

ESO 207A: QUIZ - 1

Answer the questions in the spaces provided on the question sheets.

Name: _____

Roll No: _____

(June 25, 2018)

1. (5 points) Suppose $T_1(n) = O(f(n))$ and $T_2(n) = O(f(n))$ which of the following is true? If it is not true, give appropriate explanation with a counter example in each case.

(A) $T_1(n) + T_2(n) = O(f(n))$.

(B) $\frac{T_1(n)}{T_2(n)} = O(1)$.

(C) $T_1(n) = O(T_2(n))$

Solution:

ONLY (A) is correct.

(B) is incorrect. For example, let $T_1(n) = n^2$ and $T_2(n) = n$, and $f(n) = n^2$. Then

$$\lim_{n \rightarrow \infty} \frac{T_1(n)}{T_2(n)} = \lim_{n \rightarrow \infty} \frac{n^2}{n} = \infty$$

(C) is also incorrect. The counter example provided in (B) also works in this case

2. (5 points) A quadratic algorithm with processing time $T(n) = cn^2$ spends $T(N)$ seconds for processing N data items. How much time will be spent for processing $n = 5000$ data items, assuming that $N = 100$ and $T(N) = 1\text{ms}$?

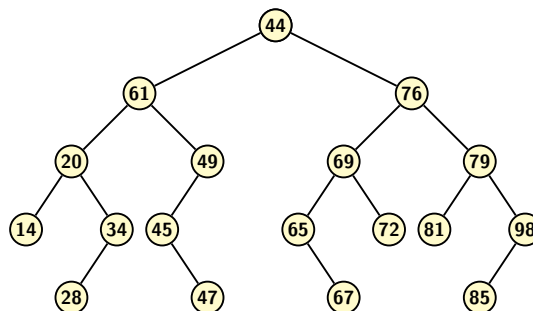
Solution:

The constant factor $c = \frac{T(N)}{N^2}$. Therefore, $\frac{T(N)}{N^2} n^2 = T(N) \frac{n^2}{N} = \frac{n^2}{10^5} \text{ms}$, and $T(5000) = 2500\text{ms}$.

3. (5 points) A BST is a symmetric order tree in which the element at each internal node is:

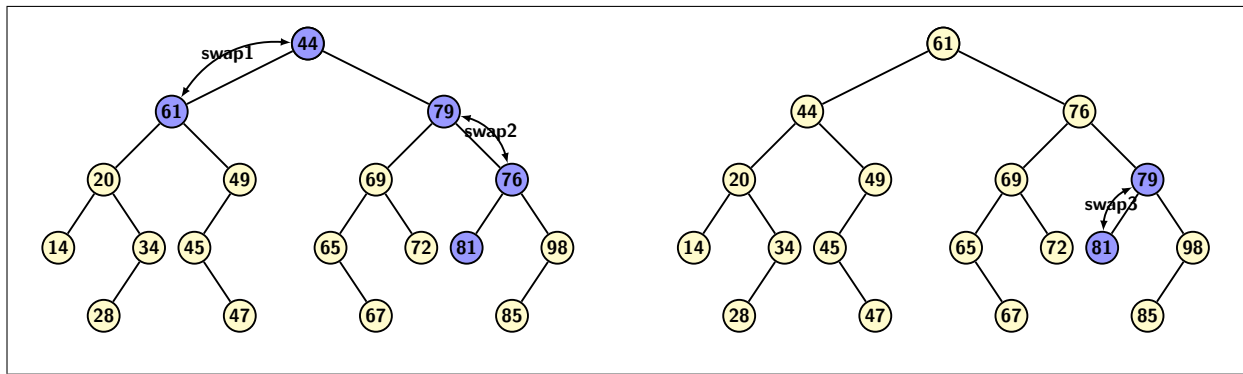
1. Less than all the elements in stored in the right subtree.
2. Greater than all the elements in stored in the left subtree.

Is the following tree a BST? If, not, modify the tree with minimum number of swaps involving parent-child nodes to turn it into a BST.



Solution:

The tree is not a BST, because BST property is violated at four nodes indicated in blue. Three exchange of values as indicated below will restore the BST property: (1) first swap the values 61 and 44, (2) the next swap the values 76 and 81, (3) finally swap 81 and 79 as shown in figure below.



4. (5 points) Consider the function in C like pseudo code given below. It takes a queue Q as an argument, and uses a local stack S to do processing. What the best way to describe the utility of this function? Assuming that initially Q has 4 values: {8, 6, 5, 3}, execute the code to justify your answer.

```
void utilityFunction(Queue *Q) {
    Stack S; // It creates an empty stack S

    // Run while Q is not empty
    while (!isEmpty(Q)) {
        // dequeue an item from Q and push the dequeued item to S
        push(&S, dequeue(Q));
    }

    // Run while Stack S is not empty
    while (!isEmpty(&S))
    {
        // Pop an item from S and enqueue the popped item to Q
        enqueue(Q, pop(&S));
    }
}
```

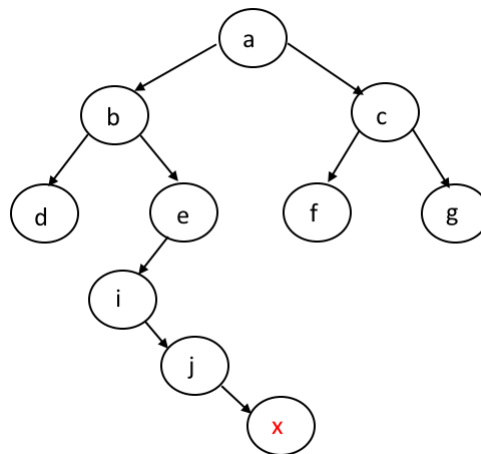
(No mark will be awarded for partial/incomplete answer.)

Solution:

Reverses the queue. The statuses of Q and S will be as shown below:

Queue Q	Stack S	Queue Q	Stack S
{8, 6, 5, 3}	{ }	{3}	{8, 6, 5}
{6, 5, 3}	{8}	{3, 5}	{8, 6}
{5, 3}	{8, 6}	{3, 5, 6}	{8}
{3}	{8, 6, 5}	{3, 5, 6, 8}	{ }
{ }	{8, 6, 5, 3}		

5. (5 points) List the nodes of the tree below both in preorder and postorder.

**Solution:**

Preorder: a b d e i j x c f g

Postorder: d x j i e b f g c a

6. (5 points) Evaluate the following postfix expression

$$4\ 5\ 7\ * \ +\ 3\ /\ 6\ 4\ - \ +$$

Show the status of the stack when "/" operation gets evaluated.

(No mark will be awarded for partial/incomplete answers.)

Solution:

The value of the post fix expression is 15. At the time "/" operation is evaluated, the stack will have: 3, 39. The status of stack during evaluation process at the time each operator is scanned will be as follows:

Stack status	Current input
4, 5, 7	*
4, 35	+
39, 3	/
13, 6, 4	-
13, 2	+

Thus, the final value is 15.

Space for Rough Work