**Giving Change**

John is working at a local supermarket. One day as he’s serving a customer he thinks about all the different ways he could give change. In the till there are 1p, 2p, 5p, 10p, 20p, 50p, £1 and £2 coins. You may assume that there is an infinite number of each coin.

a) Given the amount of change that he must give, calculate the number of ways he can give change using the above coins. The order in which he gives the coins does not matter.

Input: A single integer N, the amount of change in pence to give

Output: A single integer, the total number of ways of giving the change

Constraints: 1 <= N <= 100,000

Sample Input:

6

Sample Output:

5

Explanation:

There are 5 ways to give 6p change – as listed below in part b

b) Consider all the ways of giving change of a particular amount. Write each set from largest to smallest (ie 2p 2p 1p 1p not 2p 1p 1p 2p). We can sort all the ways of giving change ‘alphabetically’, treating £2 as A, £1 as B, etc. in order.

For example, we can order the 5 ways of giving 6p as

5p, 1p

2p, 2p, 2p

2p, 2p, 1p, 1p

2p, 1p, 1p, 1p, 1p

1p, 1p, 1p, 1p, 1p, 1p

Given the amount of change to give, find the Kth way of giving change when ordered in the above manner.

Input: Two integers - N, the amount of change in pence to give, and K.

Output: 8 integers, denoting how many of each coin in the Kth ordering, starting from the number of 1p coins up to the number of £2 coins.

Constraints: 1 <= N <= 100,000, 1<= K <= Total ways of giving N pence change

Sample Input:

6 4

Sample Output:

4 1 0 0 0 0 0 0

Explanation:

The 4th way of giving 6p of change has four 1p coins and a single 2p coin.

**Moving House**

Helene is moving house, but unfortunately forgot to get someone to help her unload the moving van. Steve the van driver has agreed to pass her the items out of the van one by one for Helene to take into the house. Helene doesn’t want to make too many trips back and forth, so decides she can carry more than one item at a time.

Given the weights W1…WN of the items that Steve gives her in order, and the maximum number of times Helene is willing to go back and forth between the van and her house, decide how she should carry the items. You should choose to group items together such that the maximum total weight of items she carries at any one time is minimized. Note that she cannot change the order that items are given to her.

Input:

Line 1 – Two integers - N, the number of items, and M, the number of times she can carry items from the van to her house

Line 2 – N space separated integers W1 to WN, where Wi is the weight of the ith item that Steve gives Helene

Output: A single integer, the lowest maximum total weight of items she will have to carry at any time.

Constraints: 1 <= N <= 100,000, 1 <= M <= N, 0 < Wi <= 1,000

Sample Input:

6 3

30 40 60 50 20 10

Sample Output:

80

Explanation:

On the first trip she carries item 1 and 2 (total 70kg), then on the second trip carries item 3 (60kg), then on the third trip carries items 4 to 6 (total 80kg). The most she ever carries is 80kg. Any other method (with at most 3 trips) leads her to carry more than 80kg at some point.

*Note that she cannot change the order that Steve gives the items, so she couldn’t carry the 60kg and 10kg items together without also carrying the 50kg and 20kg items.*

**Stock Prices**

Nina has started stock trading, and wants to analyse how well she’s doing. To do so, she’s looking back at the previous stock prices of MSO.

You are given the stock prices of MSO every second over some interval. Calculate the best profit she could have made by buying a single share during this interval, and then selling it later within the same interval. Note that she must buy the stock before selling it.

Input:

Line 1 – A single integer N, the number of data points given

Line 2 – N space separated integers, P(1) to P(N), where P(i) is the price of the stock in the ith second.

Output: A single integer, the maximum possible profit she could have made

Constraints: 1 <= N <= 1,000,000, 0 <= P(i) <= 10,000

Sample Input:

9

8 7 13 5 8 12 3 4 9

Sample Output:

7

Explanation:

She can make £7 profit if she buys the stock for £5, and sells for £12. Buying and selling at any other point would lead to a lower profit.

**Swaps**

Given a list of 1s, 2s and 3s in a random order, calculate the minimum number of swaps you must make to put them in numerical order, with all the 1s first, followed by all the 2s, followed by all the 3s. You may swap any two numbers.

Input:

Line 1 – A single integer N, the number of values in the list

Line 2 – N space separated integers, with each integer either 1, 2 or 3

Output: A single integer, the minimum number of swaps required

Constraints: 1 <= N <= 1,000,000

Sample Input:

7

2 1 2 1 3 3 1

Sample output:

3

Explanation:

First swap items 1 and 7, giving - 1 1 2 1 3 3 2

Then swap items 3 and 4, giving - 1 1 1 2 3 3 2

Then swap items 5 and 7, giving - 1 1 1 2 2 3 3

There are other ways to sort the list using 3 swaps, but no ways to sort it in less than 3 swaps.