

Birla Institute of Technology and Science, Pilani Hyderabad Campus


BITS F232: Foundations of Data Structures and Algorithms

2nd Semester 2022-23 (**Assignment 2**) Max. Marks: 10

Date given: 05.04.2023

Date of submission: **21.04.2023**

Q.1 [Binary Trees] Find all possible binary trees having the same in-order traversal.

<p>Input:</p> <p>2 (Iterations)</p> <p>1 2 3 (Input 1)</p> <p>8 9 5 4 (Input 2)</p> <p>Output:</p> <p>Total binary trees are 5</p> <p>Preorder traversal for each tree:</p> <p>1 2 3</p> <p>1 3 2</p> <p>2 1 3</p> <p>3 1 2</p> <p>3 2 1</p> <p></p>	<p>Total binary trees are 14</p> <p>Preorder traversal for each tree:</p> <p>8 9 5 4</p> <p>8 9 4 5</p> <p>8 5 9 4</p> <p>8 4 9 5</p> <p>8 4 5 9</p> <p>9 8 5 4</p> <p>9 8 4 5</p> <p>5 8 9 4</p> <p>5 9 8 4</p> <p>4 8 9 5</p> <p>4 8 5 9</p> <p>4 9 8 5</p> <p>4 5 8 9</p> <p>4 5 9 8</p>
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Print the pre-order transversal of each possible tree.

[3 Marks]

Q.2 [Priority Queues] We have **N** Bags with different numbers of balls in each. The i^{th} of these bags contains **A_i** balls. Whenever you remove balls from 1 bag, the number of balls in the bag halves automatically. Say the bag that used to contain **X** balls (before removing), now contains $\lfloor X/2 \rfloor$ balls, where $\lfloor x \rfloor$ is the greatest integer less than x (Greatest Integer Function).

You have **K** minutes to collect as many balls as possible. In a **single** minute, you can collect all the balls in a **single** bag, regardless of the number of candies in it.

Find the **maximum** number of balls you can collect.

Input:

First line contains an integer **T**. **T** test cases follow.

The first line of each test case contains two space-separated integers **N** and **K**.

Second line of each test case contains **N** space-separated integers, the number of balls in the bags.

e.g.

1
4 8
6 3 7 8

Output:

36

[3 Marks]

Q.3 [Binary search tree] You are given a binary tree containing n nodes and the value associated with each node. Convert the binary tree into a binary search tree without changing the structure of the binary tree and you decide to go on a euler tour on that BST and collect all the points from a node every time you visit it. Print the value of total points collected during the tour.

INPUT FORMAT (input arrives from the terminal / stdin):

The first line contains n which is the number of nodes the tree contains. The next line contains n values which represent the value associated with i th node. Then $n-1$ lines follow which contain 2 values say x and y stating that x is the parent of y . (make sure that the parent gets only 2 children because it is a binary tree).

OUTPUT FORMAT (print output to the terminal / stdout):

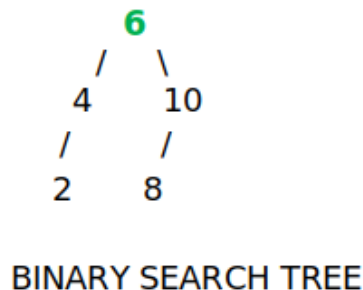
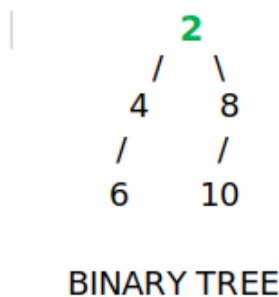
Print the total points collected during the traversal.

SAMPLE INPUT 1:

```
5
2 4 8 6 10
1 2
1 3
2 4
3 5
```

SAMPLE OUTPUT 1:

56 (6+4+2+4+6+10+8+10+6)



[2 Marks]

Q.4 [Stack] A teacher is collecting checked answer sheets of students of the course FDSA. He keeps them in the form of a stack of answer sheets. If a student scores less than 34 out of 100, they will fail the examination. If the score is greater than 33, he will keep the answer sheet on top of the stack or discard it. If a student fails the examination, he gives them the punishment of a value equivalent to the score of the sheet that is present on the top of the stack. What is the maximum amount of punishment the teacher can give ?

Input:

The first line of input data contains a single integer t ($1 \leq t \leq 10^4$) — the number of test cases in the test.

The first line of each test case contains one integer n ($1 \leq n \leq 2 \cdot 10^5$) — the number of answer sheets.

The second line of each test case contains n integers (s_1, s_2, \dots, s_n , ($0 \leq s_i \leq 10^9$)) — score of the i th sheet.

It is guaranteed that the sum of n over all test cases does not exceed $2 \cdot 10^5$.

Output:

Output t numbers in t different lines, each representing the maximum amount of punishment the teacher can give.

Sample Input 1

```
3
5
80 90 99 10 20
5
10 50 50 12 14 50
7
40 50 60 9 88 82 10
```

Sample Output 1

```
189
100
148
```

Explanation:

In the first case, for the 4th sheet, the score from the 3rd sheet will be used, which is 99. For the 5th sheet, the 2nd sheet score will be 90. Hence, the total punishment will be 189.

In the second case, for $i=1$, nothing can be done. For $i=4$ and 5 , $50+50=100$ will be used.

In the third case, for $i=4$, $i=3$ can be used. For $i=7$, $i=5$ will be used. Hence, the total score will be $60+88=148$.

[2 Marks]

Submission Instructions:

You should maintain the same grouping as the first assignment. This grouping is allowed only for allowing peer learning. However, you need to solve all the questions. There will be a demo and viva for this assignment after submission. You should submit a compressed folder (a zip file) consisting of exe and source files no later than 24:00, 21st April 2023 (Friday) at google class page (Assignment2). Your submitted code should also run on Ubuntu systems (that are there in the D block: regular labs) for the evaluation purpose. You should also keep a copy of your code. Any clarification or queries regarding Q1 and Q2 may be emailed to Nitya Shah (f20201443@hyderabad.bits-pilani.ac.in) and for Q3 and Q4, emails may be sent to Samadeep Singh (f20200065@hyderabad.bits-pilani.ac.in) or Krishna Murali (h20221030088@hyderabad.bits-pilani.ac.in)

Instructors, BITS F232
