IT5003 Mar-May 2024

Data Structures and Algorithms

Tutorial+Lab 04
Priority Queue (Lighter)

Document is last modified on: January 5, 2024

1 Introduction and Objective

This session marks the end of the first $\frac{3}{8}$ of IT5003: Review of basic Python, basic analysis of algorithms (worst case time complexity only), a few sorting algorithms (Bubble/Insertion/Selection/Merge Sort/(Randomized) Quick Sort and a bit of Counting Sort; but skipping Radix Sort), and a few linear Data Structures (DSes): Python List/Singly Linked List/Stack/Queue/Doubly Linked List/Deque).

This session marks the start of the next $\frac{1}{4}$ of IT5003: A few non-linear DSes. Today, we will discuss the Priority Queue (PQ) ADT with its Binary Heap implementation (use `https://visualgo.net/en/heap` to help you answer some questions in this tutorial).

However for this semester, Sat, 30 Mar 2024 falls inside the long passion weekend that starts with NUS well-being day (Thu, 28 Mar 2024), Good Friday (Fri, 29 Mar 2024), and Easter Sunday (Sun, 31 Mar 2024). Thus, Saturday lab groups are cancelled, but Mon, 01 Apr 2024 lab groups still running (and recorded – then shared to Saturday groups). To compensate for this, Prof Halim has reduced the topics for this Lab4 to be the essential ones especially to help students with PS4, and will catch-up with more theoretical details of Binary Heap data structure during Lab5.

2 Questions

Basic Binary Heap

Q1). Quick check by TA for Monday group (self-check for Saturday group): Let's review all basic operations of Binary Heap that are currently available in VisuAlgo (use the Exploration mode of `http://visualgo.net/en/heap`). During the tutorial session, the tutor will randomize the Binary Heap structure, ask student to compare Binary Tree versus (1-based) Compact Array mode, `Insert(random-integer)` (you can try inserting duplicates, it is now allowed), perform `ExtractMax()`

operations (once, K-times (i.e., partial sort), or N-times (i.e., `HeapSort()`)), the $O(N \log N)$ or the $O(N)$ `Create(from-a-random-array)`, `UpdateKey(i, newv)` and `Delete(i)`.

Q2). Show an easy way to convert a Binary Max Heap of a set integers (as shown in VisuAlgo `https://visualgo.net/en/heap`) into a Binary Min Heap (of the 'same' set of integers) without changing the underlying data structure at all. Hint: modify the data.

Hands-on 4

TA will run the second half of this session with a few to do list:

- PS3 Quick Debrief,

- Do a sample speed run of VisuAlgo online quiz that are applicable so far, e.g.,
  `https://visualgo.net/training?diff=Medium&n=5&tl=5&module=heap`.

- Finally, live solve another chosen Kattis problem involving a Priority Queue.

Problem Set 4

We will end the tutorial with high level discussion of PS4 A+B.