Midterm Exam

Sessions Given

- Tuesday, March 30, 8:00am - 9:15am EST
- Tuesday, March 30, 12:30 - 1:45pm EST

This exam is:

- open notes/books/any printed resources
- open laptop (anything that you have on your own computer, not online storage)

Online resources that you are allowed to access:

- Gradescope
- course website
- language documentation:
  - Java: https://docs.oracle.com/javase/10/docs/api/
  - C++: https://www.cplusplus.com/reference/ and/or https://en.cppreference.com/w/

Instructions:

Solve three out of the four problems given on the next pages. You will **not** get extra credit for solving all four problems. If you do attempt four problems, we will pick the three with highest scores. For each problem, your last submission counts.

Grading:

Every exam problem is graded out of 10 points. The total exam grade is the weighted sum computed as follows (assume *scoreN* is a score for a particular problem with *score1 >= score2 >= score3*):

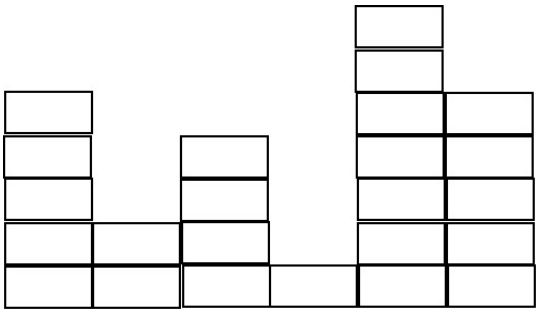
*exam = 5 * score1 + 3 * score2 + 2 * score3*

The total score for a problem is determined by the maximum between zero and the sum of scores for individual tests based on their results. The maximum score for each test is determined by *max_score = 10/number_of_tests*.

test outcome	test score
passed test	*max_score*
wrong answer	*- 0.5 max_score*
runtime error	*- 0.5 max_score*
timeout error	*- 0.5 max_score*
presentation error	*0.75 max_score*

Ayu’s Wall

Ayu loves cakes and she likes to design things with boxes in which she buys the cakes. One day Ayu decided to build a wall with them but she was not good at construction and thus built an very uneven wall.



She wants to rearrange the boxes one by one so that all *columns* have the same height. She is asking you to help her figure out the smallest number of boxes that need to be moved to accomplish that.

Input

The first line of input contains an integer N (1 <= N <= 50) representing the number of *columns*. The next line contains N numbers, the number of boxes (1 <= #boxes <= 100) in each *column*.

The total number of boxes is divisible by the number of *columns* and thus it is always possible to rearrange the boxes such that all *columns* have the same height.

Output

You should print the line `The minimum number of moves is k.` , where k is the minimum number of boxes to be moved in order for all the *columns* to have the same height.

Example 1

```
Input:
6
5 2 4 1 7 5

Output:
The minimum number of moves is 5.
```

CD

You are planning a long drive in a car that can only play music from the old fashioned CD's. All your musing is now on your computer in various playlists, so you decide to burn a CD before the trip.

The objective is to use as much of the CD's capacity as possible (afterall, you love all your music, so it does not matter which songs you get, as longs as the total number of minutes you record is maximized).

Input

The first line of the input contains two integers V (1 <= V <= 10,000) and N (1 <= N <= 20), representing the capacity of the CD and the number of songs in your collection.

The second line contains N integers, indicating the length of each songs in minutes. All of these integers are between 1 and 10,000.

Output

Print one line containing a single integer W, the total number of minutes of recorded songs so that the unused space on the CD is as small as possible.

Example 1

```
Input:
5 3
1 3 4

Output:
5
```

Example 2

```
Input:
10 4
9 8 4 2

Output:
10
```

Example 3

```
Input:
20 4
10 5 7 4

Output:
19
```

Example 4

```
Input:
90 8
10 23 1 2 3 4 5 7

Output:
```

55

Angor

Angor is a new system developed by a security agency. It collects measurements from various sensors (temperature, wind speed, wind direction, humidity, light intensity, …) at fixed time intervals.

Angor is fully automated. Initially, the user needs to register all the sensors and the frequency at which they should be read. Once this is done, the system provides the readings at the requested times. Each request is of the format:

Register *id interval*

where *id* is the ID of the sensor and *interval* is the interval between two consecutive readings.

All requests are registered at exactly same starting time. The first reading for a sensor is performed *interval* hours after the request is registered and then after every *interval* hours.

Your task is to list the *id*'s of the first N sensor readings in order in which they will occur. If there is more than one sensor reading occurring at the same time, they should be listed in the ascending order of *id*'s.

Input

The input consists of two parts. Each line of the first part contains a single register request as described above where 1 <= #requests <= 1,000, 1 <= *id* <= 3000 and 1 <= *interval* <= 3000. It is guaranteed that there are no duplicated *id*'s.

The second part consists of only one line, containing a single integer N (1 <= N <= 10000), representing the number of sensor readings you have to list.

The two parts are separated by a single # symbol on a line by itself.

Output

You should print the *id*'s of the first N sensor readings. One *id* per line.

Example 1

```
Input:
Register 2004 200
Register 2005 300
#
5

Output:
2004
2005
2004
2004
2005
```

Network

Alice is a network administrator. She is keeping a log of all connections between the computers in the network.

Each connection is bi–directional. Two computers are interconnected if they are directly connected or if they are interconnected with the same computer (of course, any computer is directly connected with itself).

Alice is wondering if two given computers are interconnected at a particular moment, according to the log.

Write a program that counts the number of *yes* and *no* answers to the questions of the kind: *is computer c_i interconnected with computer c_j?*

Input

The 1st line contains a single integer n, 1 <= n <= 10^6 , the number of computers in the network.

At the beginning, there is no direct connection between any two computers.

The following lines contain commands in the form:

- c c_i c_j - which means *connect c_i to c_j*, i.e., a new direct link between c_i and c_j is created. This instruction may appear any number of times for a pair of computers, but only the first occurrence of it changes the state of the network; repeated occurrences do not matter.
- q c_i c_j - which means *query: is c_i interconnected with c_j* (given the sequence of *connect* instructions that came before).

You can assume 1 <= c_i, c_j <= n. And there will be no more than 10^6 commands.

Output

Each of the queries can be answered either *yes* or *no*. The output should be a pair of integers that indicates the total number of the *yes* answers and *no* answers, respectively. The two numbers should be on a single line and be separated by a comma (no space).

Example 1

```
Input:
10
c 1 3
c 2 4
q 6 1
c 3 4
c 9 3
q 2 9

Output:
1,1
```

Example 2

```
Input:
1
q 1 1
c 1 1
q 1 1

Output:
2,0
```