Problem for Online on Greedy Algorithm for Section A1
Huffman Coding

The Problem:

You are given a set of unique characters/symbols occurring in some text file and associated frequencies of each character in the file. Your task is to find optimal prefix code, also known as 'Huffman Code' for the given set of symbols. In prefix codes, the code a symbol is not a prefix of the codes assigned to other symbols. For this online, you only need to output the lengths of the codes, printing the actual codes is not required.

The Greedy Solution: To be discussed in the class.

The Input:

The first line of the input contains an integer '*t*' representing the number of test cases. Then '*t*' test cases follow. Each test case has the following form:

- Line 1: A single integer, *N* representing the number of symbols/characters.
- Line 2: Space separated *N* integers representing frequencies of the symbols;

The Output

For each test case, there will be a single line of output. The line will be as per following format:

- Lines 1: Space separated *N* integers representing the length of the prefix codes assigned to the symbols.

Sample Input:	**Sample Output**
2 6 5 6 12 4 23 7 7 5 5 5 5 5 5 5	4 3 3 4 1 3 3 3 3 3 3 3 2

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1. The problem for the offline is the same as the online. However you need to print the actual codes assigned to each symbol. To generate the codes you need to save the characters in a complete binary tree. Then the codes can be generated by traversing the tree.

2. You are required to use HEAP data structure in to extract symbols of the lowest two frequencies.

3. Submit a **hand written** report with the following components:

a) Problem description
b) Data structure used
c) Pseudo code of the algorithm
d) Proof of correctness
e) Analysis of running time