CS5800: Algorithms — Spring '21 — Virgil Pavlu

Homework 9
Submit via Gradescope

Name:
Collaborators:

Instructions:

- Make sure to put your name on the first page. If you are using the LaTeX template we provided, then you can make sure it appears by filling in the `yourname` command.
- Please review the grading policy outlined in the course information page.
- You must also write down with whom you worked on the assignment. If this changes from problem to problem, then you should write down this information separately with each problem.
- Problem numbers (like Exercise 3.1-1) are corresponding to CLRS 3^{rd} edition. While the 2^{nd} edition has similar problems with similar numbers, the actual exercises and their solutions are different, so make sure you are using the 3^{rd} edition.

1. ***(25 points)*** *Exercise 17.3-3.(Hint: a reasonable potential function to use is* $\phi(D_i) = kn_i \cdot \ln n_i$ *where* n_i *is the number of elements in the binary heap, and* k *is a big enough constant. You can use this function and just show the change in potential for each of the two operations.)*

Solution:

2. ***(25 points)*** *Exercise 17.3-6.*

Solution:

3. ***(25 points)*** *Exercise 19.2-1.*

Solution:

4. ***(50 points)*** *Implement binomial heaps as described in class and in the book. You should use links (pointers) to implement the structure as shown in the fig 1.*

Your implementation should include the operations: Make-heap, Insert, Minimum, Extract-Min, Union, Decrease-Key, Delete

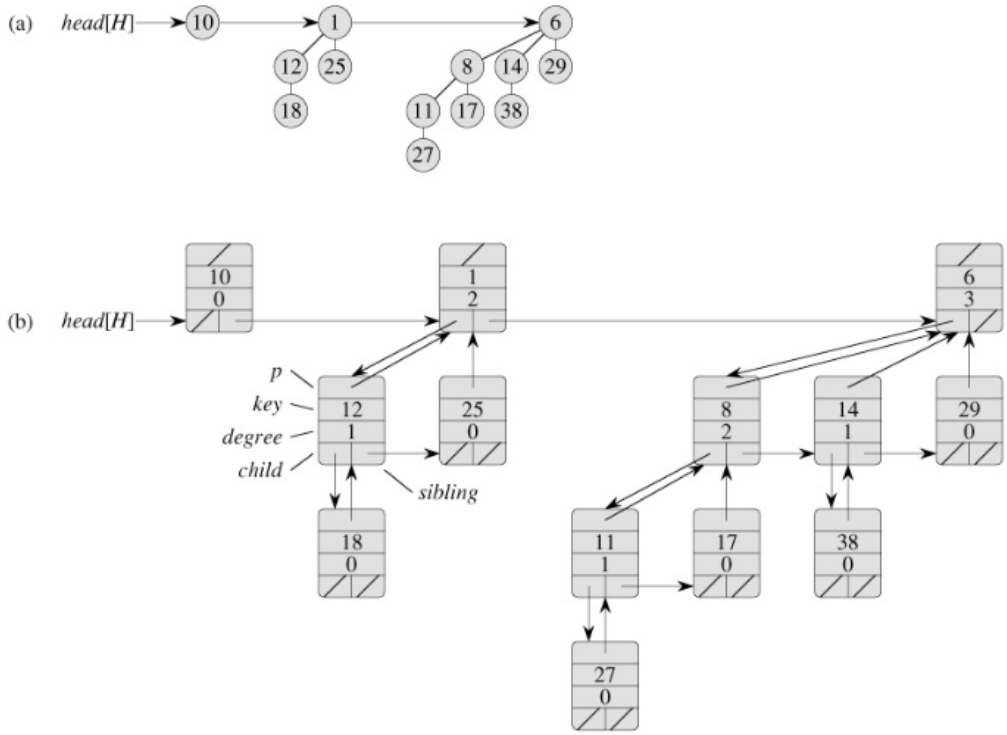

Figure 1: Binomial Heaps

Make sure to preserve the characteristics of binomial heaps at all times:

(1) each component should be a binomial tree with children-keys bigger than the parent-key;

(2) the binomial trees should be in order of size from left to right. Test your code several arrays set of random generated integers (keys).

Solution:

5. ***(Extra Credit)*** *Find a way to nicely draw the binomial heap created from input, like in the figure.*

Solution:

6. ***(Extra Credit)*** *Write code to implement Fibonacci Heaps, with discussed operations:ExtractMin, Union, Consolidate, DecreaseKey, Delete.*

Solution:

7. ***(Extra Credit)*** *Figure out what are the marked nodes on Fibonacci Heaps. In particular explain how the potential function works for FIB-HEAP-EXTRACT-MEAN and FIB-HEAP-DECREASE-KEY operations.*

Solution: