FIT3155: Week 8 tutorial
Covering concepts from Weeks 5-7

Objectives: The tutorials, in general, give practice in problem solving, in analysis of algorithms and data-structures, and in logic useful in the above.

Instructions to the class: Prepare your answers to the questions **before** the tutorial. It will probably not be possible to cover all questions unless the class has prepared them all in advance.

Instructions to Tutors:

i. The purpose of the tutorials is not to solve the practical exercises.

ii. The purpose is to check answers, and to discuss particular sticking points, not to simply make answers available.

1. Write pseudocode to compute which (order) binomial trees form a binomial heap for any given n elements.

2. Using mathematical induction, for a binomial tree B_k of order k, prove that:

   (a) B_k contains 2^k nodes.

   (b) B_k has a height k.

   (c) B_k has exactly k-choose-d nodes at each depth $0 \leq d \leq k$.

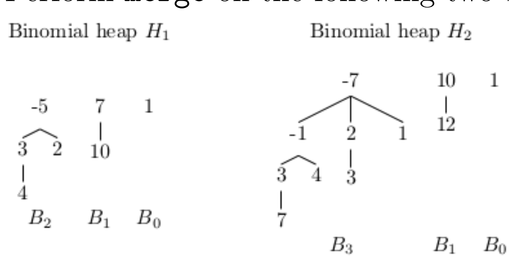
3. Insert the following elements in a binomial heap:

$$8, 2, 6, 8, 10, 11, 12$$

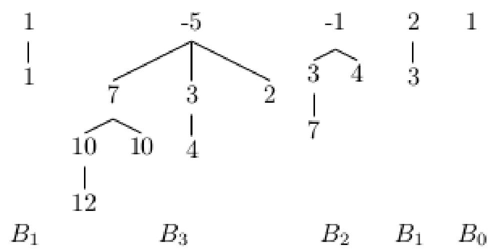
4. Insert the following elements in a binomial heap:

$$2, 8, 10, 11, 5, 11, 103, 4$$

5. Perform `merge` on the following two binomial heaps:

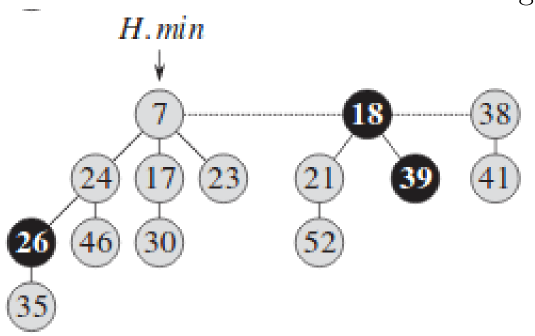


6. Perform `merge` followed by `extract-min` on the following (improper state of) binomial heap:

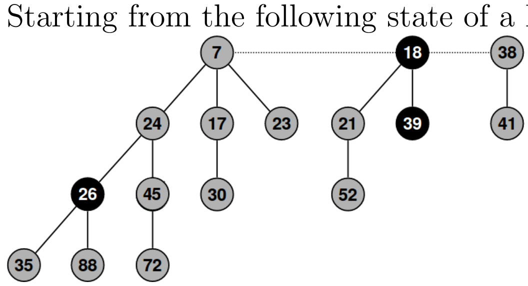


7. Show that the amortized complexity to `insert` n elements into a binomial heap is $O(n)$.

8. Perform `extract-min` on the following Fibonacci heap:



9. Starting from the following state of a Fibonacci heap:



Run the following sequence of operations, and after each step, draw the resultant heap:

(a) `decrease-key` of 45 to 40.

(b) `decrease-key` of 40 to 12.

(c) `decrease-key` of 35 to 1.

(d) `extract-min`.

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