

For all of these exercises you need to find a solution and write it down as two or three sentences along with the complexity computation. Unless specified otherwise your program should run in 1s with a reasonable amount of RAM (i.e. less than 100 Mo).

Exercise 1: No duplicate

Given a list of k integers ($k \leq 10^6$) print the list in the same order but where each value appears only once. When a value appears multiple times in the input, remove all occurrences except the first.

Exercise 2: Ex-aequo

An election has been organized between N candidates numbered 1 to N . You have all the ballots represented as a list of K integers, each integer describing a vote (the number i means this ballot was for candidate i). Determine whether 2 candidates got the same number of votes.

You know that $K, N \leq 10^6$.

Exercise 3: Pictures

You are in charge of taking N pictures from a plane. Each picture captures a rectangular surface of the earth. Each picture can be described by its most north-western side and its most south-eastern one, hence four integers x_1, y_1, x_2, y_2 . You want to determine whether you are asked to take twice the same picture or if all pictures are different.

You know that $N \leq 10^6$ and $1 \leq x_1, x_2, y_1, y_2 \leq 10^6$.

Exercise 4: Marbles

You have a brand new video game where you start with a sequence of N colored marbles. Each marble has a color, an integer between 1 and C . The game is played with an integer K , if you click on K consecutive marbles of the same color, they disappear and the marbles before and after now become consecutive. Given an initial configuration, compute a configuration that can be obtained by playing some moves until there is no more valid move, i.e. where there are no K consecutive marbles of the same color.

You know that $1 \leq N, K, C \leq 10^6$.

Exercise 5: Colored houses

In a street, each house has a given color represented as an integer between 1 and C . Given a list of the colors of houses $C_1 \dots C_K$ what are the two closest houses that have the same color? The distance between houses i and j is $|j - i|$.

You know $1 \leq K, C \leq 10^6$.

Exercise 6: Frequent words

You have a book where words are written using only the letters 'a' to 'z' and have at most 10 letters. What is the most frequent word? The book contains at most 10^6 characters.

Exercise 7: Pizza party

A giant pizza has been made for you and your guests. Olives and capers have been put on the top of the pizza that has already been cut into S slices. Each slice i contain O_i olives and C_i capers. You tell your guest that they can take multiple consecutive slices but they can only ask for a set of slices that contains more olives than capers.

You need to determine for each query (starting slice, ending slice) of your guests whether the set of slice is valid or not. There are $1 \leq S \leq 10^6$ slices and $1 \leq O_i, C_i \leq 10^3$ olives and capers on each slice and a total of $1 \leq Q \leq 10^6$ queries.

Exercise 8: Homework

You have to work on a big project for a class. With your experience you know exactly how many hours you need for the project and using your agenda you know exactly how many hours you spend on homework each day (3h for day 1, 1h for day 2, 0h for day 3, 5h for day 4, etc.).

Since it would be wasteful to work less than the exact amount that you can work on a given day and since you don't know to work on multiple homeworks at once, your goal is now to find a set of consecutive days such that the total homework time for those days is exactly the number of hours of work needed for the project.

There are 10^5 days and at most 24 hours of homework per day.

Exercise 9: IT Consulting

You are in a small IT consulting firm, and you are in charge of keeping the amount of work to a reasonable level. You have access to the list of contracts your firm has with different companies. Each contract includes a starting day, a day it ends and an amount of minutes of work per day for all days between the start and the end.

Of course the firm handles more than one contract at once but, to be reasonable, you want to make sure the firm never offers more than 1000 min of work per day.

There are less than 10^6 contracts spanning over 10^6 days.

Exercise 10: Favorite number

You are waiting in a big queue (10^6 people) and you already know the favorite number (between 0 and 10^9) of everyone. You know people are friends when their favorite number are equal modulo 2 or modulo 3. What is the biggest segment of the queue (i.e. a contiguous set of people) such that all people in that segment are all friends with each other?

Exercise 11: Building bridge

You are building a bridge between positions 1 and 10^6 . The structure of the bridge is already there but to finish the bridge, the construction team needs to pour concrete at various places. On day i ($1 \leq i \leq N \leq 10^6$) they intend to pour 1kg at positions $a_i, a_i + 1, \dots, b_i - 1, b_i$ (hence a total of $1 + b_i - a_i$ kg).

To check the soundness of the bridge, the architects asks you lots (i.e. 10^6) of questions of the form "how many kg of concrete between position b_j and e_j ". You need to answer them.