# AI EX 5

## <u>BEST FIRST SEARCH</u>

**<u>AIM:</u>** To create a Graph and implement the traversal technique best first search

**<u>PROBLEM STATEMENT:</u>**

In BFS and DFS, when we are at a node, we can consider any of the adjacent as next node. So, both BFS and DFS blindly explore paths without considering any cost function. The idea of Best First Search is to use an evaluation function to decide which adjacent is most promising and then explore. Best First Search falls under the category of Heuristic Search or Informed Search. We use a priority queue to store costs of nodes. So the implementation is a variation of BFS, we just need to change Queue to Priority Queue.

**<u>ALGORITHM:</u>**

1. Create an empty PriorityQueue

 PriorityQueue pq;

2. Insert "start" in pq.

 pq.insert(start)

3. Until PriorityQueue is empty

 u = PriorityQueue.DeleteMin

 If u is the goal

 Exit

Else

Foreach neighbor v of u

If v "Unvisited"

Mark v "Visited"

pq.insert(v)

Mark u "Examined"

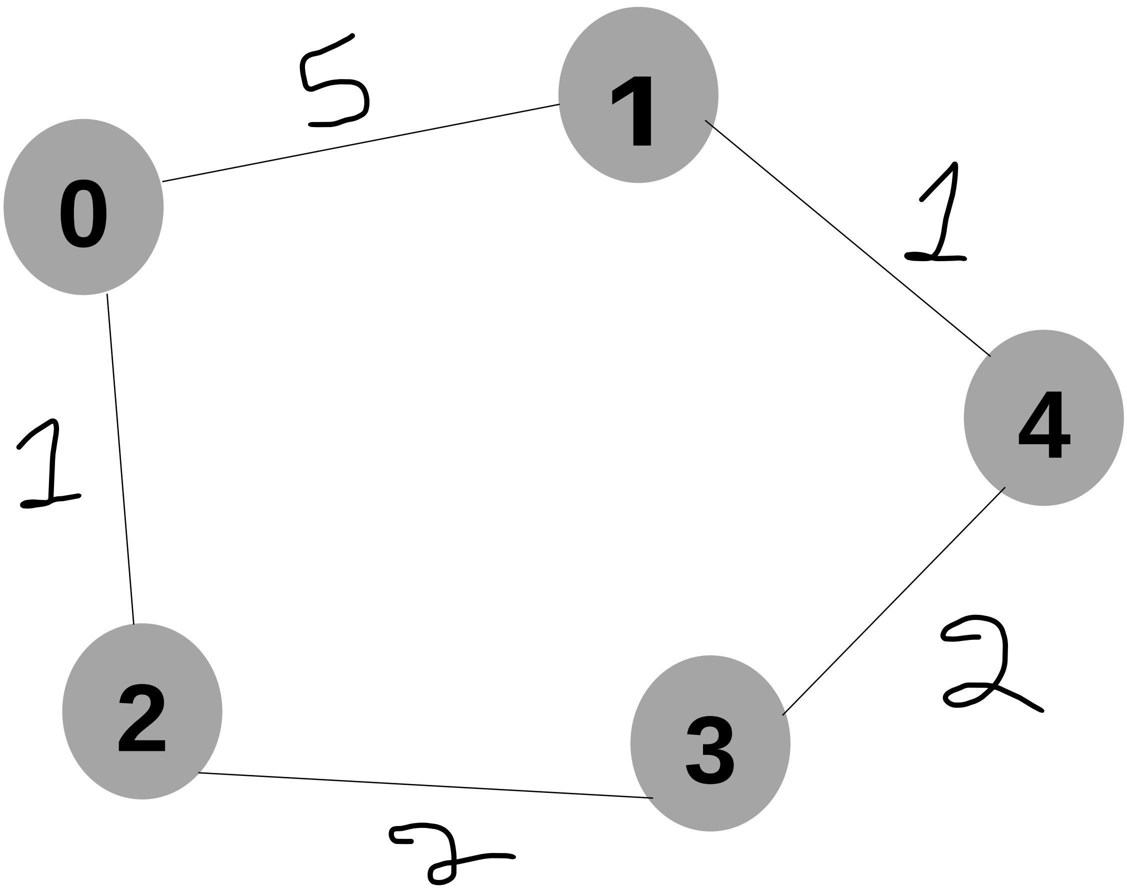
End procedure

**CODE:**

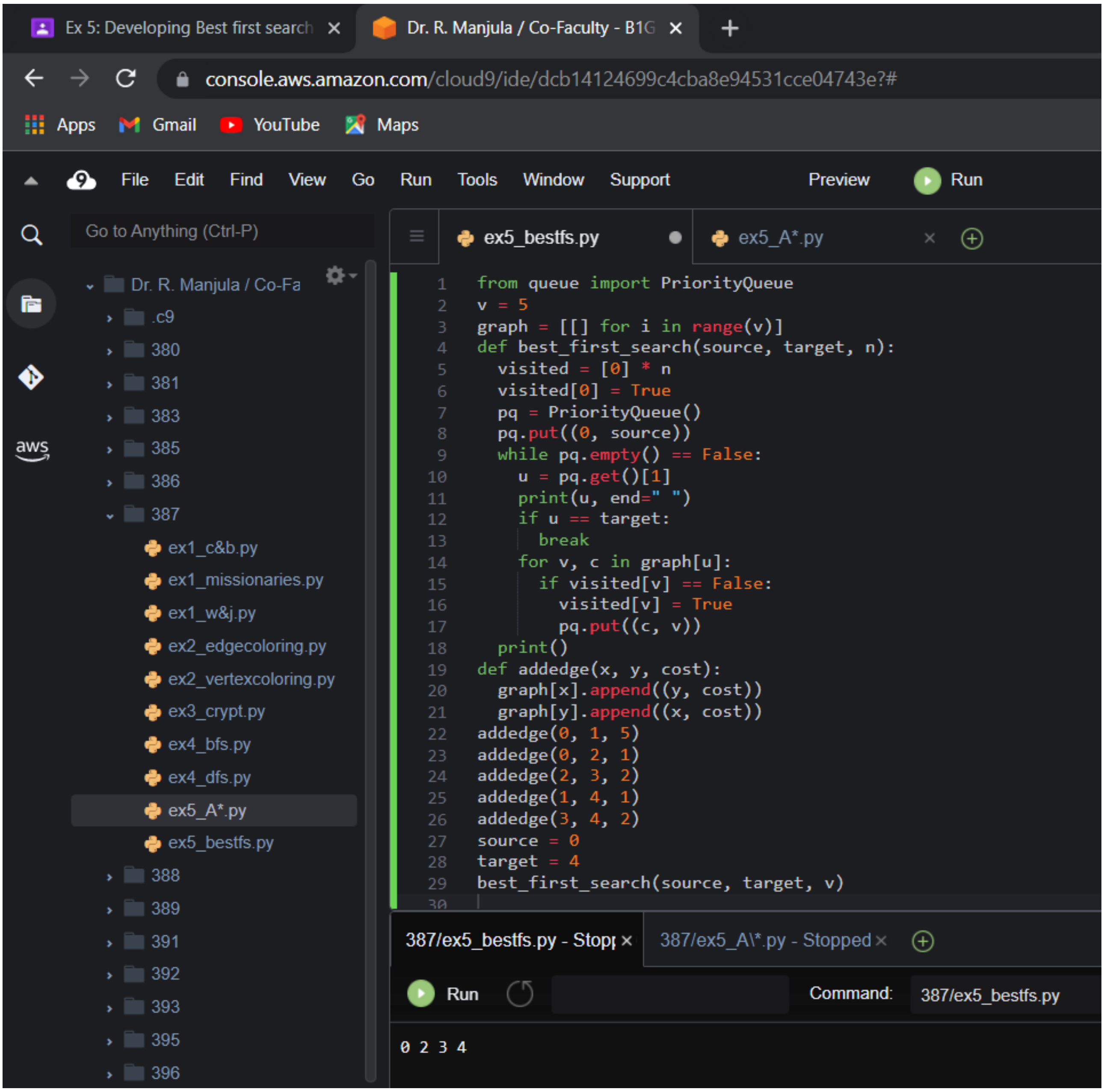
```
from queue import PriorityQueue
v = 5
graph = [[] for i in range(v)]
def best_first_search(source, target, n):
  visited = [0] * n
  visited[0] = True
  pq = PriorityQueue()
  pq.put((0, source))
  while pq.empty() == False:
    u = pq.get()[1]
    print(u, end=" ")
    if u == target:
      break
    for v, c in graph[u]:
      if visited[v] == False:
        visited[v] = True
        pq.put((c, v))
  print()
```

```
def addedge(x, y, cost):
  graph[x].append((y, cost))
  graph[y].append((x, cost))
addedge(0, 1, 5)
addedge(0, 2, 1)
addedge(2, 3, 2)
addedge(1, 4, 1)
addedge(3, 4, 2)
source = 0
target = 4
best_first_search(source, target, v)
```

**GRAPH:**



## OUTPUT:




**RESULT:** **Best First Search algorithms is implemented Successfully**

# A * SEARCH

**AIM:** To create a Graph and implement the traversal technique A* search

**PROBLEM STATEMENT:**

A heuristic algorithm sacrifices optimality, with precision and accuracy for speed, to solve problems faster and more efficiently. All graphs have different nodes or points which the algorithm has to take, to reach the final node. The paths between these nodes all have a numerical value, which is considered as the weight of the path. The total of all paths transverse gives you the cost of that route. Initially, the Algorithm calculates the cost to all its immediate neighboring nodes,n, and chooses the one incurring the least cost. This process repeats until no new nodes can be chosen and all paths have been traversed. Then, you should consider the best path among them. If f(n) represents the final cost, then it can be denoted as :

$f(n) = g(n) + h(n)$, where:

$g(n)$ = cost of traversing from one node to another. This will vary from node to node

$h(n)$ = heuristic approximation of the node's value. This is not a real value but an approximation cost

**ALGORITHM:**

1. Make an open list containing starting node

   i. If it reaches the destination node: Make a closed empty list

   ii. If it does not reach the destination node, then consider a node with the lowest f-score in the open list

We are finished

2. Else :

Put the current node in the list and check its neighbors

3. For each neighbor of the current node :

If the neighbor has a lower g value than the current node and

is in the closed list:

Replace neighbor with this new node as the neighbor's parent

4. Else If (current g is lower and neighbor is in the open list):

Replace neighbor with the lower g value and change the neighbor's parent to the current node.

5. Else If the neighbor is not in both lists:

Add it to the open list and set its g

**CODE:**

```
from collections import deque


class Graph:
    # example of adjacency list (or rather map)
    # adjacency_list = {
    # 'A': [('B', 1), ('C', 3), ('D', 7)],
```

```
    # 'B': [('D', 5)],
    # 'C': [('D', 12)]
    # }

    def __init__(self, adjacency_list):
        self.adjacency_list = adjacency_list

    def get_neighbors(self, v):
        return self.adjacency_list[v]

    # heuristic function with equal values for all nodes
    def h(self, n):
        H = {
            'A': 1,
            'B': 1,
            'C': 1,
            'D': 1
        }

        return H[n]

    def a_star_algorithm(self, start_node, stop_node):
        # open_list is a list of nodes which have been visited, but
who's neighbors
        # haven't all been inspected, starts off with the start node
```

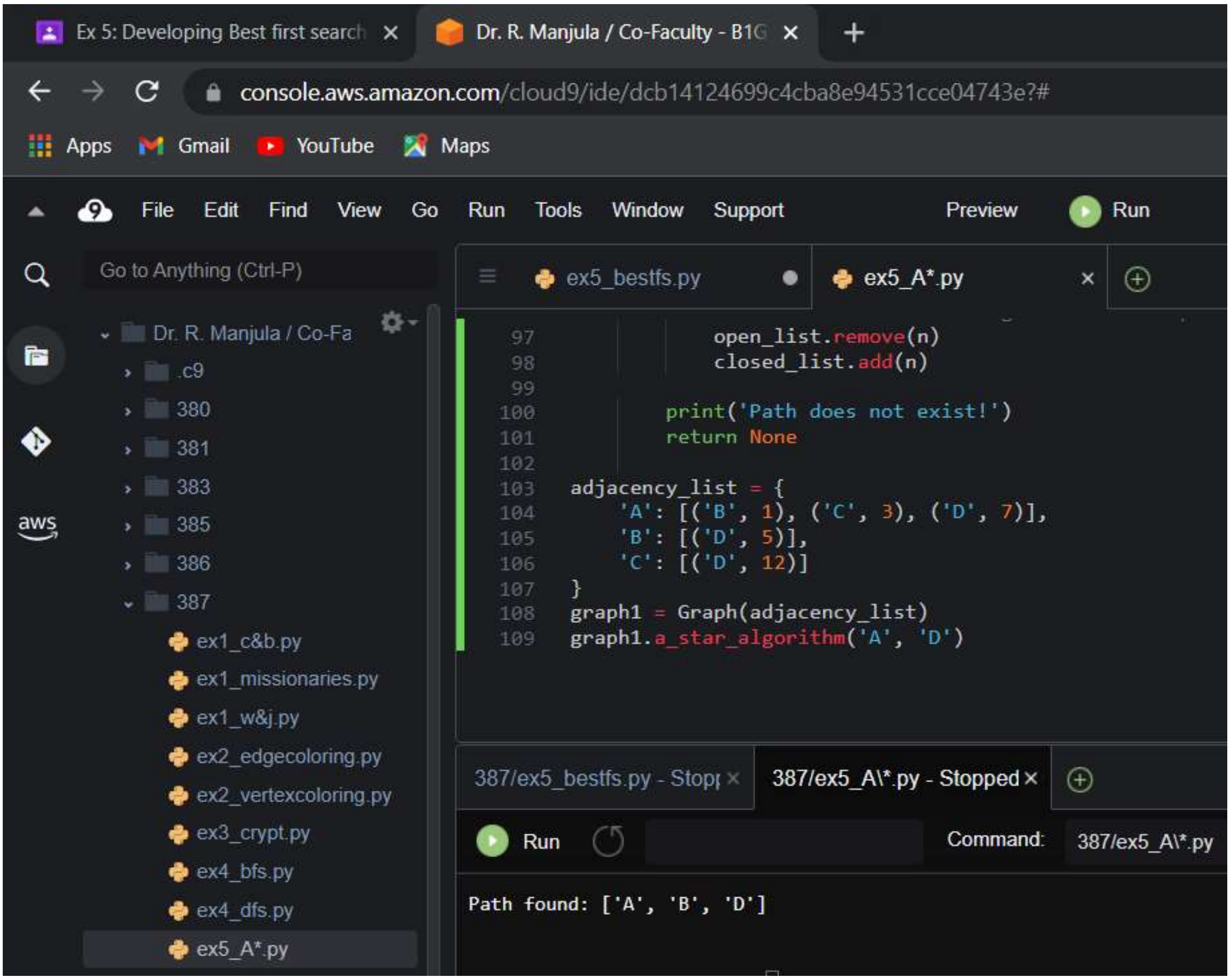
```
        # closed_list is a list of nodes which have been visited
        # and who's neighbors have been inspected
        open_list = set([start_node])
        closed_list = set([])

        # g contains current distances from start_node to all other
nodes
        # the default value (if it's not found in the map) is +infinity
        g = {}

        g[start_node] = 0

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

        while len(open_list) > 0:
            n = None

            # find a node with the lowest value of f() - evaluation
function
            for v in open_list:
                if n == None or g[v] + self.h(v) < g[n] + self.h(n):
                    n = v;
```

```
            if n == None:
                print('Path does not exist!')
                return None

            # if the current node is the stop_node
            # then we begin reconstructin the path from it to the
start_node
            if n == stop_node:
                reconst_path = []

                while parents[n] != n:
                    reconst_path.append(n)
                    n = parents[n]

                reconst_path.append(start_node)

                reconst_path.reverse()

                print('Path found: {}'.format(reconst_path))
                return reconst_path

            # for all neighbors of the current node do
            for (m, weight) in self.get_neighbors(n):
                # if the current node isn't in both open_list and
closed_list
```

```
            # add it to open_list and note n as it's parent
            if m not in open_list and m not in closed_list:
                open_list.add(m)
                parents[m] = n
                g[m] = g[n] + weight

            # otherwise, check if it's quicker to first visit n, then m
            # and if it is, update parent data and g data
            # and if the node was in the closed_list, move it to
open_list
            else:
                if g[m] > g[n] + weight:
                    g[m] = g[n] + weight
                    parents[m] = n

                    if m in closed_list:
                        closed_list.remove(m)
                        open_list.add(m)

        # remove n from the open_list, and add it to closed_list
        # because all of his neighbors were inspected
        open_list.remove(n)
        closed_list.add(n)

    print('Path does not exist!')
```

```
        return None

adjacency_list = {
    'A': [('B', 1), ('C', 3), ('D', 7)],
    'B': [('D', 5)],
    'C': [('D', 12)]
}
graph1 = Graph(adjacency_list)
graph1.a_star_algorithm('A', 'D')
```

## **OUTPUT:**



**<u>RESULT:</u>** **A* Search algorithms is implemented Successfully**

**CHITRALEKHA.CH**

**RA1911003010387**