National University of Singapore
School of Computing

IT5003: Data Structure and Algorithm

Semester I, 2019/2020

Tutorial x Lab 7 Suggested Solution
Heap and Graph

As this is the last tutorial, there is **no** lab questions. Solution will be uploaded after Saturday's PE.

1. [Heap Insertion vs Construction] Suppose we have this sequence of integers: { 8, 4, 9, 2, 1, 6, 11, 12, 3, 10, 7, 5 }, let us see the difference in building a heap via insertion vs heapify algorithm.

   a. [Using Insertion] Insert the given sequence into an empty max heap.

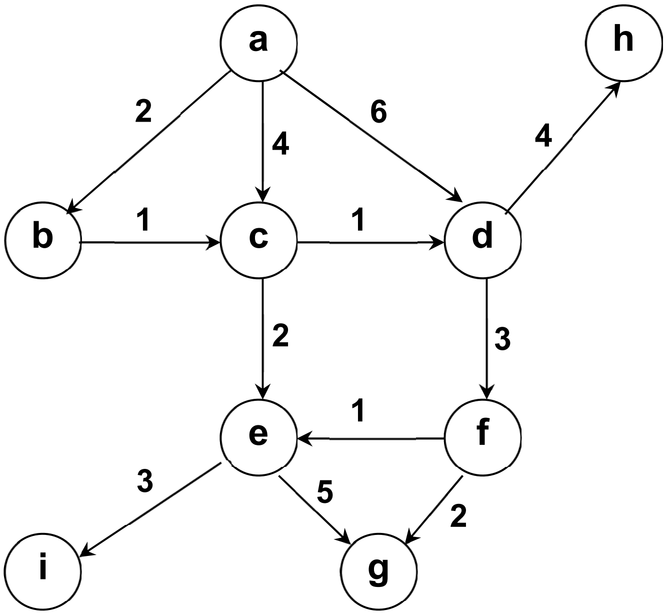
   b. [Using Heapify] Perform heapify on the given sequence into a single max heap.

2. [Additional Heap Operations] Given a max-heap stored in ***items*****[0..size -1]**, write two functions as follows. You can utilize the ***bubbleUp*****()** and ***bubbleDown()*** functions given in the lecture notes. Also, state the time complexity for each function.

   a. ***updateKey*****(p, v)**, which changes the value of the key at position **p** to **v**.

   b. ***delete*****(p)**, which deletes the key at position **p** of the heap

3. [Graph Traversals & Algorithms]



a. Given the graph above, give one possible **Breath-First Search** (BFS) sequence that starts at vertex “**a**”.

b. Give one possible **Depth-First Search** (DFS) sequence that starts at vertex “**a**”. Although DFS is not formally covered in the lecture, the idea should be reasonably simple. Give it a try?

c. Give one possible **topological sort** sequence.

d. Use **Dijkstra’s shortest path algorithm** on the graph using vertex "**a**" as the starting point. You can use a table (example given below) for your working instead of the more graphical tracing used in the lecture.

			Shortest distance from source								
Step	**v**	**S**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**
Init	-	-	0	∞	∞	∞	∞	∞	∞	∞	∞
1	-	[a]	0	2	4	6	∞	∞	∞	∞	∞
2	b	[a,b]	0	2	3	6	∞	∞	∞	∞	∞

Note: The “S” column is the set of fixed nodes with confirmed shortest distance (i.e. the "red" vertices"). “v” is the vertex picked in each round for updating its neighbors.