Computer Science 477/677 Spring 2019

University of Nevada, Las Vegas Computer Science 477/677 Spring 2019

Practice for Second Examination March 13, 2019

1. Review Assignment 3.

2. Construct a treap with alphabetic key and numeric min-heap order. You are to insert the items one at a time and show the treap after each rotation. Insert letters in this order: A, B, C, D, E, F. The numeric heap keys (the random numbers) are given in the following table.

A	23
B	12
C	11
D	7
E	4
F	1

3. Find the asymptotic complexity, in terms of n, for each of these fragments, expressing the answers using O, Θ, or Ω, whichever is most appropriate.

   (a)
   ```
   for(i = 0; i < n; i = i+1);
    cout << "Hi!" << endl;
   ```

   (b)
   ```
   for(i = 1; i < n; i = 2*i);
    cout << "Hi!" << endl;
   ```

   (c)
   ```
   for(i = 2; i < n; i = i*i);
    cout << "Hi!" << endl;
   ```

   (d) The following code models the first phase of heapsort.

   ```
   for(int i = n; i > 0; i--)
    for(int j = i; 2*j <= n; j = 2*j)
     cout << "swap" << endl;
   ```

   (e) The following code models the second phase of heapsort.

   ```
   for(int i = n; i > 0; i--}
    {
     cout << "swap" << endl;
     for(int j = 1; 2*j <= i; j = 2*j)
      cout << "swap" << endl;
    }
   ```

   (f) The following code models insertion of n items into an AVL tree.

   ```
   for(int i = 1; i < n; i++)
    for(int j = n; j > 0; j = j/2)
      cout << "check AVL property and possibly rotate" << endl;
   ```

4. Solve each of the following recurrences, expressing the answers using O, Θ, or Ω, whichever is most appropriate.

   (a) $F(n) = F(n/2) + 1$

   (b) $F(n) = F(n-1) + O(\log n)$

   (c) $F(n) = F\left(\frac{n}{2}\right) + 2F\left(\frac{n}{4}\right) + n$

   For this problem, as well as the next one, see

   `https://en.wikipedia.org/wiki/Akra%E2%80%93Bazzi_method#Example`

   That article is difficult to understand, so I will give a simplified version in class on Monday.

   (d) $F(n) = F\left(\frac{3n}{5}\right) + F\left(\frac{4n}{5}\right) + n^2$

   Use the same method you used for the previous problem. Hint: $3^2 + 4^2 = 5^2$.

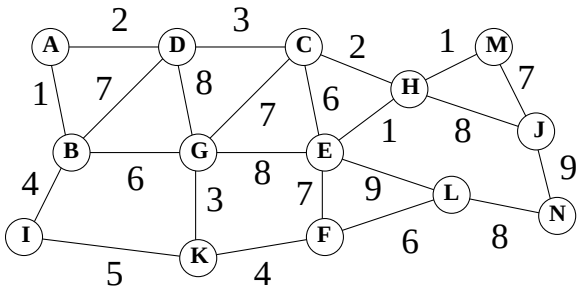
   (e) $F(n) = F(n-2) + n$

5. Use Huffman's algorithm to construct an optimal prefix code for the alphabet $\{A, B, C, D, E, F\}$ where the frequencies of the symbols are given by the following table.

A	7
B	3
C	4
D	8
E	12
F	3

6. G is an acyclic directed graph with vertices $\{s, a, b, c, d\}$. G has exactly five topological orderings, namely
   s, a, b, c, d
   s, a, b, d, c
   s, a, d, b, c
   s, b, a, c, d
   s, b, a, d, c
   Draw G.

7. Find a minimum spanning tree of the weighted graph shown below.



Use union/find, with path compression.

8. Insert the letters A, B, C, D, E, F into an AVL tree in that order. Show the rotations (if any) after each insertion.

9. Write pseudo-code for binary search.

10. Walk through heapsort for the following array: **A Q R B X S M L N T**