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CSC 3110 – Homework 4

1. Find the order of growth for solutions of the following recurrences:
   a. T(n) = 5T(n/3)+n

1a) $T(n) = 5T\left(\frac{n}{3}\right) + n$

$a = 5$ $\quad f(n) \in \Theta(n^d)$ $\quad d \geq 0$

$b = 3$

$d = 1$

$5 > 3^1$ ✓ $\quad T(n) \in \Theta(n^{\log_3 5}) \approx n^{1.46}$

$5 = 3^1$ X

$5 < 3^1$ X

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b. $T(n) = 9T(n/3)+n^2$

b) $T(n) = 9T\left(\frac{n}{3}\right) + n^2$

$a = 9$ $f(n)\ \Theta(n^d)\ d \geq 0$

$b = 3$

$d = 2$

$5 < 3^2$ ✓ $T(n) \in \Theta(n^2)$

$5 = 3^2$ X

$5 > 3^2$ X

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c. $T(n) = 10T(n/3)+n^3$

c) $T(n) = 10\,T(n/3) + n^3$

$a = 10$ $\quad$ $f(n) \in \Theta(n^d)$ $\quad d \geq 0$

$b = 3$

$D = 3$

$10 < 3^3$ ✓ $T(n) \in \Theta(n^3)$

$10 = 3^3$ ✗

$10 > 3^3$ ✗

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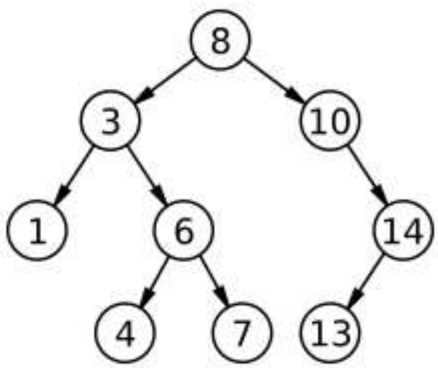
2. Traverse the following binary tree in



   a. Preorder = 8,3,1,6,4,7,10,14,13
   b. Inorder = 1,3,4,6,7,8,10,13,14
   c. Postorder = 1,4,7,6,3,13,14,10,8

3. Indicate the time efficiency classes of the three main operations of the priority queue implemented as
   a. Unsorted array
      i. Insert = O(1)
      ii. Delete = O(n)
      iii. Peek = O(n)
   b. Sorted array
      i. Insert = O(log n)
      ii. Delete = O(1)
      iii. Peek = O(1)
   c. Binary Search Tree
      i. Insert = O(log n)
      ii. Delete = O(log n)
      iii. Peek = O(log n)
   d. AVL tree
      i. Insert = O(log n)
      ii. Delete = O(log n)
      iii. Peek = O(log n)
   e. Heap
      i. Insert = O(log n)
      ii. Delete = O(log n)
      iii. Peek = O(1)

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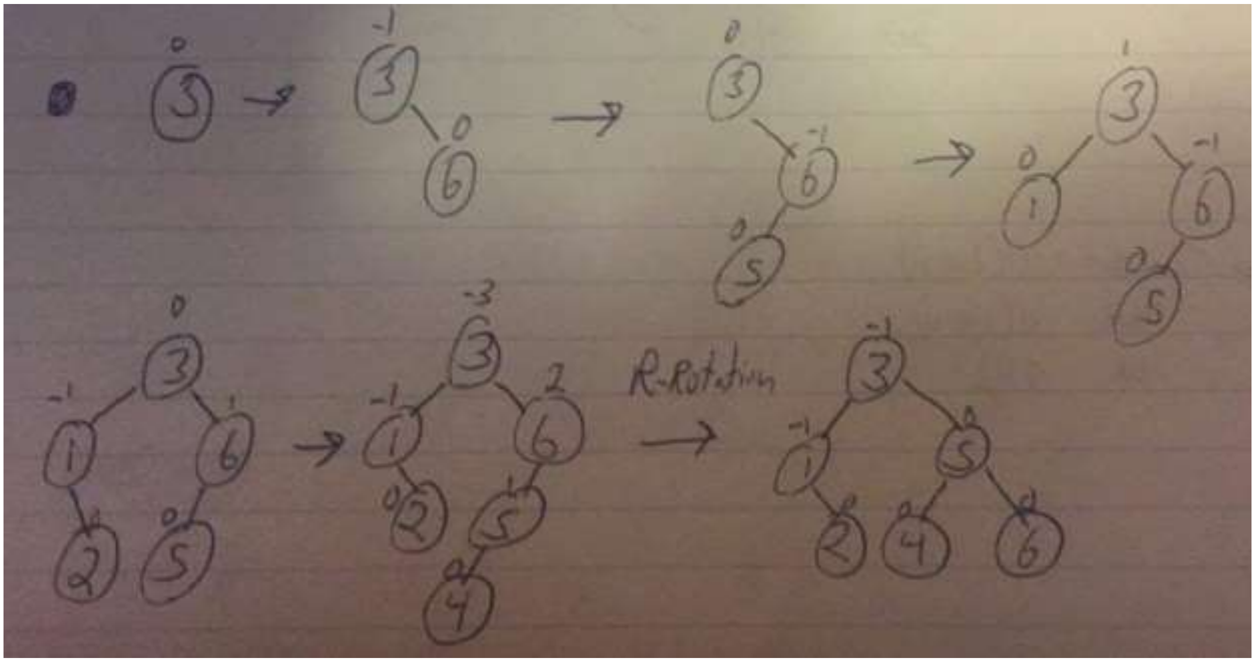
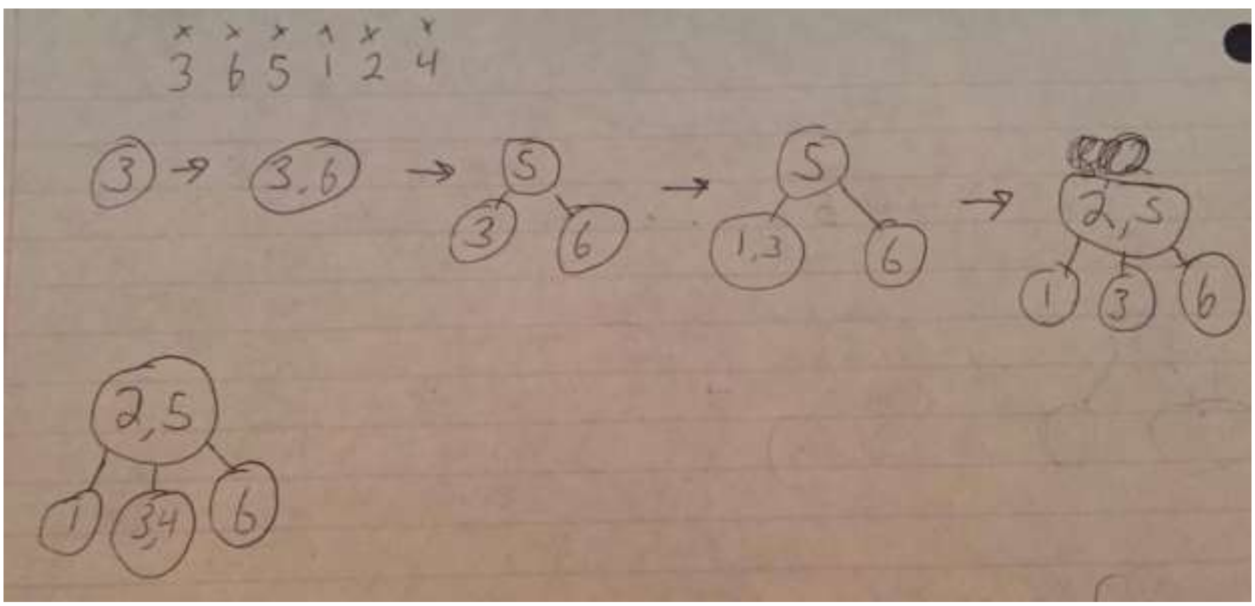
4. Construct both an AVL tree and a 2-3 tree for the values 3 6 5 1 2 4
    a. AVL tree



    b. 2-3 Tree



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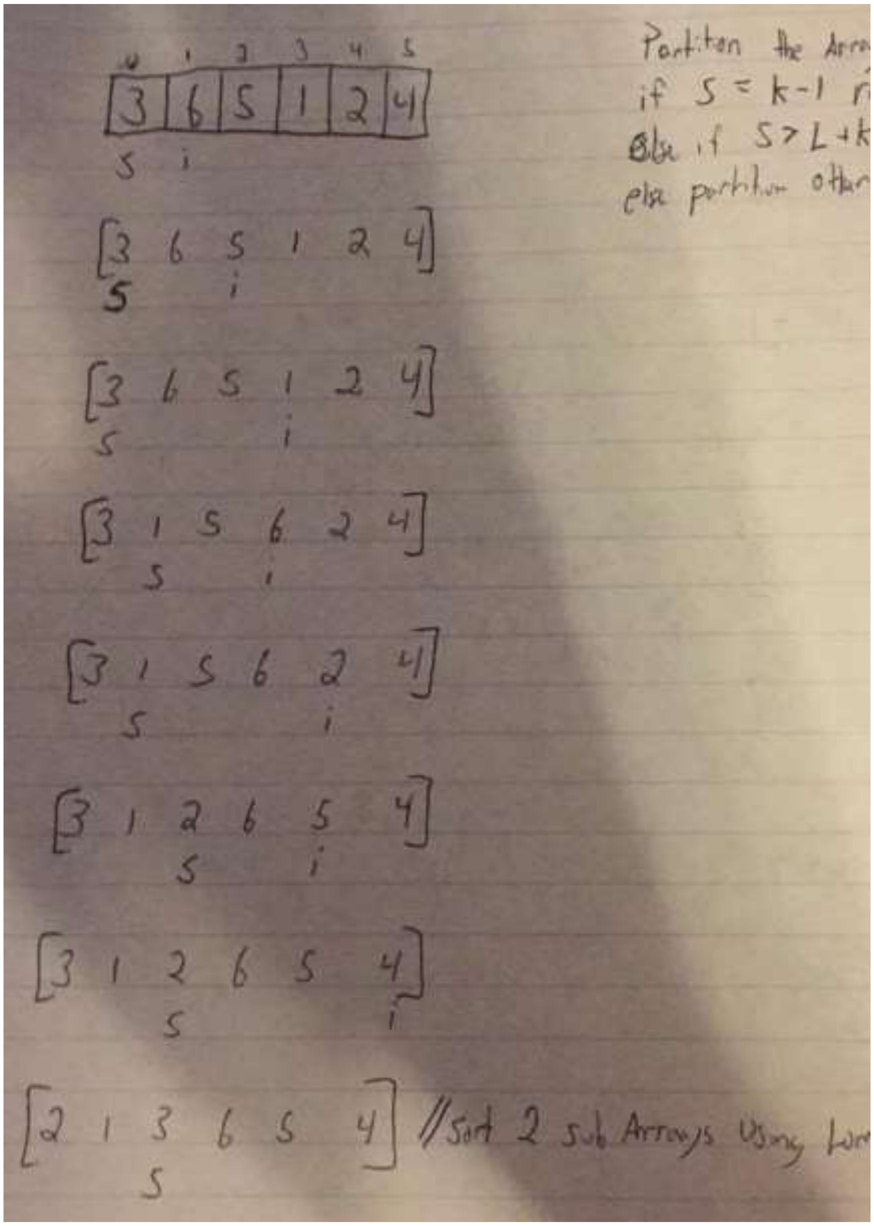
5. Apply Quicksort using both Lomuto's and Hoare's partitioning algorithms on 3 6 5 1 2 4
    a. Lomuto's



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P=2 [2 1 | 3 6 5 4]
s i

[2 1 | 3 6 5 4]
s i

[1 2 | 3 6 5 4]
s i

//sort other side

P=6 [1 2 3 | 6 5 4]
s i

[1 2 3 | 6 5 4]
s i

[1 2 3 | 6 5 4]
s i

[1 2 3 | 6 5 4]
s i

[1 2 3 4 5 6]

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b. Hoare's

$p=3$

$$\begin{array}{cccccc} 3 & 6 & 5 & 1 & 2 & 4 \\ \cancel{i} & i & & & j & \cancel{j} \end{array}$$

$$\begin{array}{cccccc} 3 & 2 & 5 & 1 & 6 & 4 \\ & \cancel{i} & i & j & \cancel{j} & \end{array}$$

$$\begin{array}{cccccc} 3 & 2 & 1 & 5 & 6 & 4 \\ & & j\,\cancel{i} & \cancel{j}\,i & & \end{array}$$

$p=1$

$$\begin{array}{cccccc} 1 & 2 & |3| & 5 & 6 & 4 \\ & i\,j & & & & \end{array} \quad i==j$$

$p=5$

$$\begin{array}{cccccc} 1 & 2 & |3| & 5 & 6 & 4 \\ & & & & i & j \end{array}$$

$$\begin{array}{cccccc} 1 & 2 & |3| & 5 & 4 & 6 \\ & & & & j\,\cancel{i} & \cancel{j}\,i \end{array}$$

$$[1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6]$$