Friday, 06 April 2018 – It is PE Day!!

For early birds: Turn on the PC in front of you (it will take a few minutes)

During actual PE, you will be allowed to login at 06.50pm to deal with this

LAB DEMO 08

PS4 3m Debrief – Common Mistakes

Common mistakes:

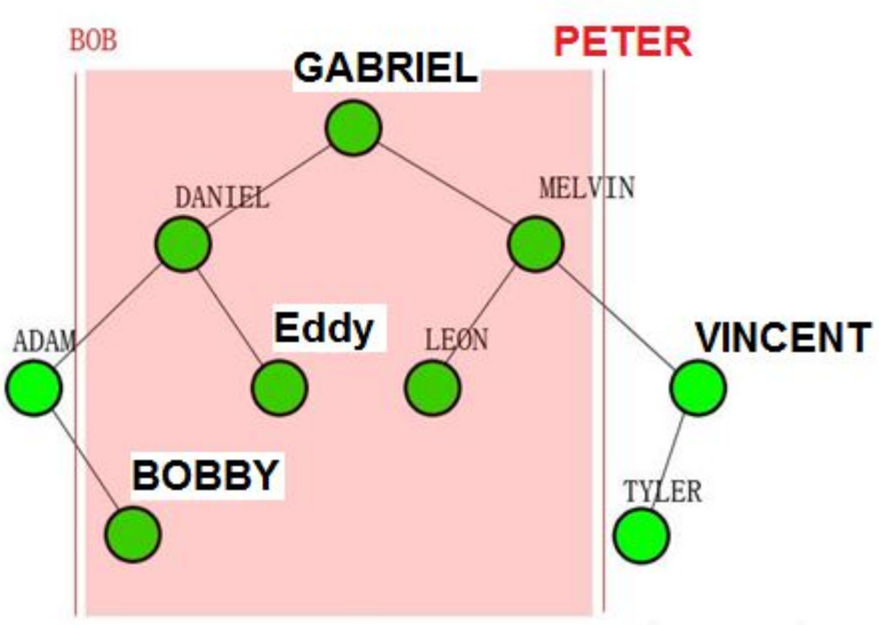
- WA/RTE in PS4 C: likely bug(s) in AVL tree insertion, reference (pointer) errors in rotateLeft/rotateRight, update height/ balance factor wrongly
- TLE in PS4 C: your 'rank' method maybe **O(n)** and not **O(log n)**, potential reasons: not splitting male vs female names, not searching upper bound and lower bound, not **using 'size'** to obtain *rank* efficiently, one quick check for **O(n)** that Lab TA have performed → see if student's solution checks BOTH left+right subtrees of bBST!
- Not AC in D (but AC in C): Your AVL tree **deletion** is incorrect

PS4 3m Debrief – Our Answer

The expected solution for PS4 Subtask C+D

- Write a Balanced BST routine, e.g. AVL Tree
  - Make sure the rotateLeft/rotateRight operations and all the 4 cases during insertion/deletion are handled without bug
- We split the boys and girls baby names into TWO bBSTs!
  - Important to achieve **O(log n)** per query that will be described below
- Augment this BST with "size" attribute, so that you can get a "rank" of a certain vertex in **O(log n)** as you search for it
  - This is a classic variant of BST and it has been discussed briefly in class
- Then, the answer is rank(upperbound)-rank(lowerbound)
  - See the next slide for a visual explanation

Visual Explanation (Boy Names Only)



How to find boy names that contain prefix BOB (inclusive) to PETER (exclusive)?

1. Find the **rank** of the START name (BOB). If the START name does not exist, return the rank of a name > BOB. In this example, we return the rank of BOBBY (rank 2)
2. Find the rank of the END name (PETER). If the END name does not exist, return the rank of a name > PETER. In this example, we return the rank of TYLER (rank 8)
3. The answer is 8-2 = 6
4. PS: You can implement this idea in several other ways

PS5 Discussion, Subtask A+B

Big Question: Does parameter **k** matters?

PS5 Subtask A+B Summary

Nothing to hide here, parameter **k** does not matter for these two subtasks…

PS5 Subtask A and B are there to force you to code **at least one** SSSP algorithm:

- Subtask A → the graph is a **tree**, **V** < 1K, **Q** ≤ 100K therefore the best algorithm is _____________
- Subtask B → the graph is **weighted**, **V+E** < 201K, **Q** ≤ 10K therefore the best algorithm is _____________

But how to deal with that big **Q**?

Dijkstra’s is a very standard algorithm, but to avoid (minimize) plagiarism check…

- Choice of Dijkstra’s version
  - Original or Modified **(2 options)**
- Choice of Priority Queue implementation for Dijkstra’s
  - TreeSet, TreeMap :O, PriorityQueue (Lazy DS), your own PS4 code (AVL Tree), your own PS3 code (Binary Heap), or even Fibonacci Heap (or other exotic Heap DS)… **(6 options)**
- Or 1 other alternative outside Dijkstra’s: SPFA **(+1 option)**
- Technically, we have **2*6+1 = 13 combinations** ☺

PS5 Subtask C

Why it is hard(er)?

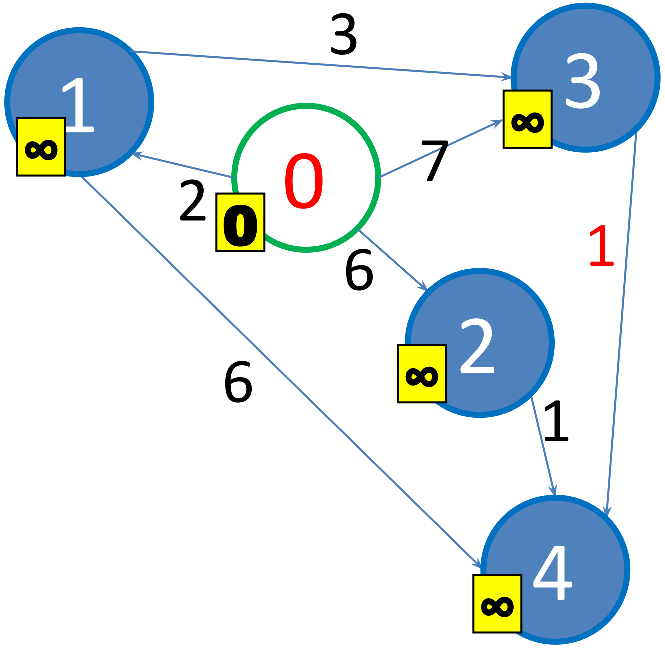
The additional constraint is quite relevant in real life

- Google around for recent (taxi) accidents videos in SG
  - Many happened around junctions
- Note that some of those accidents are fatal :S:S:S
  so please watch those videos with caution

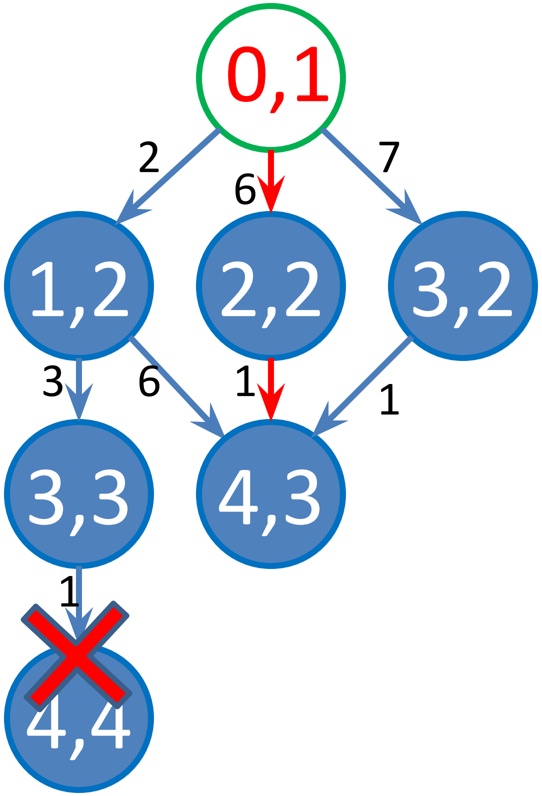
What to do in order to handle this seemingly simple additional constraint that the shortest path cannot have more than **k** vertices on it?

- Hint: Put that vertex usage information on each vertex…

Restrict SP to 3 vertices only



The transformed graph is a DAG!



Note that if I do not restrict the number of vertices in the SP, the answer is 0→1→3→4 of weight 2+3+1 = 6 instead of 7 from path 0→2→4

VisuAlgo Online Quiz is Next Week!

VisuAlgo Online Quiz (12%) is done during the Lab Demo 09 slot itself ***(just to prove that you are the one doing the quiz, not someone else)***

Online Quiz covers **all stuffs** in CS2040C: Sorting, Linked List, Binary Heap, Hash Table, BST, AVL Tree, Graph DS, DFS/BFS, SSSP

Man versus Machine (1)

How to ace VisuAlgo Online Quiz?

Answer: Simple, **practice like crazy**

- VisuAlgo Online Quiz is just a collection of (PHP+MySQL) scripts at the server side and (JS) scripts at the client side
  - Unless Steven sets up new (hard) questions which will only appear during the actual Online Quiz, Steven won’t be able to change questions that are already in the system easily
  - So, after enough # of trainings, you will start seeing similar question types*, just with random^ parameters…

Man versus Machine (2)

Some questions have shortcuts…

- Example 1: Perform ExtractMax() **k** times from Binary Max Heap of **n** elements, click all elements that are left behind?
  - Naïve: Perform ExtractMax **k** times, click elements that are left behind
  - Clever: Click **n-k** smallest elements in that Binary max Heap :O…
- Example 2: How many structurally different BSTs can you form with <a randomized small number> distinct elements?
  - Woah, what kind of question is this?
  - It was from Written Quiz 1 in S1 AY 2014/2015
  - Super hard if you don't know what to do, but very easy otherwise if you can think (or find solution a.k.a. Googling) **outside** the test time
  - The answer is …

Show Off

Let’s try the training mode of CS2040C OQ topics

- I will do one round of show-off to motivate you all to do the same thing in your official Online Quiz so that your basic understanding of these topics are top notch ☺
- Watch and analyze me as I do a **speed run**
  (10 hard questions in only 5 minutes)

https://visualgo.net/training?diff=Hard&n=7&tl=5&module=sorting,list,heap,hashtable,bst,avl,graphds,dfsbfs,sssp

Mock PE 4

Solve CS2040C PE S1 Q2 at Mooshak
http://algorithmics.comp.nus.edu.sg/~mooshak
Select Mock PE S1 Q2

Before this Lab session runs out (xx.50)!!
(or until 2pm, but you won’t be able to correctly time yourself otherwise)

Start from this template code (share your repl link)
But use the PC in front of you (don’t use own laptop!)

Gradual hints will be added in few minutes interval

All the best for tonight…
If you want more exercises

- Just ask your Lab TA on what topic that you want to practice on
  - Lab TA will then show an online judge exercise on the topic with the highest demand in that lab group, and as usual, do live solving (this time without waiting for students as we may run out of time otherwise)
- Come to your assigned PL by 06.45pm to login to desktop and ensure you are not late for PE