JOI 2015-2016 Qualification contest

Authors: JCIOI (Japanese Committee for the IOI)

Translators: Jasmine Chua, France-ioi

License: Creative Commons Attributions-ShareAlike 4.0 International License (CC BY-SA 4.0)

**Selecting Subjects**

**QUESTION**

JOI took 6 tests for the following subjects: Physics, Chemistry, Biology, Earth Sciences, History, and Geography. Each test has a maximum score of 100 points.

JOI must choose 3 subjects out of the following 4: Physics, Chemistry, Biology, and Earth Sciences. He also must choose 1 subject out of the following 2: History and Geography.

Assuming he makes choices to ensure he will get the highest score, what is the total number of points from the tests JOI chose?

**INPUT**

The input has 6 rows, with 1 integer written in each row.

In the 1st row, JOI's score for Physics, A, is written.

In the 2nd row, JOI's score for Chemistry, B, is written.

In the 3rd row, JOI's score for Biology, C, is written.

In the 4th row, JOI's score for Earth Sciences, D, is written.

In the 5th row, JOI's score for History, E, is written.

In the 6th row, JOI's score for Geography, F, is written.

All scores, A, B, C, D, E, and F, are 0 ≦ A/B/C/D/E/F ≦ 100.

**OUTPUT**

Output one row, containing the total number of points from the tests JOI chose.

**INPUT/OUTPUT EXAMPLES**

**INPUT 1**

100

34

76

42

10

0

**OUTPUT 1**

228

**INPUT 2**

15

21

15

42

15

62

**OUTPUT 2**

140

In INPUT EXAMPLE 1, JOI gets the highest score from choosing Physics, Biology, Earth Sciences, and History.

The points he scored from Physics, Biology, Earth Sciences, and History are 100, 76, 42, and 10 respectively, with a total score of 228 points.

In INPUT EXAMPLE 2, JOI gets the highest score from choosing Chemistry, Biology, Earth Sciences, and Geography.

The points he scored from Chemistry, Biology, Earth Sciences, and Geography are 21, 15, 42, and 62 respectively, with a total score of 140 points.

In INPUT EXAMPLE 2, JOI gets the same score even if he chooses Physics, Chemistry, Earth Sciences, and Geography instead.

※Save each example's input/output data as a file by right-clicking the links.

**Swapping Bibs**

**QUESTION**

N students from JOI High School are standing in a row from East to West. Student i is the ith student from the West. Each student is wearing a bib with an integer written on it. A bib is a sleeveless shirt worn over clothing in sports to identify players. At the beginning, student i is wearing the bib with integer Ai.

There are M batons, which are labelled from 1 to M. For k = 1, 2, ..., M, the following process takes places. The process for baton k, where 2 ≦ k ≦ M, takes place only after the process for baton (k - 1) is complete.

1. The teacher passes baton k to student 1.
2. The student with the baton passes it on, following the rules below:

* Rules: Student i receives baton k:
  + When 1 ≦ i ≦ N - 1: Divide the integer on student i's bib by k. Divide the integer on student (i + 1)'s bib by k. If the remainder of the division is larger in the case of student i, students i and (i + 1) will swap bibs, and student i will pass the baton to student (i + 1). If the remainder of the division is larger in the case of student (i + 1), student i will pass the baton to student (i + 1) without any swapping of bibs.
  + When i = N: Student N will pass the baton to the teacher.

1. When the teacher receives baton k from student N, the process for baton k is complete.

Given the integers written on the students' bibs at first and the number of batons M, create a program to find out the integers on each of the students' bibs after the teacher receives baton M from student N.

**INPUT**

The input has (1 + N) rows.

In the 1st row, two integers are written with a space between them.

* N, where 1 ≦ N ≦ 100. This represents the number of students.
* M, where 1 ≦ M ≦ 100. This represents the number of batons.

For the next N rows, in the ith row, where 1 ≦ i ≦ N, one integer is written.

* Ai, where 1 ≦ Ai ≦ 1000. This represents the integer on the bib that was originally worn by student i.

**OUTPUT**

The input has N rows.

In the ith row, where 1 ≦ i ≦ N, output the integer on student i's bib after the teacher receives baton M from student N.

**INPUT/OUTPUT EXAMPLES**

**INPUT 1**

6 4

3

2

8

3

1

5

**OUTPUT 1**

2

3

1

8

5

3

**INPUT 2**

10 6

1

2

3

4

5

6

7

8

9

10

**OUTPUT 2**

6

1

2

3

10

4

8

7

9

5

In INPUT EXAMPLE 1, there are 6 students. The integers on their bibs are, in order, 3, 2, 8, 3, 1, 5. There are 4 batons.

* When the process for baton 1 is complete, the bib order is 3, 2, 8, 3, 1, 5.
* When the process for baton 2 is complete, the bib order is 2, 8, 3, 3, 1, 5.
* When the process for baton 3 is complete, the bib order is 2, 3, 3, 1, 8, 5.
* When the process for baton 4 is complete, the bib order is 2, 3, 1, 8, 5, 3.

※Save each example's input/output data as a file by right-clicking the links.

**Russian Flag**

**QUESTION**

Chairman K needs to make a flag for the IOI 2016 event taking place in Russia. First, he took out an old flag from storage. Then, he divided the flag into a grid with N rows and M columns. Each square on the grid is already painted with 1 of the following colors: white, blue, or red.

Chairman K plans to repaint some of the squares to create the **Russian flag**. However, the following rules must be followed for the flag:

* Several rows from the top (≥1 rows) must have all squares painted white.
* The following rows (≥1 rows) must have all squares painted blue.
* The rest of the rows (≥1 rows) must have all squares painted red.

What is the minimum number of squares Chairman K needs to repaint to create the Russian flag?

**INPUT**

The input has (1 + N) rows.

In the 1st row, two integers are written with a space between them.

* N, where 3 ≦ N ≦ 50. This represents that the flag is divided into a grid with N rows.
* M, where 3 ≦ M ≦ 50. This represents that the flag is divided into a grid with M columns.

For the next N rows, strings composed of M characters are written to represent the original colors on the old flag. The jth character in the ith row, where 1 ≦ i ≦ N and 1 ≦ j ≦ M, is written with one of the following characters to represent the original color of the jth square in the ith row:

* 'W' represents white.
* 'B' represents blue.
* 'R' represents red.

**OUTPUT**

Output the minimum number of squares Chairman K needs to repaint to create the Russian flag in one row.

**INPUT/OUTPUT EXAMPLES**

**INPUT 1**

4 5

WRWRW

BWRWB

WRWRW

RWBWR

**OUTPUT 1**

11

**INPUT 2**

6 14

WWWWWWWWWWWWWW

WBBBWWRRWWBBBW

WWBWWRRRRWWBWW

BWBWWRRRRWWBWW

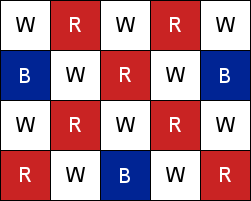
WBBWWWRRWWBBBW

WWWWWWWWWWWWWW

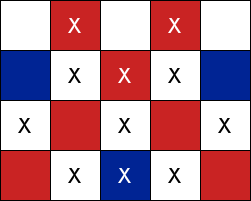
**OUTPUT 2**

44

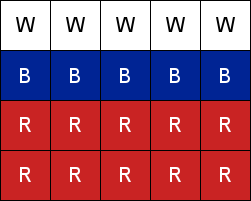
In INPUT EXAMPLE 1, the colors on the old flag are shown below:



11 squares, marked with 'X' in the image below, need to be repainted.

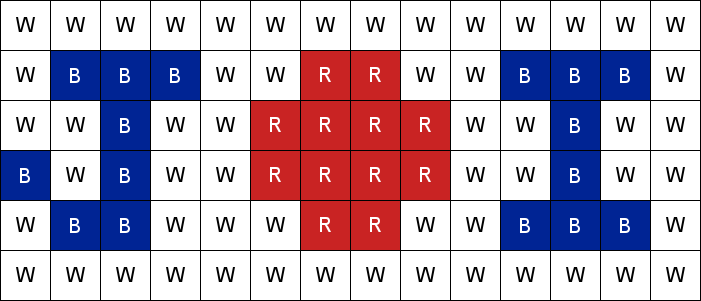


Doing so will yield the Russian flag, as shown below:



11 is the minimum number of squares Chairman K needs to repaint to create the Russian flag, so the output is 11.

In INPUT EXAMPLE 2, the colors on the old flag are shown below:



※Save each example's input/output data as a file by right-clicking the links.

**Walking in JOI Kingdom**

**QUESTION**

There is a long road running through JOI Kingdom from East to West. The palace is located next to this road, and each point along the road is indicated by integer A. The palace is located at A = 0. When A > 0, A represents a point that is A meters away from the palace towards the East. When A < 0, A represents a point that is -A meters away from the palace towards the West.

There are N houses located next to the road, and each house is labelled from 1 to N, starting from the West. There are N citizens living in JOI Kingdom, and each citizen is also labelled from 1 to N. Citizen i lives in house i. House i is located at point Ai, where Ai ≠ 0. There are A1, ..., AN points, all of which are different numbers.

The citizens of JOI Kingdom have not been getting enough exercise recently. Concerned about their health, JOI Kingdom's king ordered all citizens to go on a walk. At his command, all citizens will start to walk towards the East or West. Each citizen can choose which direction to walk in. They will walk at the speed of 1 meter per second.

Everyone in JOI Kingdom loves to chat. If they meet another citizen during their walk, they will stop walking and start to chat. Any citizen who meets other citizens already in a conversation will also stop walking. Once a citizen stops walking, they will not start again.

There are Q important citizens in JOI Kingdom. T seconds after the king sends out his command, he wants to determine the positions of these Q citizens. Create a program to find out the position of the Q important citizens T seconds after the king sends out his command.

**INPUT**

The input has (1 + N + Q) rows.

In the 1st row, three integers are written with a space between them.

* N, where 1 ≦ N ≦ 100000 (= 105). This represents that there are N houses in JOI Kingdom.
* T, where 0 ≦ T ≦ 1018. This represents the number of seconds after the king sends out his command.
* Q, where 1 ≦ Q ≦ 1000, and 1 ≦ Q ≦ N. This represents that there are Q important citizens whose positions the king wants to determine.

For the next N rows, in the ith row, two integers are written with a space between them.

* Ai, where -1018 ≦ Ai ≦ 1018 and Ai ≠ 0. This represents that house i is located at position Ai. For i, where 1 ≦ i ≦ N - 1, Ai < Ai+1.
* Di, where 1 ≦ Di ≦ 2. This represents the direction citizen i will walk in after the king sends out his command. When Di = 1, citizen i will walk towards the East. When Di = 2, citizen i will walk towards the West.

For the following Q rows, in the ith row, one integer is written.

* Xi, where 1 ≦ Xi ≦ N. This represents that citizen i, an important citizen, lives in house Xi. For i, where 1 ≦ i ≦ Q - 1, Xi < Xi +1.

For the 5 input data given:

For Input 1, N ≦ 100 and T ≦ 10000.

For Input 2, N ≦ 5000.

For Input 3, for integer M, where 1 ≦ M ≦ N - 1, Di = 1 for all i, where 1 ≦ i ≦ M, and Dj = 2 for all j, where M + 1 ≦ j ≦ N.

For Inputs 1, 2, and 3, the absolute value should not exceed 1000000000 (= 109).

For Inputs 4 and 5, note that the given integers cannot fit into the 32-bit integer range.

**OUTPUT**

The output has Q rows.

In the ith row, where 1 ≦ i ≦ Q, output the position of important citizen i, T seconds after the king sends out his command. Ensure that the output is an integer and adheres to the conditions given in the question.

**INPUT/OUTPUT EXAMPLES**

**INPUT 1**

5 5 3

-8 1

-4 2

-2 2

4 2

10 1

1

3

5

**OUTPUT 1**

-6

-6

15

**INPUT 2**

7 18 5

-100 1

-56 2

-34 1

-30 1

-22 1

-4 2

18 2

1

3

4

5

7

**OUTPUT 2**

-82

-16

-13

-13

0

※Save each example's input/output data as a file by right-clicking the links.

**Zombie Island**

**QUESTION**

JOI's island is invaded by zombies, so he decided to escape to an emergency shelter, deemed as the safest place on the island.

There are N towns on JOI's island, from town 1 to town N, with roads connecting the towns. There are M roads on the island, with each road joining 2 different towns. JOI is free to move in either direction along the roads, but he cannot travel between towns via methods other than the roads.

Several towns have been infested with zombies and are inaccessible. Towns that are ≦S roads away from the infested town are known as **'at risk' towns**. Other towns are known as **'safe' towns**.

JOI's house is in town 1, and the emergency shelter is in town N. Town 1 and town N are not infested with zombies. Since it takes a long time to travel between towns by road, JOI must spend 1 night in a town after each move. JOI can stay at a cheap inn that costs P yen in 'safe' towns. However, he will stay at a high-security inn that costs Q yen in 'at risk' towns. JOI prefers to pay as little accommodation fee as possible during his journey to the emergency shelter. There is no need to pay to stay in town 1 and town N.

What is the minimum amount of accommodation fee JOI has to pay to travel from town 1 to town N?

**INPUT**

The input has (2 + K + M) rows.

In the 1st row, four integers are written with a space between them.

* N, where 2 ≦ N ≦ 100000. This represents that there are N towns on JOI's island.
* M, where 1 ≦ M ≦ 200000. This represents that there are M roads on JOI's island.
* K, where 0 ≦ K ≦ N - 2. This represents the number of towns that are infested with zombies.
* S, where 0 ≦ S ≦ 100000. This represents that towns that are ≦S roads away from infested towns are known as 'at risk' towns.

In the 2nd row, two integers are written with a space between them.

* P, where 1 ≦ P ＜ Q ≦ 100000. This represents that JOI pays P yen to stay in a 'safe' town.
* Q, where 1 ≦ P ＜ Q ≦ 100000. This represents that JOI pays Q yen to stay in an 'at risk' town.

For the next K rows, in the ith row, where 1 ≦ i ≦ K, one integer is written.

* Ci, where 2 ≦ Ci ≦ N - 1. This represents that town Ci is infested with zombies. C1, ..., CK are all different numbers.

For the following M rows, in the jth row, where 1 ≦ j ≦ M, two integers are written with a space between them.

* Aj and Bj, where 1 ≦ Aj＜ Bj ≦ N. This represents that a road exists between towns Aj and Bj. The pair (Aj, Bj) cannot be written more than once.

For the given data, ensure that there is an open path of un-infested towns between town 1 to town N.

**OUTPUT**

Output the minimum amount of accommodation fee JOI has to pay to travel from town 1 to town N in one row.

Note that the output does not fit into the 32-bit integer range.

**INPUT/OUTPUT EXAMPLES**

**INPUT 1**

13 21 1 1

1000 6000

7

1 2

3 7

2 4

5 8

8 9

2 5

3 4

4 7

9 10

10 11

5 9

7 12

3 6

4 5

1 3

11 12

6 7

8 11

6 13

7 8

12 13

**OUTPUT 1**

11000

**INPUT 2**

21 26 2 2

1000 2000

5

16

1 2

1 3

1 10

2 5

3 4

4 6

5 8

6 7

7 9

8 10

9 10

9 11

11 13

12 13

12 15

13 14

13 16

14 17

15 16

15 18

16 17

16 19

17 20

18 19

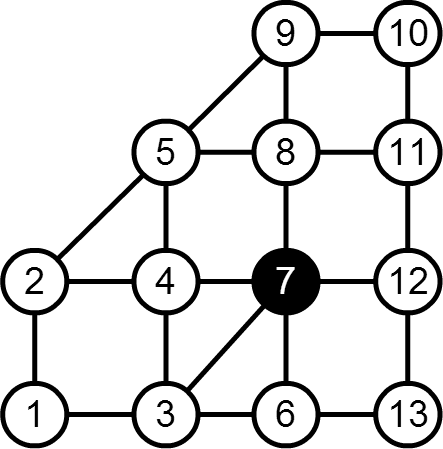
19 20

19 21

**OUTPUT 2**

15000

In INPUT EXAMPLE 1, the towns (circles) and roads (lines) are arranged as shown below:



In this situation, towns 3, 4, 6, 8, and 12 are 'at risk' towns.

To pay the minimum accommodation fee, JOI has to travel in such a way:

* Move from town 1 to town 2. He can stay at a cheap inn that costs 1000 yen in 'safe' town 2.
* Move from town 2 to town 5. He can stay at a cheap inn that costs 1000 yen in 'safe' town 5.
* Move from town 5 to town 9. He can stay at a cheap inn that costs 1000 yen in 'safe' town 9.
* Move from town 9 to town 10. He can stay at a cheap inn that costs 1000 yen in 'safe' town 10.
* Move from town 10 to town 11. He can stay at a cheap inn that costs 1000 yen in 'safe' town 11.
* Move from town 11 to town 12. He will stay at a high-security inn that costs 6000 yen in 'at risk' town 12.
* Move from town 12 to town 13. There is no need to pay at town 13.

By following this route, JOI will pay 11000 yen in accommodation fees. The output is 11000.

※Save each example's input/output data as a file by right-clicking the links.

**Food stalls**

**QUESTION**

JOI lives in IOI City, which is separated into a grid of H × W rectangular sections, with H sections in the North-South direction and W sections in the East-West direction. The ith section from the North and jth section from the West is known as section (i, j). Currently, a large-scale festival is being held in conjunction with an international programming contest that is taking part in IOI City. Several sections have set up food stalls selling different types of sweets. There are no stalls adjacent to the North, South, East, or West of sections (1, 1) and (H, W).

JOI is travelling from section (1, 1) to section (H, W). To shorten his traveling time, JOI will only move south or east. JOI also loves sweets and will perform the following actions each time he enters a section.

1. If there is a food stall selling sweets he has not bought, he will buy the sweets.
2. If there is a food stall selling sweets he has not bought in any section adjacent to the North, South, East, or West of the current section, he will call over the stall owners of all the food stalls in those adjacent sections and buy their sweets, excluding 1.

JOI will not buy the same type of sweet twice.

Given the size of IOI City, position of food stalls, and the price of sweets sold at each stall, what is the minimum amount of money JOI will spend buying sweets as he travels from section (1, 1) to section (H, W)?

**INPUT**

The input has (1 + H) rows.

In the 1st row, two integers are written with a space between them.

* H, where 3 ≦ H ≦ 1000. This represents that IOI City is divided into H x W sections.
* W, where 3 ≦ W ≦ 1000. This represents that IOI City is divided into H x W sections.

For the next H rows, strings composed of W characters are written to represent the information of IOI City. The jth character in the ith row, where 1 ≦ i ≦ H and 1 ≦ j ≦ W, is written with one of the following characters:

* '.' if there is no food stall in the section (i, j).
* '1', '2', ..., '9' to represent the price of the sweets sold in that food stall.

For the 5 input data given:

For Input 1, the number of sections with food stalls is ≦20.

**OUTPUT**

Output one row containing the minimum amount of money JOI will spend buying sweets as he travels from section (1, 1) to section (H, W).

**INPUT/OUTPUT EXAMPLES**

**INPUT 1**

5 5

..483

.59.9

3.866

79...

4.8..

**OUTPUT 1**

20

**INPUT 2**

12 10

..498522.4

.633527629

54.4621596

634.213458

1924518685

7739539767

276155.3.6

87716372.2

.858877595

7998739511

3438.5852.

568.9319..

**OUTPUT 2**

63

In INPUT EXAMPLE 1, JOI will move following this route: section (1, 1), section (2, 1), section (3, 1), section (3, 2), section (4, 2), section (4, 3), section (4, 4), section (4, 5), section (5, 5). He will buy sweets from sections (3, 1), (3, 3), and (4, 2), to spend the minimum amount of money to buy sweets.

※Save each example's input/output data as a file by right-clicking the links.