Birla Institute of Technology & Science, Pilani

SSZG519, Data Structures Algorithm & Design

MID-Semester - Solution, EC-2 (Regular) S1 18-19

1.

for G: $O(n \log n)$

The loop runs n times, and member + insert takes $O(\log n)$ time.

Append takes amortised $O(1)$ time so the sequence of n-appends takes $O(n)$ time.

for VG: $O(n \log m)$ - the set S always contains at most m-elements.

$2+2=4M$

2.

a) By case 3 of the master method, we have $T(n) = \Theta(n \log n)$ ↳ 2M

b) By case 1 of the master method, we have $T(n) = \Theta(n^{\log_5 3})$ — 2M

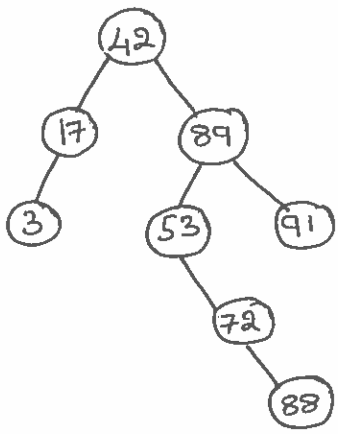
c) Does not apply (non-polynomial difference between $f(n)$) and $n^{\log_b a}$. — 2M

3.

a) 101 → The full binary tree theorem says that an FBT with K internal nodes has K+1 leaf nodes. Applying that Fact. — 2M.

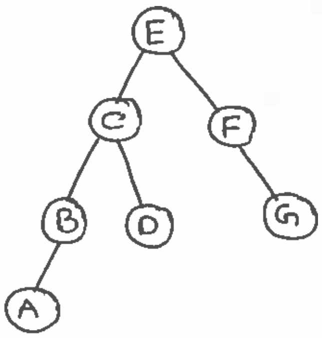
b) 500 ↳ 2M

4.



3M

5.



4M

6. SSSXXSSXSXXX outputs 325641. 154623 cannot be output as 2 is pushed much before 3 so can appear only after 3 is output. — 5M

7.

a) True, The operation add() and delete () spend O(the height of min-heap)
Because the min heap is a complete tree, the height of min heap $\leq \log n$.
$\Rightarrow$ the time complexity of add() and delete() = $O(\log n) = O(n)$ 1M

b) false, A min-heap cannot provide the next largest element in $O(\log n)$ time. To find the next largest element, we need to do a linear, $O(n)$. search through the heap's array. 1M

c) True, NP is contained in Exp. 1M

d) false. 1M

*** End of the Solution ***