LAB # 7:

A* SEARCH FOR GRAPHS

Objectives:

- To implement optimal A* algorithm for graphs using python

Hardware/Software Required:

Hardware: Desktop/ Notebook Computer
Software Tool: Python 2.7/ 3.6.2

Introduction:

A* is the best form of greedy first search that gives path with optimal cost for reaching goal from the start node. A* search not only checks the heuristic value at each node but it also adds the path cost for reaching that node as well along with the heuristics through which the global optimal path is achieved. The shortest path is obtained through Dijkstra's algorithm where the path cost at each node is calculated as:

$$f(n) = g(n) + h(n)$$

Where f(n) is the path cost at n^{th} node, h(n) is the heuristic value of n^{th} node to goal, g(n) is the cost for reaching n^{th} node from start. The pseudocode for the A* search is given below:

```
AStar(graph, cost, startNode, goal):
  Initialize PriorityQueue
  Add 'startNode' in PriorityQueue with minimal priority
  Initialize a dictionary 'cameFrom' with the first key as startNode
  Initialize another dictionary 'costSoFar' with first key as startNode along with its cost
  while q is not empty:
    currentNode = PriorityQueue.get()
    foreach neighbor in graph[currentNode]:
      for key in neighbor.keys():
        newCost = costSoFar[currentNode] + costToReachNeighbor
```

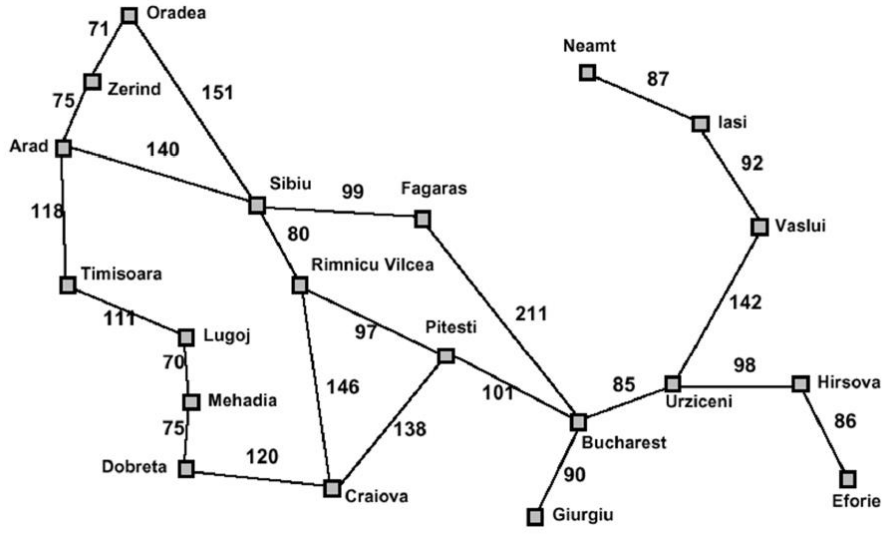
```
            if key not in costSoFar or newCost < costSoFar[key]:
                costSoFar[key] = [newCost]
                priority = newCost + heuristics[key]
                q.put((key,priority))
                cameFrom[key] = [currentNode]
    return reconstructPath(cameFrom, startNode, goal)


reconstructPath(cameFrom, start, goal):
    current = goal
    initialize 'path' list
    while current is not start:
        append 'current' in path
        update 'current' to cameFrom[current]
    append 'start' in 'path'
    reverse the 'path' list
    return path
```

Lab Tasks:

1. Implement Priority Queue.

2. Implement A* algorithm in python for following graph:

Graph1: Start Node: Arad, **Goal:** Bucharest



Straight−line distance to Bucharest	
Arad	366
Bucharest	0
Craiova	160
Dobreta	242
Eforie	161
Fagaras	178
Giurgiu	77
Hirsova	151
Iasi	226
Lugoj	244
Mehadia	241
Neamt	234
Oradea	380
Pitesti	98
Rimnicu Vilcea	193
Sibiu	253
Timisoara	329
Urziceni	80
Vaslui	199
Zerind	374

Graph 1

3. Write a script to decompose the given image into an undirected graph where the pixel represents the vertices and adjacent vertices are connected to each other via 4-connectivity and the cost on edges between adjacent nodes is their absolute intensity differences. The heuristic values should be calculated by taking the Manhattan distance for each pixel coordinates. The Manhattan distance between two points (x_0, y_0) and (x_1, y_1) can be calculated as:

$$D = |y_1 - y_0| + |x_1 - x_0|$$

Use A* algorithm to traverse decomposed image starting from pixel 150 to pixel 165.

150	2	5
80	145	45
74	102	165

Conclusion:
Write the conclusion about this lab

NOTE: A lab journal is expected to be submitted for this lab.