**EXERCISE-5**

**AIM:** Write a code to implement A\* Algorithm

**Problem**:

## A\* Algorithm

A\* search is the most commonly known form of best-first search. It uses heuristic function h(n), and cost to reach the node n from the start state g(n). It has combined features of UCS and greedy best-first search, by which it solve the problem efficiently. A\* search algorithm finds the shortest path through the search space using the heuristic function. This search algorithm expands less search tree and provides optimal result faster. A\* algorithm is similar to UCS except that it uses g(n)+h(n) instead of g(n).

In A\* search algorithm, we use search heuristic as well as the cost to reach the node. Hence we can combine both costs as following, and this sum is called as a **fitness number**.

## Informed Search Algorithms

### Algorithm of A\* search:

**Step1:** Place the starting node in the OPEN list.

**Step 2:** Check if the OPEN list is empty or not, if the list is empty then return failure and stops.

**Step 3:** Select the node from the OPEN list which has the smallest value of evaluation function (g+h), if node n is goal node then return success and stop, otherwise

**Step 4:** Expand node n and generate all of its successors, and put n into the closed list. For each successor n', check whether n' is already in the OPEN or CLOSED list, if not then compute evaluation function for n' and place into Open list.

**Step 5:** Else if node n' is already in OPEN and CLOSED, then it should be attached to the back pointer which reflects the lowest g(n') value.

**Step 6:** Return to **Step 2**.

**Source Code:**

def aStarAlgo(start\_node, stop\_node):

open\_set = set(start\_node)

closed\_set = set()

g = {} #store distance from starting node

parents = {} # parents contains an adjacency map of all nodes

#distance of starting node from itself is zero

g[start\_node] = 0

#start\_node is root node i.e it has no parent nodes

#so start\_node is set to its own parent node

parents[start\_node] = start\_node

while len(open\_set) > 0:

n = None

#node with lowest f() is found

for v in open\_set:

if n == None or g[v] + heuristic(v) < g[n] + heuristic(n):

n = v

if n == stop\_node or Graph\_nodes[n] == None:

pass

else:

for (m, weight) in get\_neighbors(n):

#nodes 'm' not in first and last set are added to first

#n is set its parent

if m not in open\_set and m not in closed\_set:

open\_set.add(m)

parents[m] = n

g[m] = g[n] + weight

#for each node m,compare its distance from start i.e g(m) to the

#from start through n node

else:

if g[m] > g[n] + weight:

#update g(m)

g[m] = g[n] + weight

#change parent of m to n

parents[m] = n

#if m in closed set,remove and add to open

if m in closed\_set:

closed\_set.remove(m)

open\_set.add(m)

if n == None:

print('Path does not exist!')

return None

# if the current node is the stop\_node then we begin

# reconstruct in the path from it to the start\_node

if n == stop\_node:

path = []

while parents[n] != n:

path.append(n)

n = parents[n]

path.append(start\_node)

path.reverse()

print('Path found: {}'.format(path))

return path

# remove n from the open\_list, and add it to closed\_list

# because all of his neighbors were inspected

open\_set.remove(n)

closed\_set.add(n)

print('Path does not exist!')

return None

#define fuction to return neighbor and its distance

#from the passed node

def get\_neighbors(v):

if v in Graph\_nodes:

return Graph\_nodes[v]

else:

return None

#we ll consider heuristic distances given

#and this function returns heuristic distance for all nodes

def heuristic(n):

H\_dist = {

'A': 11,

'B': 6,

'C': 5,

'D': 7,

'E': 3,

'F': 6,

'G': 5,

'H': 3,

'I': 1,

'J': 0

}

return H\_dist[n]

#Describe your graph here

Graph\_nodes = {

'A': [('B', 6), ('F', 3)],

'B': [('A', 6), ('C', 3), ('D', 2)],

'C': [('B', 3), ('D', 1), ('E', 5)],

'D': [('B', 2), ('C', 1), ('E', 8)],

'E': [('C', 5), ('D', 8), ('I', 5), ('J', 5)],

'F': [('A', 3), ('G', 1), ('H', 7)],

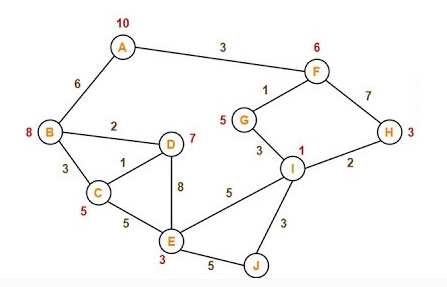
'G': [('F', 1), ('I', 3)],

'H': [('F', 7), ('I', 2)],

'I': [('E', 5), ('G', 3), ('H', 2), ('J', 3)],

}

aStarAlgo('A', 'J')

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**Output:**

Path found: ['A', 'F', 'G', 'I', 'J']