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class Graph:
    def __init__(self, graph, heuristicNodeList, startNode): #instantiate graph object with graph topology, heuristic values, start node

        self.graph = graph
        self.H=heuristicNodeList
        self.start=startNode
        self.parent={}
        self.status={}
        self.solutionGraph={}

    def applyAOStar(self): # starts a recursive AO* algorithm
        self.aoStar(self.start, False)

    def getNeighbors(self, v): # gets the Neighbors of a given node
        return self.graph.get(v, '')

    def getStatus(self, v): # return the status of a given node
        return self.status.get(v, 0)

    def setStatus(self, v, val): # set the status of a given node
        self.status[v]=val

    def getHeuristicNodeValue(self, n):
        return self.H.get(n, 0) # always return the heuristic value of a given node

    def setHeuristicNodeValue(self, n, value):
        self.H[n]=value # set the revised heuristic value of a given node

    def printSolution(self):
        print("FOR GRAPH SOLUTION, TRAVERSE THE GRAPH FROM THE STARTNODE:", self.start)
        print("-----")
        print(self.solutionGraph)
        print("-----")

    def computeMinimumCostChildNodes(self, v): # Computes the Minimum Cost of child nodes of a given node v
        minimumCost=0
        costToChildNodeListDict={}
        costToChildNodeListDict[minimumCost]=[]
        flag=True
        for nodeInfoTupleList in self.getNeighbors(v): # iterate over all the set of child node/s
            cost=0
            nodeList=[]
            for c, weight in nodeInfoTupleList:
                cost=cost+self.getHeuristicNodeValue(c)+weight
                nodeList.append(c)

            if flag==True: # initialize Minimum Cost with the cost of first set of child node/s
                minimumCost=cost
                costToChildNodeListDict[minimumCost]=nodeList # set the Minimum Cost child node/s
                flag=False
            else: # checking the Minimum Cost nodes with the current Minimum Cost
                if minimumCost>cost:
                    minimumCost=cost
                    costToChildNodeListDict[minimumCost]=nodeList # set the Minimum Cost child node/s

        return minimumCost, costToChildNodeListDict[minimumCost] # return Minimum Cost and Minimum Cost child node/s

    def aoStar(self, v, backTracking): # AO* algorithm for a start node and backTracking status flag

        print("HEURISTIC VALUES :", self.H)
        print("SOLUTION GRAPH :", self.solutionGraph)
        print("PROCESSING NODE :", v)

        print("-----")

        if self.getStatus(v) >= 0: # if status node v >= 0, compute Minimum Cost nodes of v
            minimumCost, childNodeList = self.computeMinimumCostChildNodes(v)
            self.setHeuristicNodeValue(v, minimumCost)
            self.setStatus(v, len(childNodeList))

            solved=True # check the Minimum Cost nodes of v are solved

            for childNode in childNodeList:
                self.parent[childNode]=v
                if self.getStatus(childNode)!=-1:
                    solved=solved & False

            if solved==True: # if the Minimum Cost nodes of v are solved, set the current node status as solved(-1)
                self.setStatus(v, -1)
                self.solutionGraph[v]=childNodeList # update the solution graph with the solved nodes which may be a part of solution

            if v!=self.start: # check the current node is the start node for backtracking the current node value
                self.aoStar(self.parent[v], True) # backtracking the current node value with backtracking status set to true

            if backTracking==False: # check the current call is not for backtracking

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        for childNode in childNodeList: # for each Minimum Cost child node
            self.setStatus(childNode,0) # set the status of child node to 0(needs exploration)
            self.aoStar(childNode, False) # Minimum Cost child node is further explored with backtracking status as false

h1 = {'A': 1, 'B': 6, 'C': 2, 'D': 12, 'E': 2, 'F': 1, 'G': 5, 'H': 7, 'I': 7, 'J':1, 'T': 3}
graph1 = {
    'A': [(('B', 1), ('C', 1)), (('D', 1))],
    'B': [(('G', 1)), (('H', 1))],
    'C': [(('J', 1))],
    'D': [(('E', 1), ('F', 1))],
    'G': [(('I', 1))]
}
G1= Graph(graph1, h1, 'A')
G1.applyAOStar()
G1.printSolution()

h2 = {'A': 1, 'B': 6, 'C': 12, 'D': 10, 'E': 4, 'F': 4, 'G': 5, 'H': 7} # Heuristic values of Nodes
graph2 = { # Graph of Nodes and Edges
    'A': [(('B', 1), ('C', 1)), (('D', 1))], # Neighbors of Node 'A', B, C & D with repective weights
    'B': [(('G', 1)), (('H', 1))], # Neighbors are included in a list of lists
    'D': [(('E', 1), ('F', 1))] # Each sublist indicate a "OR" node or "AND" nodes
}

G2 = Graph(graph2, h2, 'A') # Instantiate Graph object with graph, heuristic values and start Node
G2.applyAOStar() # Run the AO* algorithm
G2.printSolution() # print the solution graph as AO* Algorithm search

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