Reykjavík University Spring Contest 2019

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Problems

A A Tale of Two Queues
B Back to Studying
C Circular Painting
D Danger Zone
E Emergency Exits
F Fetch the Stuff
G Group Lockers
H Hot Dog Deals

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

Do not open before the contest has started.

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Problem A
A Tale of Two Queues

The two queues.

Following yet another all-nighter of studying patterns in permutations at the university, Unnar is both exhausted and starving. Fortunately it is almost noon, and the cafeteria has started serving lunch.

After heading downstairs, Unnar is sad to see that the cafeteria is already full of hungry students, and that the two queues towards the two registers are already quite long. Although he would prefer shorter queues, years of eating at the cafeteria has made Unnar an expert at estimating how long different individuals take to pay for their food at the register.

The methods Unnar uses to perform these very accurate estimations require years of training to even begin to understand, but they are based on observations such as whether the individual has their credit card or cash ready, the amount and cost of the items they intend to purchase, and whether they are staff members.

After making his complex estimations for each individual in each queue, Unnar would like to know which queue he should enter in order to get to the register as quickly as possible, assuming his estimations are correct (which they always are!). At this point his sleep deprivation is really starting to kick in, and he asks you to help him with this final task.

Input

The input consists of:

- One line with two integers n and m ($1 \leq n, m \leq 5\,000$), the number of individuals in the left and right queues.
- One line with n integers, the ith of which represents the estimated time, in seconds, for the ith individual in the left queue.
- One line with m integers, the ith of which represents the estimated time, in seconds, for the ith individual in the right queue.

Individuals are listed in their queue order, with the next in queue being listed first.

Output

If it is quicker for Unnar to enter the left queue, output "`left`". If it is quicker for Unnar to enter the right queue, output "`right`". If it does not matter which queue Unnar enters, output "`either`".

Sample Input 1	Sample Output 1
4 2 10 9 8 15 32 40	left

Sample Input 2	Sample Output 2
2 3 15 15 10 10 10	either

Sample Input 3	Sample Output 3
4 1 20 20 20 20 60	right

Problem B
Back to Studying

The semester's final exams are approaching rapidly, but Arnar has yet to begin studying. Instead he does what all other Computer Science students do when exams are near: play video games all day long!

But now he's starting to get worried that he might not have enough time to prepare for all of his exams. He knows the exam schedule, and for each exam he knows how many days he must spend studying for the exam in order to pass. He can only study for at most one exam per day, and he will not be able to do any studying on days when there are exams.

Given this information, help Arnar determine if it is possible for him to study enough to pass all his exams, and, in that case, how many additional days he can spend playing video games before he has to begin studying.

Input

The input consists of:

- One line with one integer n ($1 \leq n \leq 2 \cdot 10^5$), the number of Arnar's final exams.
- n lines, the ith of which contains two integers d_i and c_i ($1 \leq d_i, c_i \leq 10^9$), the number of days before the ith exam and the number of days Arnar must study for this exam in order to pass.

There is at most one exam on any given day.

Output

If there is no way for Arnar to spend the required number of days studying in order to pass all his exams, output "`impossible`". Otherwise, output the number of days Arnar can spend playing video games before he has to begin studying in order to pass all his exams.

Sample Input 1	Sample Output 1
2 10 6 20 5	4

Sample Input 2	Sample Output 2
3 6 3 11 4 16 5	2

Sample Input 3	Sample Output 3
1 7 7	0

Sample Input 4	Sample Output 4
2 7 4 10 6	impossible

Problem C
Circular Painting

The sign outside the university.

It has been decided that the sign outside the university is too small, and a new and much bigger sign should be constructed. A huge wooden panel of sufficiently large dimensions has been built, and now you've been tasked with painting the university's logo on this panel.

The logo is composed of disjoint circular sectors around a complete circle, and you've been given instructions for how to paint the logo in terms of these sectors. Starting from a horizontal angle to the right, and proceeding in counterclockwise direction, each part of the logo is painted as a circular sector of a given angle, inner radius, and outer radius.

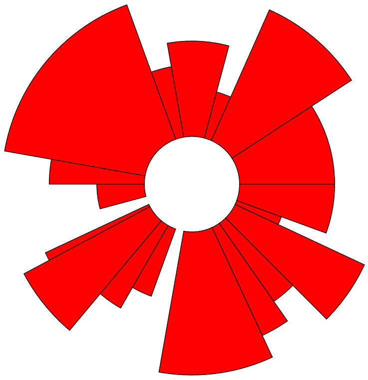

Figure C.1: Illustration of Sample Input 3.

The only thing you're missing is the paint. In order to estimate the amount of paint needed, you decide to calculate the total area that the circular sectors will cover on the sign.

Input

The input consists of:

- One line with one integer n ($1 \leq n \leq 360$), the number of circular sectors.
- n lines, the ith of which contains three integers d, r_1 and r_2 ($1 \leq d \leq 360$, $0 \leq r_1 \leq r_2 \leq 1\,000$), the angle in degrees, inner radius in centimetres, and outer radius in centimetres of the ith circular sector. $r_1 = r_2$ is used to represent an empty circular sector of the given angle.

The sum over angles of all circular sectors equals 360.

Output

Output the total area of the circular sectors in square centimetres.

Your answer should have an absolute or relative error of at most 10^{-3}.

Sample Input 1

```
2
180 0 10
180 5 20
```

Sample Output 1

```
746.128255228
```

Sample Input 2

```
4
90 0 0
45 1 20
180 0 0
45 1 20
```

Sample Output 2

```
313.373867196
```

Sample Input 3

```
20
33 10 30
33 10 40
9 10 20
25 10 30
10 10 25
60 10 40
10 10 30
15 10 20
10 0 0
3 10 34
22 10 40
10 10 30
10 10 25
10 0 0
35 10 40
10 10 35
10 10 30
20 10 40
5 10 20
20 10 30
```

Sample Output 3

```
3272.64942712
```

Problem D
Danger Zone

The round tables outside the university shop.

Will today be the day? Weeks have gone by and you barely remember the last time you were lucky enough to get some candy at the university. All because of those vicious round tables that surround the entrance to the shop, waiting for the next absentminded student to wander into their midst, and hurt themselves by walking into or tripping over one of the tables. "*I'm just going to the shop to grab some treats*" are the words of dozens of students never to be seen again.

You silently observe the tables from a distance and look at the shop entrance behind them with longing eyes. Maybe it's the current arrangement of the round tables, but you feel like — with a good plan — today might be the day you finally manage to navigate around the round tables to the entrance of the shop, and get your oh-so-wanted candy.

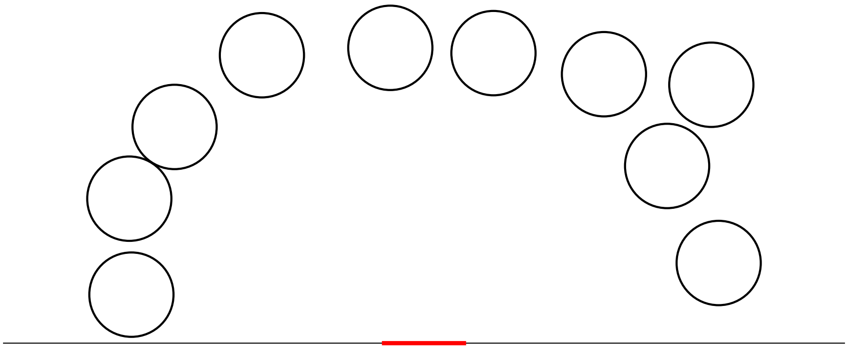

Figure D.1: Illustration of Sample Input 2, with the entrance to the shop in red.

The round tables are represented as a set of non-intersecting circles, each of diameter 80 centimetres. The front of the shop is represented as the infinite x-axis facing the positive y direction. The entrance to the shop is represented as a line segment on the x-axis, with midpoint $(0, 0)$ and length 80 centimetres. You are represented as a circle of diameter 50 centimetres. Although you can touch the front of the shop and the edges of the tables, you cannot walk through walls and you will certainly not climb over or under the tables. You're not willing to take any such chances!

Given the locations of the tables in centimetres relative to the midpoint of the shop entrance, can you navigate past the tables and reach the entrance? You are currently far enough from the entrance that your precise location is irrelevant.

Input

The input consists of:

- One line with one integer n ($0 \leq n \leq 5\,000$), the number of round tables.
- n lines, the ith of which contains two integers x_i and y_i ($|x_i| \leq 10^9$, $40 \leq y_i \leq 10^9$), the location of the center of the ith round table in centimetres relative to the midpoint of the shop entrance.

No two tables intersect, and each table is at least 2 metres away from the shop entrance.

Output

Output "`possible`" if it is possible to reach the entrance. Otherwise output "`impossible`".

Sample Input 1

```
5
-300 40
-300 300
0 300
300 300
300 40
```

Sample Output 1

```
possible
```

Sample Input 2

```
10
273 245
171 255
-154 273
-237 205
-280 137
280 76
231 168
-32 280
66 275
-278 46
```

Sample Output 2

```
impossible
```

Problem E
Emergency Exits

An emergency exit.

The university is set to undergo a comprehensive quality inspection next month. The set of requirements that will be checked are known in advance, and the university has been going through the list, making sure everything is in order.

Under the "Fire Safety" section there is a requirement concerning emergency exits that they are having a hard time assessing. It states that it must be possible to reach an emergency exit from any location within the university building in a reasonable time.

You have been asked to help with assessing the current state of these emergency exits. The university has provided you with a graph representation of the building, where each location in the building is represented as a vertex, and each pathway is represented as a weighted directed edge from one location to another. The weight of an edge represents the time in seconds required to travel along that pathway. Note that each pathway can only be traveled in one direction.

Given at which locations an emergency exit is present, determine the maximum time required to reach the closest emergency exit from any location in the building.

Input

The input consists of:

- One line with three integers n, m and k ($1 \leq k \leq n \leq 2 \cdot 10^5$, $0 \leq m \leq 2 \cdot 10^5$), the number of locations, pathways and emergency exits.
- One line with k integers, the distinct locations of the emergency exits.
- m lines, the ith of which contains three integers u_i, v_i and s_i ($1 \leq u_i, v_i \leq n, 0 \leq s_i \leq 10^6$, $u_i \neq v_i$), representing a unidirectional pathway from location u_i to location v_i that takes s_i seconds to travel along.

No two pathways have the same source and destination.

Output

Output the minimum time, in seconds, required to reach the closest emergency exit from any location in the building. If it is not possible to reach an emergency exit from all locations in the building, output "`danger`".

Sample Input 1

```
4 5 2
3 4
1 2 4
1 3 11
2 4 3
4 2 2
4 3 20
```

Sample Output 1

```
7
```

Sample Input 2

```
4 5 1
4
1 3 10
2 3 2
2 4 5
3 1 10
4 2 1
```

Sample Output 2

```
danger
```

Problem F
Fetch the Stuff

It is getting late, and after a long day of studying, Hannes is ready to head home. But now he realizes that he forgot his backpack in one of the classrooms, and his jacket is still in the student lounge. This wouldn't be such a big deal if it were not for the fact that some of the doors in the university building will automatically become locked when it is late in the evening. While Hannes will be able to exit through a locked door, the door will immediately slam shut behind him, at which point he will not be able to go back through.

Hannes now wonders if he will be able to fetch all his stuff, and then exit the building. Given a description of the n parts of the university, the m open and locked doors that separate these parts, as well as the k different parts that Hannes needs to visit to fetch his stuff, can you help him determine if he can fetch all his stuff and then exit the building?

Hannes' current location is in part 1, and outside the building is represented as part n.

Input

The input consists of:

- One line with three integers n, m and k ($3 \leq n \leq 5\,000$, $1 \leq m \leq 10^5$, $1 \leq k \leq 30$), the number of parts of the building, open and locked doors that separate them, and parts that Hannes needs to visit in order to fetch his stuff.
- One line with k distinct integers $p_1, \ldots, p_k$ ($1 < p_i < n$), the parts that Hannes needs to visit in order to fetch his stuff.
- m lines, describing the doors.

  The ith such line starts with two integers q_i and r_i ($1 \leq q_i, r_i \leq n$, $q_i \neq r_i$), indicating that there is a door that separates parts q_i and r_i of the building.

  The remainder of the line contains a string s_i, either "`open`" or "`locked`", indicating whether this door is open or locked. If the door is locked, Hannes can only use the door to go from part q_i of the building to part r_i of the building. If the door is open, Hannes can use the door to travel between parts q_i and r_i as he wishes.

Output

If it is possible for Hannes to pick up all his stuff and then exit the building, output a sequence $t_1, \ldots, t_l$ of parts that Hannes can visit, in the order that he should visit them, so that he can pick up all his stuff. It must hold that:

- He starts at his current location, i.e. $t_1 = 1$.
- He ends outside the building, i.e. $t_l = n$.
- For any two consecutive parts t_i and t_{i+1} that he visits, there must exist a door that allows Hannes to travel directly from part t_i of the building to part t_{i+1} of the building.

- Hannes must visit all the parts he needs to visit in order to fetch all his stuff, i.e. for each $i \in \{1, \ldots, k\}$ there must exist *at least* one $j \in \{1, \ldots, l\}$ such that $p_i = t_j$.

It is guaranteed that if there exists a valid sequence, there exists a valid sequence of length at most $2 \cdot 10^5$. Furthermore, your sequence must satisfy $l \leq 2 \cdot 10^5$. If there are multiple valid sequences, you may output any of them.

If it is not possible for Hannes to pick up all his stuff and then exit the building, output "`impossible`".

Sample Input 1

```
4 4 2
2 3
1 3 locked
3 4 locked
1 2 locked
2 4 open
```

Sample Output 1

```
1
3
4
2
4
```

Sample Input 2

```
5 7 2
3 4
1 2 locked
1 3 open
2 3 locked
1 5 locked
2 4 locked
5 4 locked
5 4 open
```

Sample Output 2

```
1
3
1
5
4
5
```

Sample Input 3

```
5 5 2
2 4
1 2 locked
1 3 locked
2 3 locked
1 5 locked
5 4 open
```

Sample Output 3

```
impossible
```

Problem G
Group Lockers

Sets of lockers can be found at different locations around the university. Each set is arranged into columns of equal width, with between one and four lockers in each column. At the start of each semester, students get the opportunity to rent one of these lockers for the entire semester; this can be very handy for students that would otherwise have to carry stacks of books between their classes.

A set of lockers.

Upon hearing this, a group of n friends decides that they each want their own locker. None of them have any specific requirements about the size or location of their locker, except that — being such good friends — they want their lockers to be close to each other. In fact, they insist that all of their lockers belong to the same set of lockers. Within that set, they want to minimize the distance required to walk between the leftmost and rightmost lockers that belong to the friends.

Given a candidate set of lockers, and the number of lockers that are available for rent in each column, can you help the friends determine this distance if they choose their n lockers optimally?

Input

The input consists of:

- One line with two integers n and m ($1 \leq n \leq 10^9$, $1 \leq m \leq 5 \cdot 10^5$), the number of friends and the number of columns in the candidate set of lockers.
- One line with a string of m digits $c_1 c_2 \ldots c_m$ ($0 \leq c_i \leq 4$), where c_i represents the number of available lockers in column i.

Output

Output the distance, measured in number of columns, required to walk between the leftmost and rightmost lockers that belong to the friends, assuming they rent the n lockers that minimize this distance. If it is not possible to rent n lockers, output "`impossible`".

Sample Input 1	Sample Output 1
3 10 0200110102	2

Sample Input 2	Sample Output 2
5 7 0401330	1

Sample Input 3

```
4 3
224
```

Sample Output 3

```
0
```

Sample Input 4

```
10 10
0301010400
```

Sample Output 4

```
impossible
```

Problem H
Hot Dog Deals

At the university shop the price for a single hot dog is 299 ISK (Icelandic krónas), and the price for a soda is 249 ISK. They also have two great deals:

- A hot dog and a soda for 499 ISK.
- Two hot dogs and a soda for 549 ISK.

A group of hungry university students have gathered outside the shop. Each of them wants to buy a certain number of hot dogs and a certain number of sodas. Being poor university students, they really have to be careful about how they spend their money. They realize that if they buy all their hot dogs and sodas together, and make good use of the two deals that the shop offers, they may be able to save a lot of money.

Input

One line with two non-negative integers n and m ($n, m \leq 500$), the total number of hot dogs and the total number of sodas that the students want.

Output

Output the minimum total amount of ISK so that, together, the students can get their number of hot dogs and sodas.

Sample Input 1	Sample Output 1
`1 2`	`748`

Sample Input 2	Sample Output 2
`2 2`	`798`

Sample Input 3	Sample Output 3
`3 5`	`1795`

Sample Input 4	Sample Output 4
`4 1`	`1098`

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