TASK:3

Implementation of **A * Algorithm** to find the optimal path using Python by following constraints.

3(A) A* Algorithm

Aim : To implement of A * Algorithm to find the optimal path using Jupiter notebook.

Algorithm:

Step 1: start

Step 2: Place the starting node into open and find its f(n) [start node] value.

Step 3: Remove the node from OPEN, having the smallest f(n) value, if it is x goal node, then stop and return to success.

Step 4: Else remove the node from OPEN, and find all its successors.

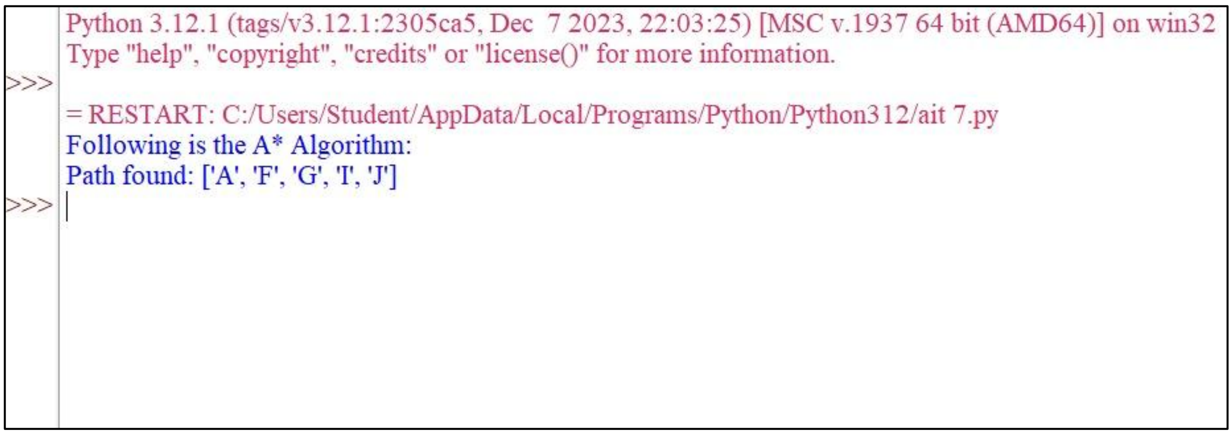
Step 5: Find the f(n) value of all the successors, Place them into OPEN and place the removed node into close **Step 6:** Go to step 2.

Step 7: Exit.

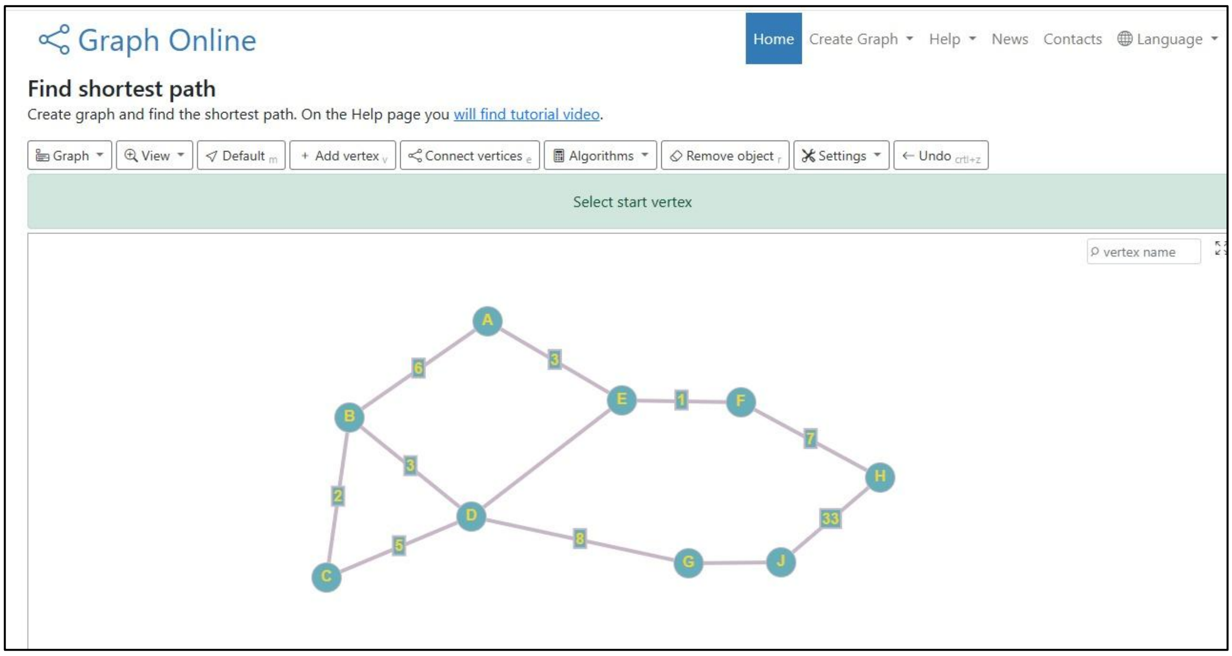
Program :

```
def aStarAlgo(start_node, stop_node):
  open_set = set([start_node]) closed_set = set() g = {} # store
  distance from starting node parents = {} # parents contain an
  adjacency map of all nodes

  # distance of starting node from itself is zero g[start_node]
  = 0
  # start_node is the root node, so 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 the lowest f() is found for
    v in open_set:
      if n is None or g[v] + heuristic(v) < g[n] + heuristic(n): n
        = v

    if n == stop_node or n is None or Graph_nodes[n] is None:
        break
    else:
        for m, weight in get_neighbors(n):
            # nodes 'm' not in open_set and closed_set are added to open_set
            # n is set as 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 is in closed_set, remove and add to
                    open_set if m in closed_set: closed_set.remove(m)
                    open_set.add(m)

    # remove n from the open_set and add it to
    closed_set # because all of its neighbors were
    inspected open_set.remove(n) closed_set.add(n)

if n is None: print('Path does
    not exist!') return None
# if the current node is the stop_node,
# then we begin reconstructing 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:',
    path) return path
    print('Path does not exist!') return
    None


# define function to return neighbors and their distances from the passed node def
get_neighbors(v):
    if v in Graph_nodes:
        return Graph_nodes[v] else:
        return None


# for simplicity, 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)], }

print("Following is the A* Algorithm:") aStarAlgo('A',
'J')
```

Output:



```
Python 3.12.1 (tags/v3.12.1:2305ca5, Dec  7 2023, 22:03:25) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:/Users/Student/AppData/Local/Programs/Python/Python312/ait 7.py
Following is the A* Algorithm:
Path found: ['A', 'F', 'G', 'I', 'J']
>>> |
```



Graph Online

Find shortest path

Create graph and find the shortest path. On the Help page you will find tutorial video.

Select start vertex

Result:

Thus the Implementation of A * Algorithm to find the optimal path using Python Was successfully executed and output was verified.

3(B) – Simplified A* Algorithm.

Aim: To implement the simplified A*Algorithm using Jupiter notebook.

Algorithm:

Step 1 : start.

Step 2: place the starting node into open and find its f(n) value

Step 3: Remove the node from OPEN , having the smallest f(n) value, if it is a goal node , then stop and return to success.

Step 4: else remove the node from OPEN, and find all its successors

Step 5: Find the f(n) value of all the successors, Place them into OPEN and place the removed node into close **Step 6:** Go to step 2.

Step 7: Exit.

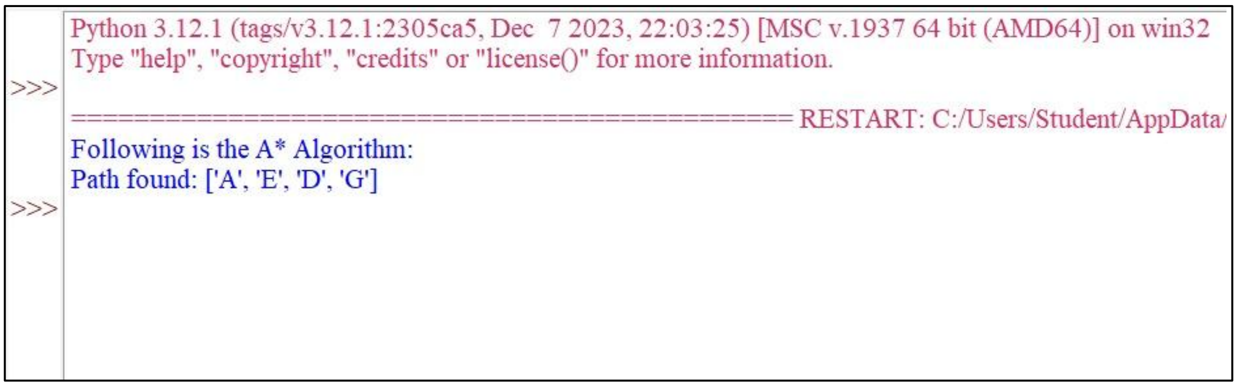
Program:

```
def aStarAlgo(start_node, stop_node):
  open_set = set([start_node]) closed_set = set() g = {} # store
  distance from starting node parents = {} # parents contain an
  adjacency map of all nodes

  # distance of starting node from itself is zero g[start_node]
  = 0
  # start_node is the root node, so 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 the lowest f() is found for
    v in open_set:
      if n is None or g[v] + heuristic(v) < g[n] + heuristic(n): n
        = v

    if n == stop_node or n is None or n not in Graph_nodes:
      break
    else:
      for m, weight in get_neighbors(n):
        # nodes 'm' not in open_set and closed_set are added to open_set
```

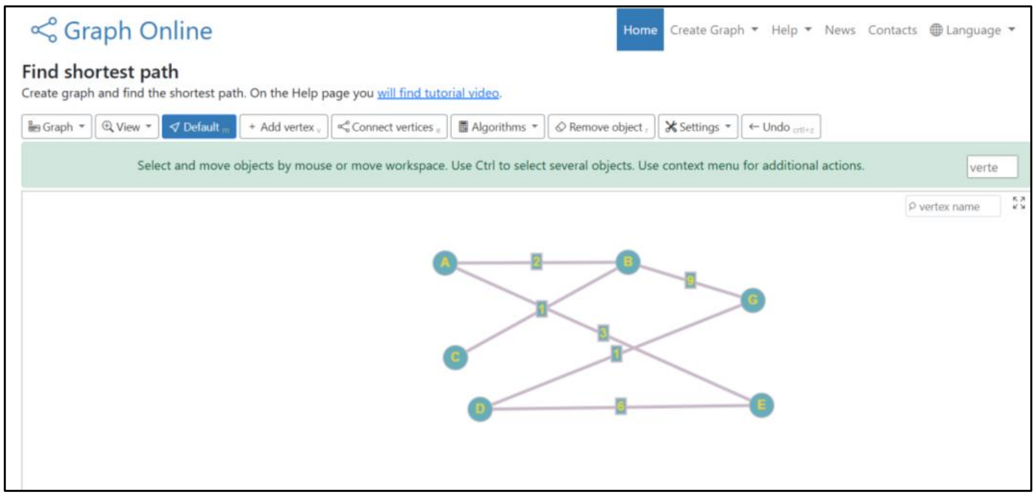
```
            # n is set as its parent if m not in open_set
            and m not in closed_set:
                open_set.add(m)
                parents[m] = n g[m]
                = g[n] + weight
            # for each node m, compare its distance from start i.e g(m)
            # to the from start 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 is in closed_set, remove and add to
                    open_set if m in closed_set: closed_set.remove(m)
                    open_set.add(m)

        # remove n from the open_set and add it to
        closed_set # because all of its neighbors were
        inspected open_set.remove(n) closed_set.add(n)

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

    # if the current node is the stop_node,
    # then we begin reconstructing 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:',
        path) return path

    print('Path does not exist!') return
    None
```

```
# define function to return neighbors and their distances from the passed node def
get_neighbors(v):
    if v in Graph_nodes:
        return Graph_nodes[v]
    else: return None

# for simplicity, 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': 99,
        'D': 1,
        'E': 7,
        'G': 0 }
    return
    h_dist[n]

# Describe your graph here Graph_nodes
= {
    'A': [('B', 2), ('E', 3)],
    'B': [('A', 2), ('C', 1), ('G', 9)],
    'C': [('B', 1)],
    'D': [('E', 6), ('G', 1)],
    'E': [('A', 3), ('D', 6)],
    'G': [('B', 9), ('D', 1)]
}

print("Following is the A* Algorithm:") aStarAlgo('A',
'G')
```

Output:



```
Python 3.12.1 (tags/v3.12.1:2305ca5, Dec  7 2023, 22:03:25) [MSC v.1937 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
================================================ RESTART: C:/Users/Student/AppData/
Following is the A* Algorithm:
Path found: ['A', 'E', 'D', 'G']
>>>
```



Find shortest path

Create graph and find the shortest path. On the Help page you will find tutorial video.

Select and move objects by mouse or move workspace. Use Ctrl to select several objects. Use context menu for additional actions.

Result:

Thus the implementation of the simplified A*Algorithm using Jupiter notebook was successfully executed and output was verified.