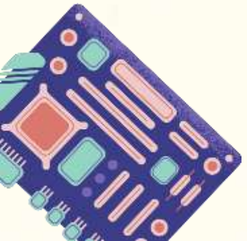
EXAMPLE

Traverse from A → I



UNIFORMED-COST SEARCH:

Uniform Cost Search (UCS) is a popular search algorithm used in artificial intelligence (AI) for finding the least cost path in a graph. It is used when all edges of the graph have different weights or costs, and the goal is to find the path with the minimum total cost from a start node to a goal node.

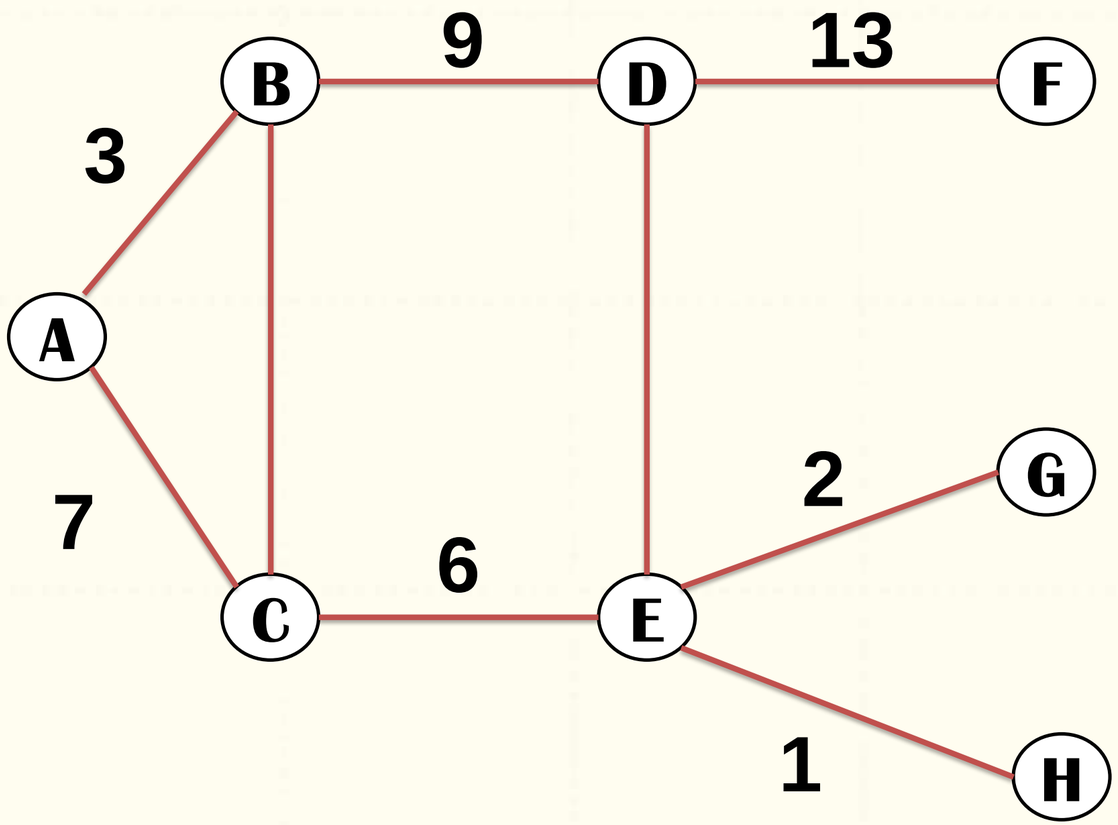


PROPERTIES

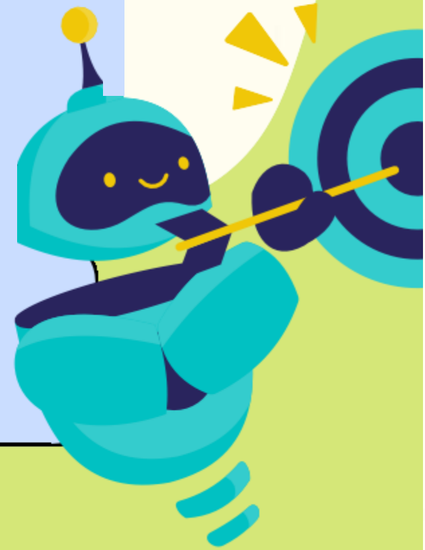
- Uninformed search.
- Used for traversing when a different cost is available for each edge.
- The goal is to find a path with least cost.
- Time Complexity : O[b(1 + C/e)]

EXAMPLE

Traverse from A → F

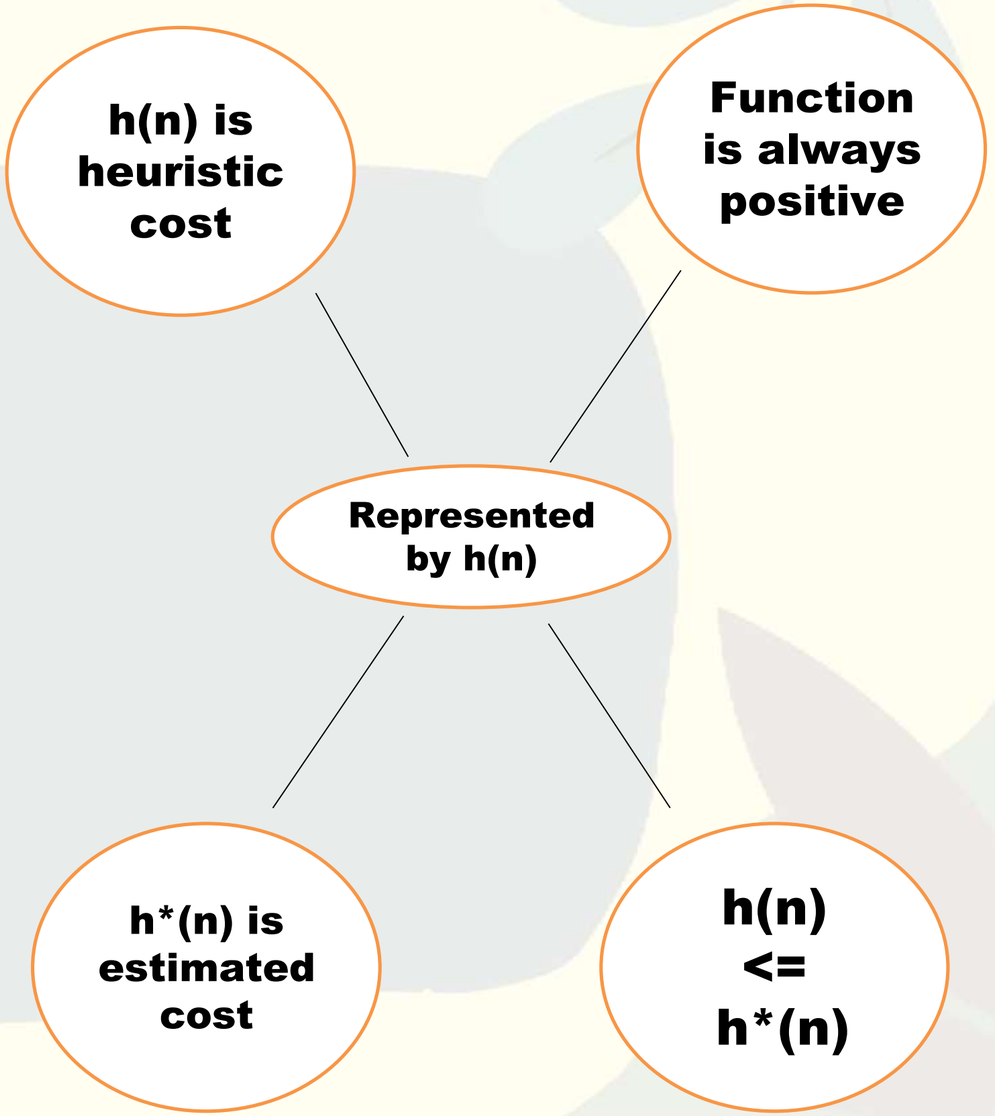


INFORMED SEARCH



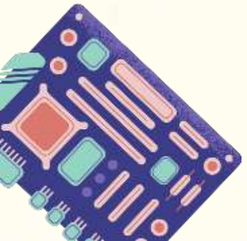
What is Heuristic?

1. Heuristic in AI refers to the technique designed to find the solution of a problem quickly.
2. a function used in informed searched and it finds the most promising path.
3. estimates how close agent is from the goal.



BEST FIRST SEARCH:

Best First Search is a heuristic search algorithm that selects the most promising node for expansion based on an evaluation function. It prioritizes nodes in the search space using a heuristic to estimate their potential. By iteratively choosing the most promising node, it aims to efficiently navigate towards the goal state, making it particularly effective for optimization problems.



PROPERTIES

- Informed search.
- Uses priority queue and heuristic search.
- Uses two lists for tracking traversals.
- f(n)= g(n) where g(n) is path distance

OPEN- current, immediate nodes for traversal

CLOSED- nodes already traversed

Algorithm- :

let 'OPEN' be the priority queue containing initial values.

LOOP-

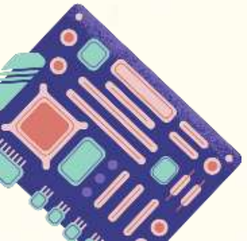
If OPEN is empty return false

Remove first node

If node is goal, return the path from initial to node

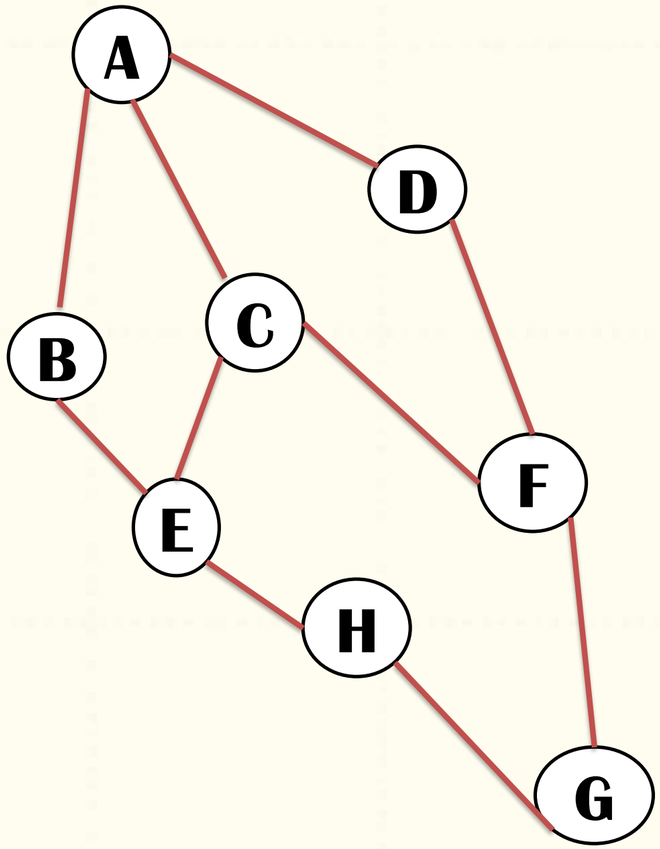
Else generate all 'immediate' next nodes and put the newly generated node into OPEN according their f values

END LOOP



EXAMPLE

Traverse from A → G



Path distance- g(n)

A-> G =40

B-> G =32

C-> G =25

D-> G =35

E-> G =19

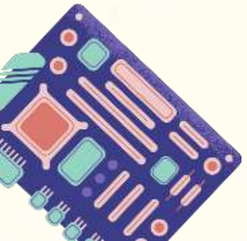
F-> G =17

H-> G =10

G-> G =0

A* SEARCH:

A* Search is a path finding algorithm that finds the single-pair shortest path between the start node(source) and the target node(destination) of a weighted graph. The algorithm not only considers the actual cost from the start node to the current node(g) but also tries to estimate the cost will take from the current node to the target node using heuristics (h). Then it selects the node that has the lowest f-value (f=g+h) to be the next node to move until it hits the target node.



PROPERTIES

- Informed search, heuristic search
- Works using heuristic value.
- Uses two functions .
- f(n)= g(n)+h(n)

h(n) : estimation cost from n to goal node

g(n): actual cost from start node to n

Algorithm :

Step-01:

- Define a list OPEN.
- Initially, OPEN consists solely of a single node, the start node S.

Step-02:

If the list is empty, return failure and exit.

Step-03:

- Remove node n with the smallest value of f(n) from OPEN and move it to list CLOSED.
- If node n is a goal state, return success and exit.

Step-04:

Expand node n.

Step-05:

- If any successor to n is the goal node, return success and the solution by tracing the path from goal node to S.
- Otherwise, go to Step-06.

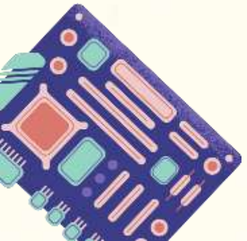
Step-06:

For each successor node,

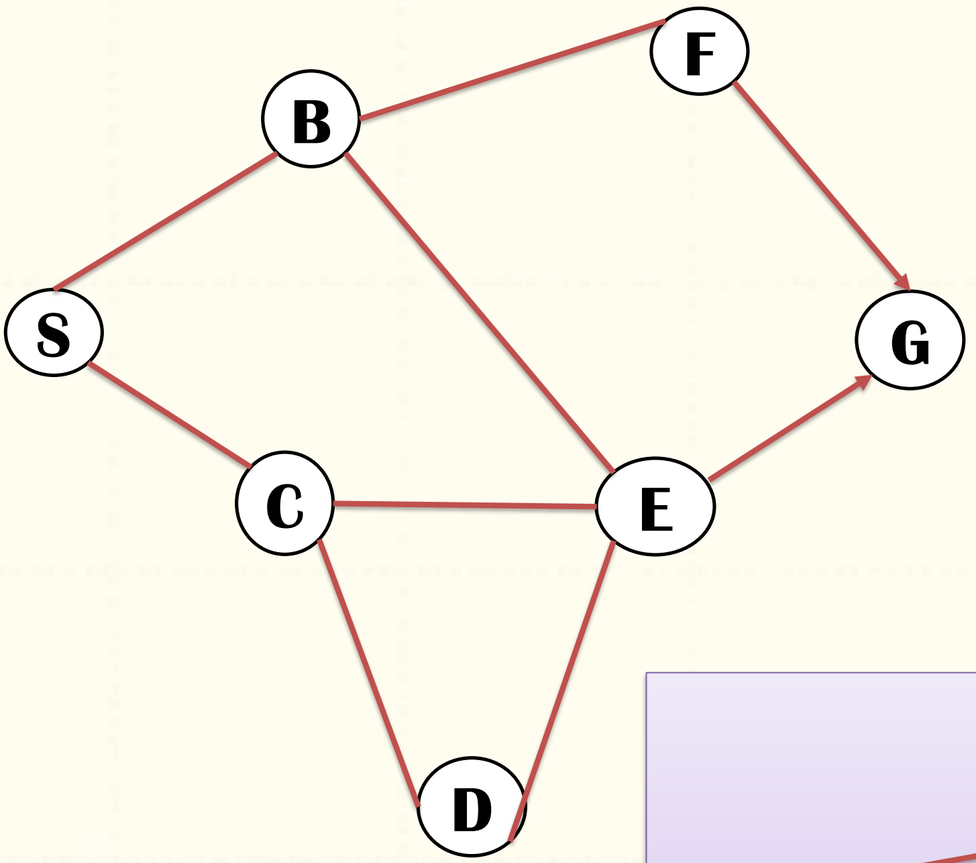
- Apply the evaluation function f to the node.
- If the node has not been in either list, add it to OPEN.

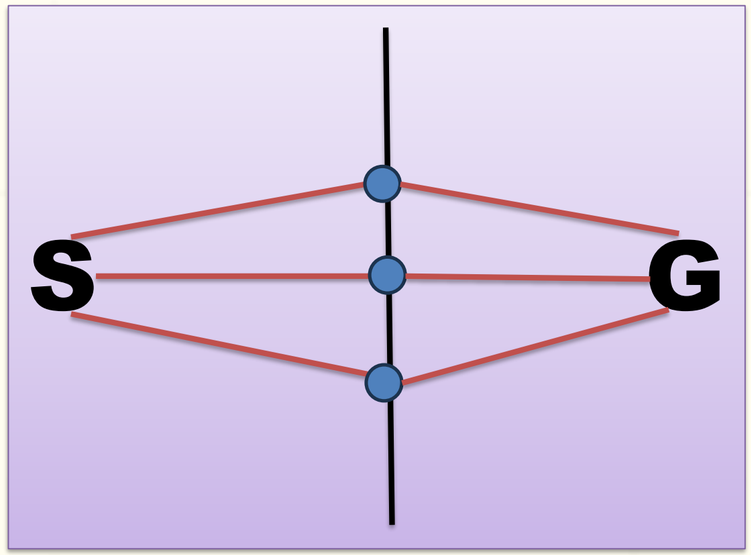
Step-07:

Go back to Step-02.



Example





f(S)= 0+14 = 14

S->B= 4+12= 16

S->C= 3+11= 14

SC->E=3+10+4=17

SC->D=3+7+6= 16

SCD->E= 3+7+2+4=16

SCDE->G=12+5+0=17

SB->F=5+4+11= 20

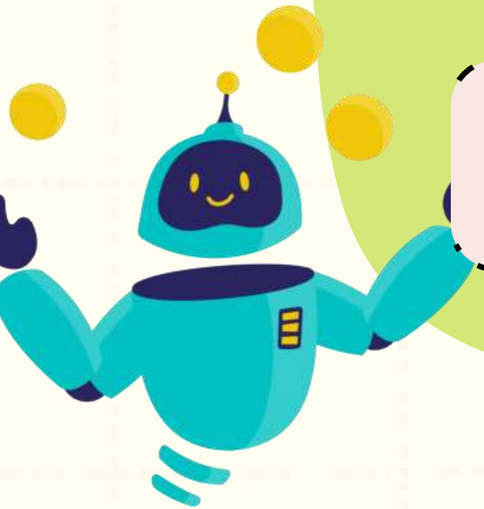
SB->E= 4+12+4=20

SBF->G=9+16+0=25

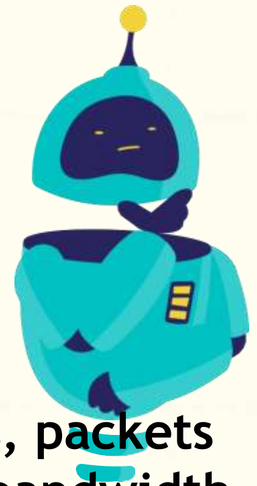
Applications Of Sorting Algorithm

Some examples of usage of sorting Algorithm are as follows :

- E-commerce Platforms
- Data analysis
- Event Scheduling
- Networking



Modern Use cases



- **Product sorting**: Customers can sort products by price, ratings, or newest arrivals, making it easier to find desired items.
- **Packet Scheduling**: In network routers, packets can be sorted by priority to optimize bandwidth usage.
- **Statistical Reports**: Sorting datasets helps in analyzing trends, such as identifying top-selling products.
- **File Organization**: Operating systems sort files in directions by name, size, or date modified for easier navigation.
- **Task Lists**: Sorting tasks by deadlines or priority ensures timely completion of important activities.
- **Query results**: When retrieving records,results are often sorted by specific fields like sorting customer names alphabetically.

Thanks for listening

Any questions?