

Problem 1(4pts): Use a stack to implement **postorder** DFS, and show what are inside the stack step by step. Note that you should push the items onto stack **alphabetically** when handling the cases where there are 2 children of some node. Then write the sequence of your **postorder** DFS.

(Don't worry if you can't write the right answer at one chance. You are provided with three stacks below and you can use them one by one until you think your answer is correct.)

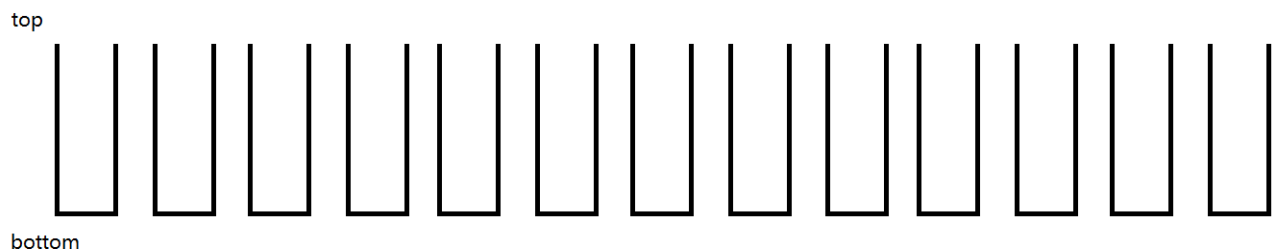
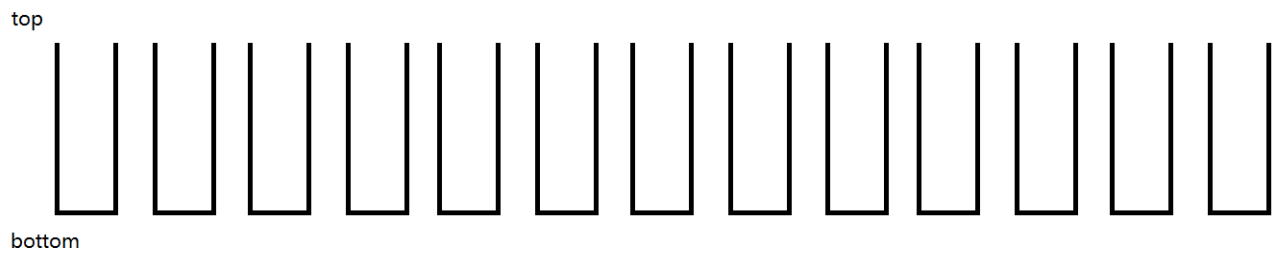
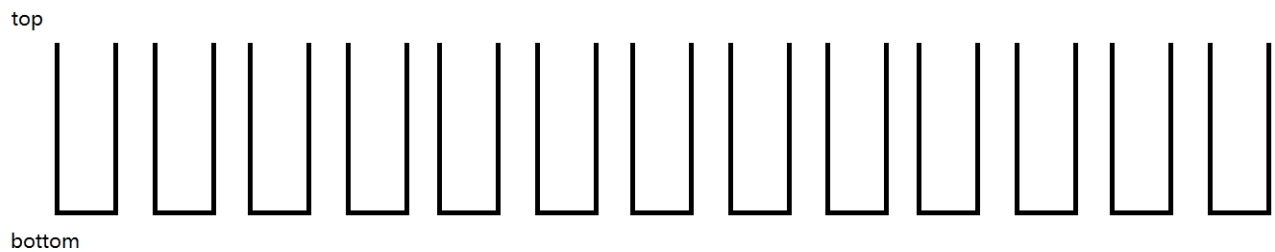
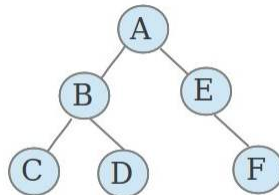


FIGURE 1.

Sequence:-----

Problem 2 Single Choice(2×2pts): The following questions are single choice questions, each question has **only one** correct answer. Select the correct answer.

Note: You should write those answers in the box below.

Question 1	Question 2

2.1: What is time complexity of running BFS which contains n nodes using a queue?

- (a) $O(n)$
- (b) $O(n \log n)$
- (c) $O(\log n)$
- (d) $O(n^2)$

2.2: Given the recurrence $f(n) = 4f(n/2) + 1$, how many sub-problems will a divide-and-conquer algorithm divide the original problem into, and what will be the size of those sub-problems?

- (a) 4 sub-problems, each of size 2
- (b) 4 sub-problems, each of size $n/2$
- (c) 2 sub-problems, each of size 4
- (d) 2 sub-problems, each of size $n/4$

Problem 3(2pts): Let $T(n)$ be the function defined by $T(1) = 1$, $T(n) = 2T(\lfloor \frac{n}{2} \rfloor) + \sqrt{n}$ for $n \geq 2$. Which of the following statements is true? Write your answer directly.

Your answer : _____

Problem 3(5pts): There are n workers working on some tasks and they are very concerned about their working hours and salary. Each worker i has 2 numbers h_i, s_i , indicating this worker's working hour and salary respectively. Worker i, j are enemies if and only if $h_i > h_j$ and $s_i < s_j$. How many pairs of enemies are there?

Design an efficient algorithm. For comparison, our algorithm runs in $O(n \log n)$ time. (Hint: extend merge sort.)