Exp- 5 A Algorithm and Best First Algorithm*

Team- Automata lab

RA1911031010128-VEER VISWAJEET SWAMI

RA1911031010129-VIJAY RENGARAJ R

RA1911031010130-THINAKAR R

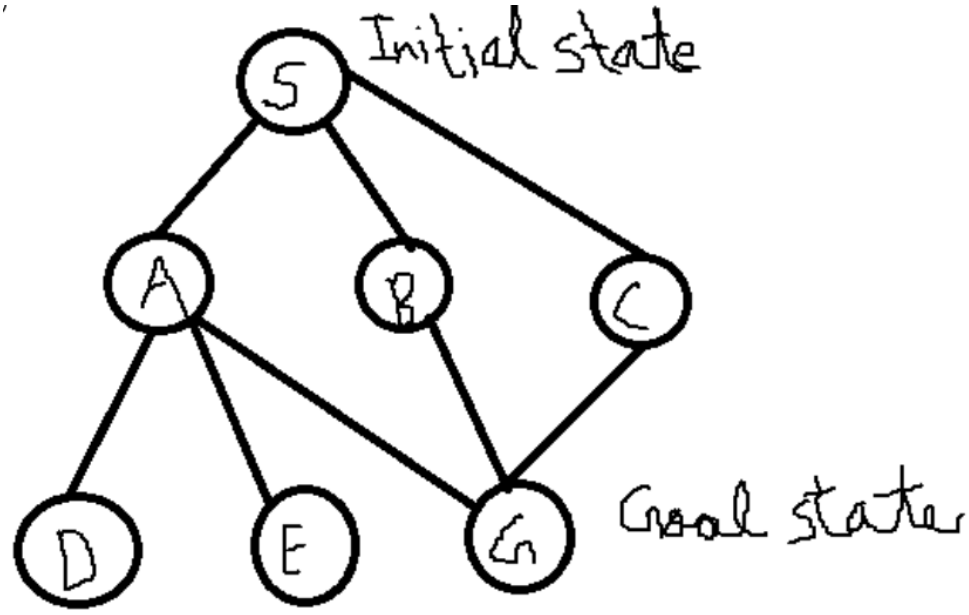
RA1911031010131-NAMARATA MISHRA

RA1911031010138-HUSNA QASIM

A Algorithm*

Problem chosen: **Graph problem**

Problem statement: **The main aim of this problem is to reach the goal state 'G' from initial state 'S' and finding out the optimal path and visited nodes of the graph using A* search algorithm.**



Code & Output:

```
tree = {'S': [['A', 1], ['B', 5], ['C', 8]],
```

```
        'A': [['S', 1], ['D', 3], ['E', 7], ['G', 9]],
        'B': [['S', 5], ['G', 4]],
        'C': [['S', 8], ['G', 5]],
        'D': [['A', 3]],
        'E': [['A', 7]]}

tree2 = {'S': [['A', 1], ['B', 2]],
         'A': [['S', 1]],
         'B': [['S', 2], ['C', 3], ['D', 4]],
         'C': [['B', 2], ['E', 5], ['F', 6]],
         'D': [['B', 4], ['G', 7]],
         'E': [['C', 5]],
         'F': [['C', 6]]
         }

heuristic = {'S': 8, 'A': 8, 'B': 4, 'C': 3, 'D': 5000, 'E': 5000, 'G': 0}
heuristic2 = {'S': 0, 'A': 5000, 'B': 2, 'C': 3, 'D': 4, 'E': 5000, 'F': 5000, 'G': 0}

cost = {'S': 0}            # total cost for nodes visited


def AStarSearch():
    global tree, heuristic
    closed = []            # closed nodes
```

```
    opened = [['S', 8]]     # opened nodes


    '''find the visited nodes'''
    while True:
        fn = [i[1] for i in opened]     # fn = f(n) = g(n) + h(n)
        chosen_index = fn.index(min(fn))
        node = opened[chosen_index][0]  # current node
        closed.append(opened[chosen_index])
        del opened[chosen_index]
        if closed[-1][0] == 'G':        # break the loop if node G has been found
            break
        for item in tree[node]:
            if item[0] in [closed_item[0] for closed_item in closed]:
                continue
            cost.update({item[0]: cost[node] + item[1]})          # add nodes to cost
dictionary
            fn_node = cost[node] + heuristic[item[0]] + item[1]     # calculate f(n) of
current node
            temp = [item[0], fn_node]
            opened.append(temp)                                   # store f(n) of current node in
array opened


    '''find optimal sequence'''
    trace_node = 'G'                    # correct optimal tracing node, initialize as node
G
    optimal_sequence = ['G']              # optimal node sequence
```

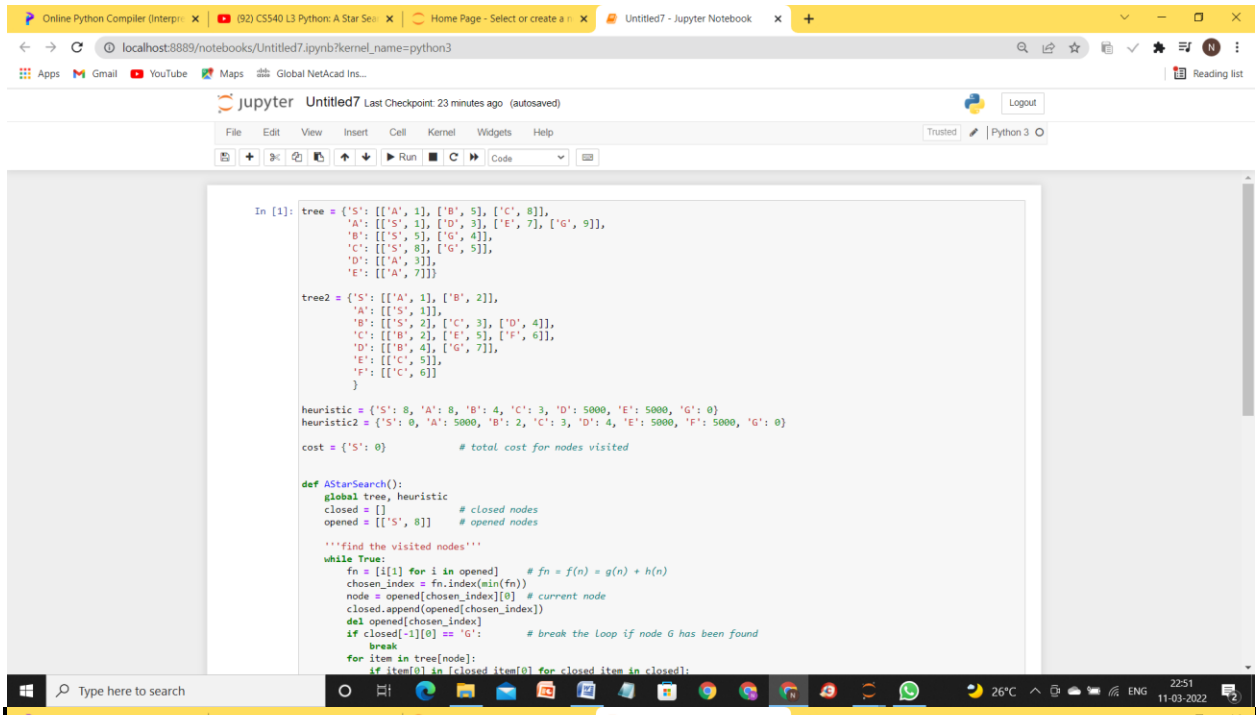
```
    for i in range(len(closed)-2, -1, -1):
        check_node = closed[i][0]          # current node
        if trace_node in [children[0] for children in tree[check_node]]:
            children_costs = [temp[1] for temp in tree[check_node]]
            children_nodes = [temp[0] for temp in tree[check_node]]

            '''check whether h(s) + g(s) = f(s). If so, append current node to optimal sequence
            change the correct optimal tracing node to current node'''
            if cost[check_node] + children_costs[children_nodes.index(trace_node)] == cost[trace_node]:
                optimal_sequence.append(check_node)
                trace_node = check_node
    optimal_sequence.reverse()            # reverse the optimal sequence

    return closed, optimal_sequence



if __name__ == '__main__':
    visited_nodes, optimal_nodes = AStarSearch()
    print('visited nodes: ' + str(visited_nodes))
    print('optimal nodes sequence: ' + str(optimal_nodes))
```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Code
In [1]:
tree = {'S': [['A', 1], ['B', 5], ['C', 8]],
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'B': [['S', 5], ['G', 4]],
'C': [['S', 8], ['G', 5]],
'D': [['A', 3]],
'E': [['A', 7]]}
tree2 = {'S': [['A', 1], ['B', 2]],
'A': [['S', 1]],
'B': [['S', 2], ['C', 3], ['D', 4]],
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}
heuristic = {'S': 8, 'A': 8, 'B': 4, 'C': 3, 'D': 5000, 'E': 5000, 'G': 0}
heuristic2 = {'S': 0, 'A': 5000, 'B': 2, 'C': 3, 'D': 4, 'E': 5000, 'F': 5000, 'G': 0}
cost = {'S': 0} # total cost for nodes visited
def AStarSearch():
global tree, heuristic
closed = [] # closed nodes
opened = [['S', 8]] # opened nodes
'''find the visited nodes'''
while True:
fn = [i[1] for i in opened] # fn = f(n) = g(n) + h(n)
chosen_index = fn.index(min(fn))
node = opened[chosen_index][0] # current node
closed.append(opened[chosen_index])
del opened[chosen_index]
if closed[-1][0] == 'G': # break the loop if node G has been found
break
for item in tree[node]:
if item[0] in [closed_item[0] for closed_item in closed]:
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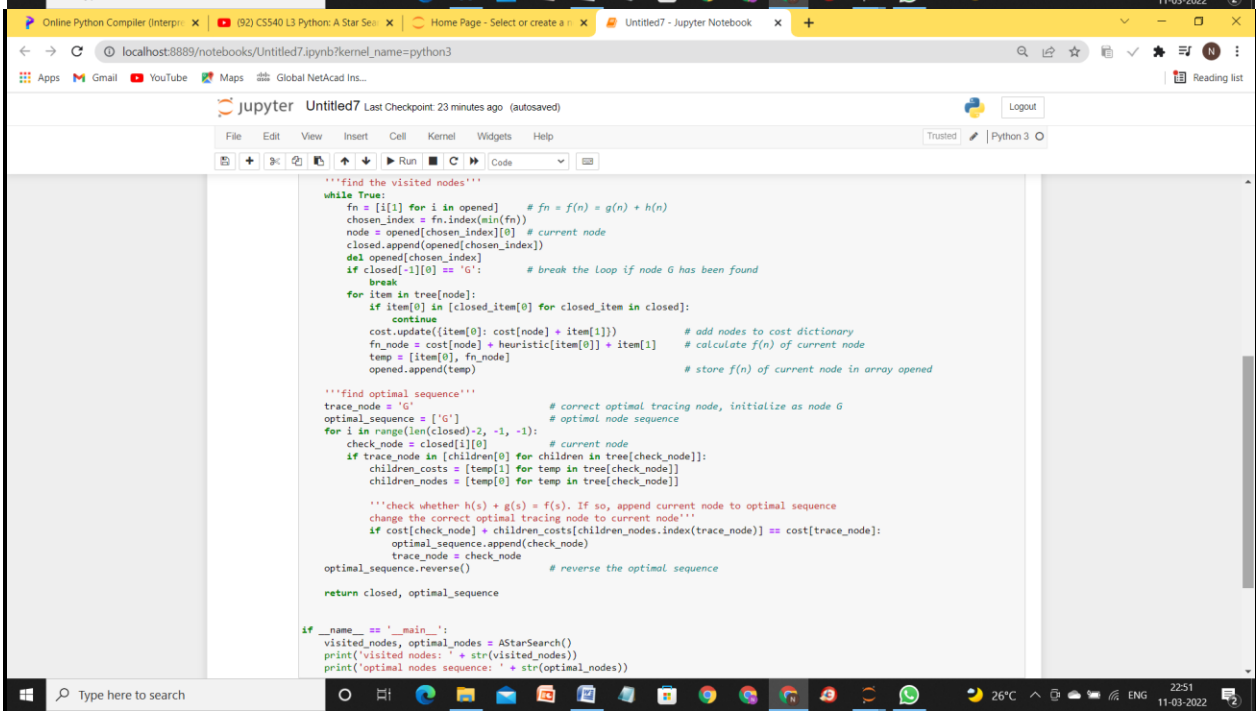
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Run
Code
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closed.append(opened[chosen_index])
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if closed[-1][0] == 'G': # break the loop if node G has been found
break
for item in tree[node]:
if item[0] in [closed_item[0] for closed_item in closed]:
continue
cost.update({item[0]: cost[node] + item[1]}) # add nodes to cost dictionary
fn_node = cost[node] + heuristic[item[0]] + item[1] # calculate f(n) of current node
temp = [item[0], fn_node]
opened.append(temp) # store f(n) of current node in array opened
'''find optimal sequence'''
trace_node = 'G' # correct optimal tracing node, initialize as node G
optimal_sequence = ['G'] # optimal node sequence
for i in range(len(closed)-2, -1, -1):
check_node = closed[i][0] # current node
if trace_node in [children[0] for children in tree[check_node]]:
children_costs = [temp[1] for temp in tree[check_node]]
children_nodes = [temp[0] for temp in tree[check_node]]
'''check whether h(s) + g(s) = f(s). If so, append current node to optimal sequence
change the correct optimal tracing node to current node'''
if cost[check_node] + children_costs[children_nodes.index(trace_node)] == cost[trace_node]:
optimal_sequence.append(check_node)
trace_node = check_node
optimal_sequence.reverse() # reverse the optimal sequence
return closed, optimal_sequence
if __name__ == '__main__':
visited_nodes, optimal_nodes = AStarSearch()
print('visited nodes: ' + str(visited_nodes))
print('optimal nodes sequence: ' + str(optimal_nodes))
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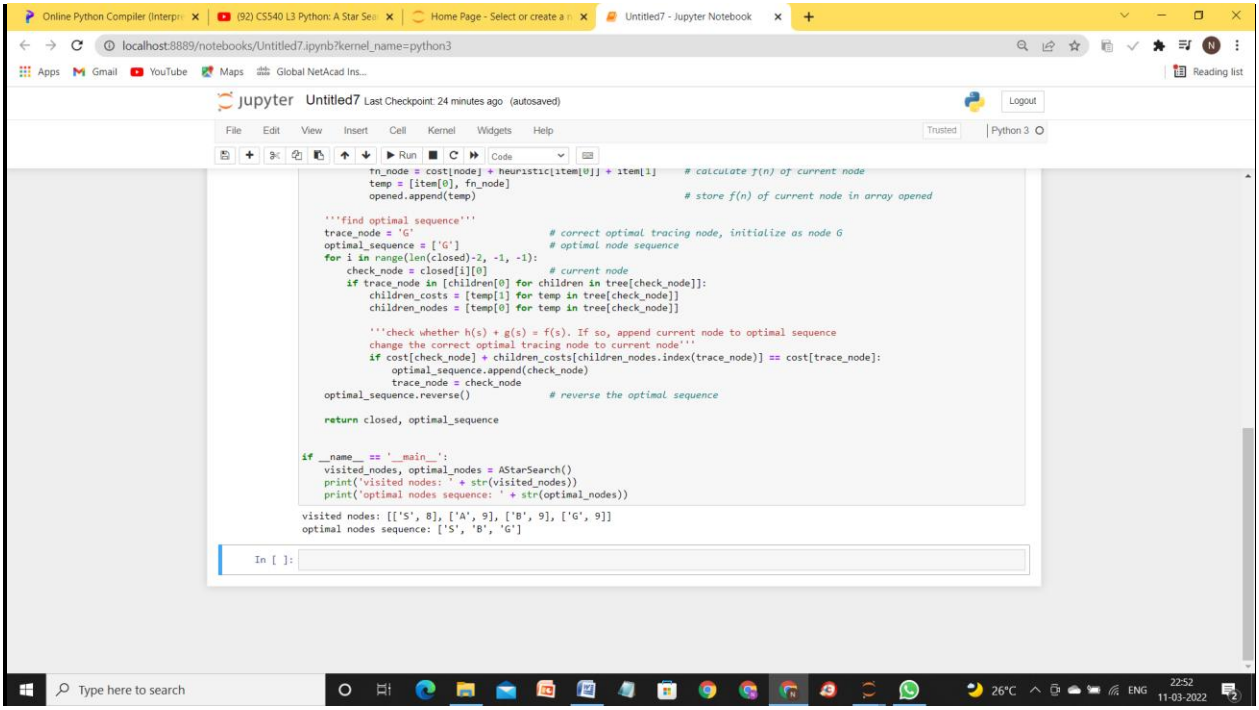
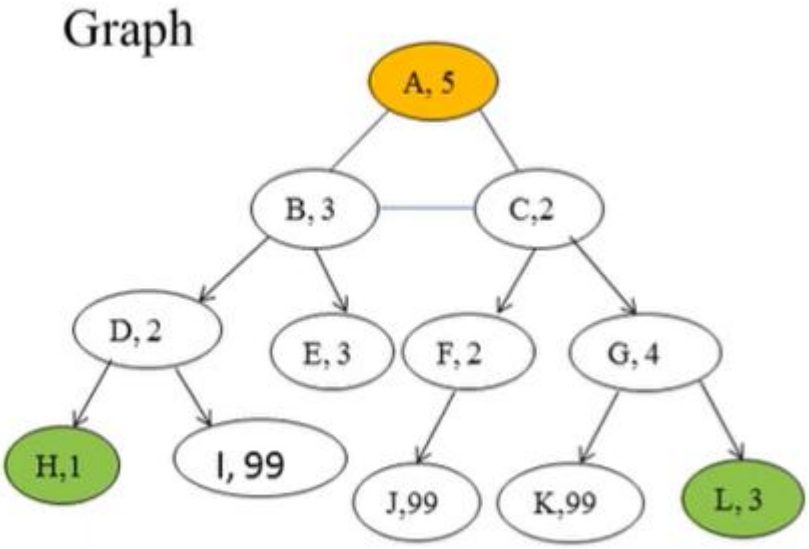


Best First Algorithm

Problem chosen: **Graph problem**

Problem statement: **A successor list is given ,i.e., a dictionary is given with start value as ‘A’, goal value as ‘H’, global closed list, success as “True”, failure as “False” and state as “Failure” initially. The main aim of this problem is to reach the goal value from start value using best first search algorithm.**



Code & Output:

```
SuccList ={ 'A':[['B',3],['C',2]], 'B':[['A',5],['C',2],['D',2],['E',3]],
'C':[['A',5],['B',3],['F',2],['G',4]], 'D':[['H',1],['I',99]],'F': [['J',99]],'G':[['K',99],['L',3]]}

Start='A'

Goal='E'

Closed = list()

SUCCESS=True

FAILURE=False

State=FAILURE


def MOVEGEN(N):
        New_list=list()
        if N in SuccList.keys():
                New_list=SuccList[N]
```

```
        return New_list

def GOALTEST(N):
        if N == Goal:
                return True
        else:
                return False

def APPEND(L1,L2):
        New_list=list(L1)+list(L2)
        return New_list

def SORT(L):
        L.sort(key = lambda x: x[1])
        return L

def BestFirstSearch():
        OPEN=[[Start,5]]
        CLOSED=list()
        global State
        global Closed
        while (len(OPEN) != 0) and (State != SUCCESS):
                print("------------")
```

```
        N= OPEN[0]
        print("N=",N)
        del OPEN[0] #delete the node we picked

        if GOALTEST(N[0])==True:
                State = SUCCESS
                CLOSED = APPEND(CLOSED,[N])
                print("CLOSED=",CLOSED)
        else:
                CLOSED = APPEND(CLOSED,[N])
                print("CLOSED=",CLOSED)
                CHILD = MOVEGEN(N[0])
                print("CHILD=",CHILD)
                for val in CLOSED:
                        if val in CHILD:
                                CHILD.remove(val)
                for val in OPEN:
                        if val in CHILD:
                                CHILD.remove(val)
                OPEN = APPEND(CHILD,OPEN) #append movegen elements to
OPEN
                print("Unsorted OPEN=",OPEN)
                SORT(OPEN)
                print("Sorted OPEN=",OPEN)
```

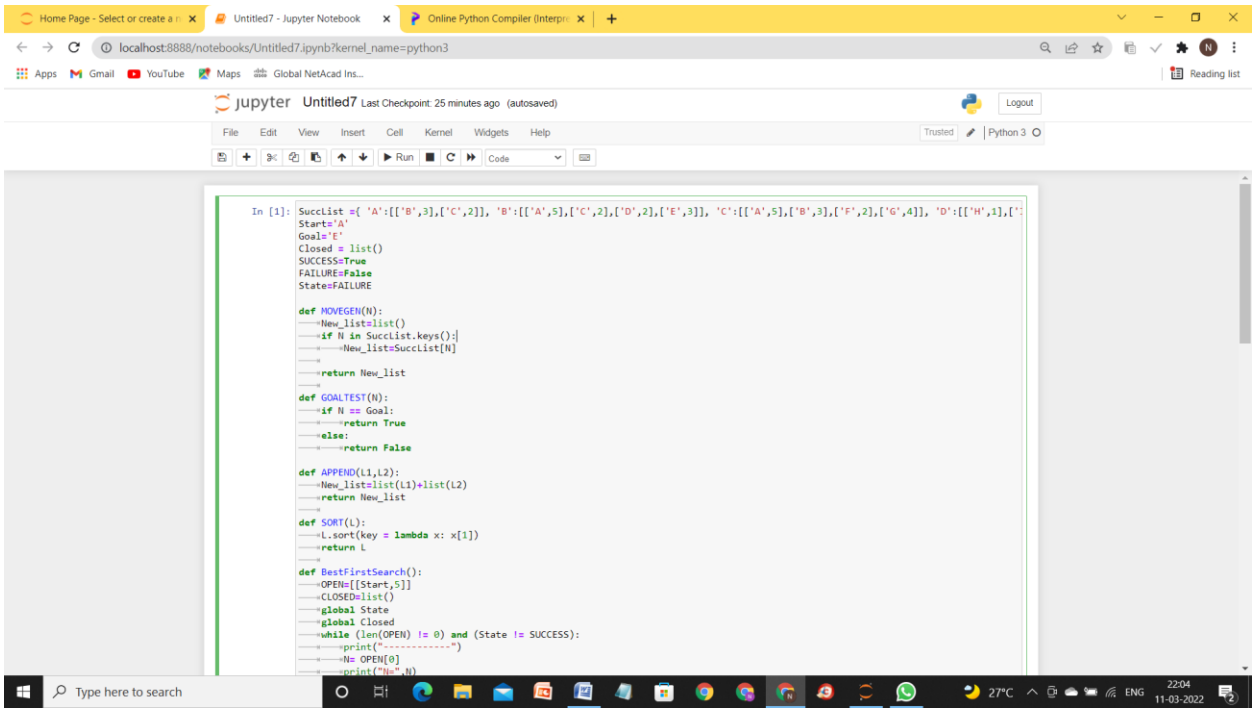
Closed=CLOSED

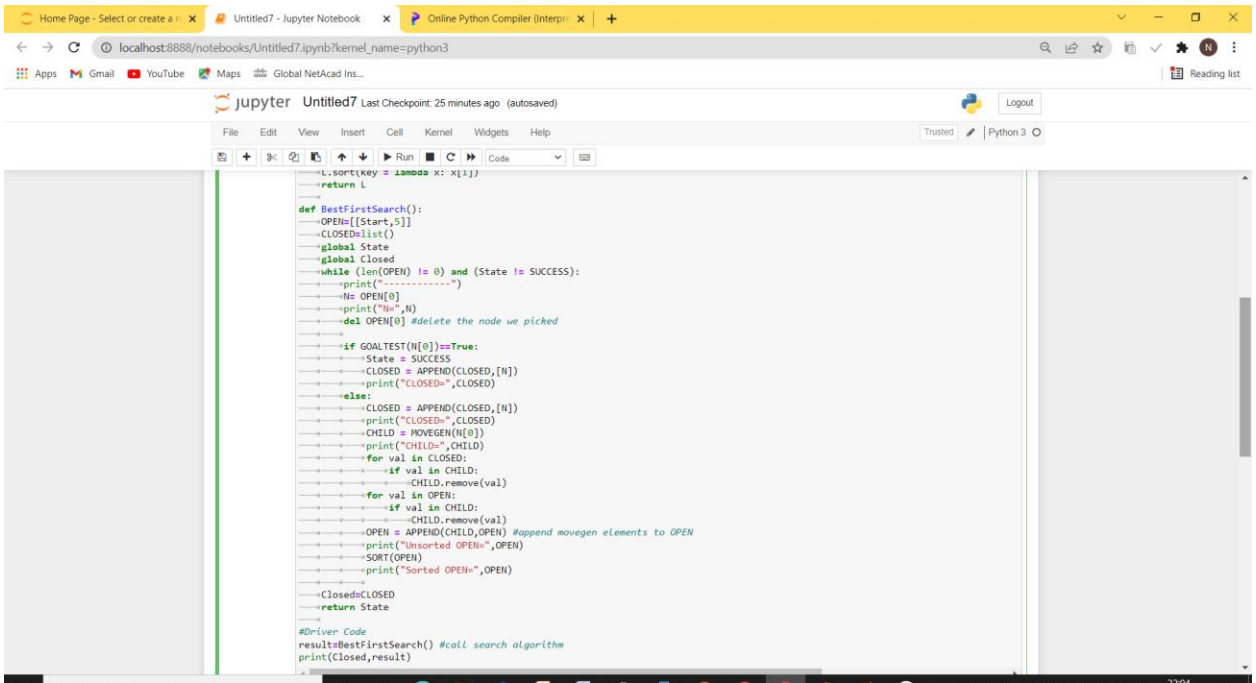
return State

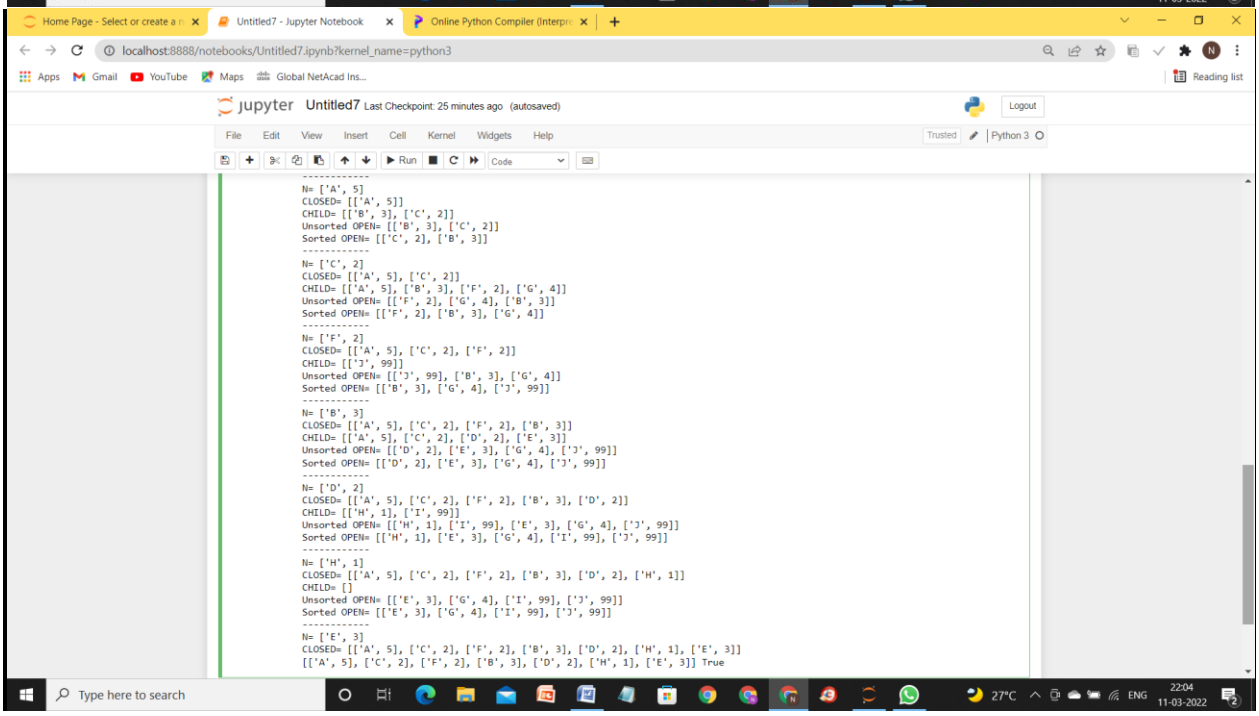
#Driver Code

result=BestFirstSearch() #call search algorithm

print(Closed,result)







RESULT:

The problem statements for both A* search and best first search(BFS) are solved.