Winter Contest 2023

January 28th

Problems

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Problem A: Alien Attack
Time limit: 3 seconds

The Trisolaran[1] fleet has arrived and is about to conquer every major city on earth. Two dozen droplet shaped strong interaction probes rest in orbit and make sure that no human escapes into space. The only unsuspicious means of transport for humans are groundcars and thus cities are solely connected by streets.

Nevertheless, there remains one slight glimmer of hope for humanity: Trisolarans cannot lie and thus their strategy is obvious. Analysts of the Planetary Defence Council (PDC) in New York discovered the following. Every day Trisolaris targets a city and uses its strong interaction droplets to wipe it out along with all the streets that are incident. To inflict maximal damage, they will always target the city with the most connecting streets. Moreover, if the Trisolarans have to choose between multiple equally well connected cities, they (like any civilized society) prefer smaller indices. To graciously grant the PDC more time to surrender, New York will be targeted last (no matter its number of streets). If at any time, a city cannot reach New York, the Earth-Trisolaris Organization (ETO) will erase them on the same day and the city is lost as well.

You are asked by the rotating chair of the PDC how much time they have left. The invasion starts tomorrow. Hesitation will inevitably lead to the extinction of humanity.

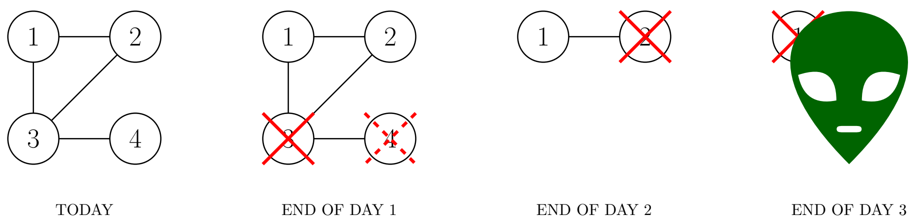

Figure A.1: Visualization of Sample Input 2. A red mark indicates that a city was erased on this day and a dashed red mark indicates cities that are lost to the ETO.

Input

The input consists of:

- One line containing two integers n and m ($1 \leq n \leq 2 \cdot 10^5$ and $n - 1 \leq m \leq 5 \cdot 10^5$), the number of cities and streets, respectively.
- m lines, each with two integers u and v ($1 \leq u, v \leq n$ and $u \neq v$) indicating a street between cities u and v.

It is guaranteed that the street network is connected, simple, and without self-loops. New York is the city number one.

Output

Print the number of days until New York is targeted by a strong interaction droplet.

[1] Trisolarans are a species native to Trisolaris, the only planet in the Alpha Centauri System.

Sample Input 1	Sample Output 1
1 0	1

Sample Input 2	Sample Output 2
4 4 1 2 2 3 1 3 3 4	3

Sample Input 3	Sample Output 3
10 18 2 3 7 2 10 2 8 2 4 5 9 4 6 5 6 9 7 9 6 4 3 6 9 8 10 3 1 10 3 1 6 7 5 8 7 5	5

Problem B: Broken Borders
Time limit: 8 seconds

Bailey loves to solve puzzles. Currently, she is obsessed with BorderQuiz, where you are presented a piece of the border of some random country and have to find the name of the country. In this game, the border of each country is a simple polygon, so you do not have to worry about silly real-world stuff like curved border segments, enclaves, exclaves, second-order enclaves, condominiums and the like. As a single piece of a border is often not sufficient for identifying a country, you may request another piece of the border until you manage to solve the puzzle. Of course, the more guesses and pieces of the border you require the worse your score gets.

Bailey is very good at this game, to the point that it has started to bore her. As her thoughts wander off, she begins to envision a (perhaps more interesting) variant of (or sequel to) BorderQuiz: Is it possible to reconstruct the entire border of a country using only the border pieces you have seen so far? To make it even more interesting, you may use each border piece arbitrarily often and border segments and vertices have to match *exactly*.

More formally, can the border pieces be rotated, translated and optionally mirrored such that

- each vertex of a border piece lies on a vertex of the country border,
- each line segment of a border piece lies on a line segment of the country border, and
- each line segment of the country border lies on (at least) one line segment of a border piece.

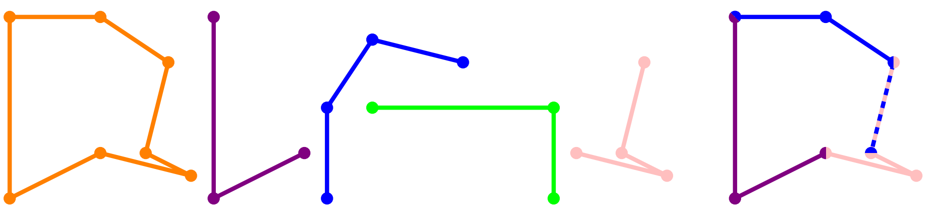

Figure B.1: Visualisation of Sample Input 1: The country border can be constructed by rotating the second border piece clockwise by 90°, not rotating the first and fourth piece, and translating them appropriately. The third piece is not required.

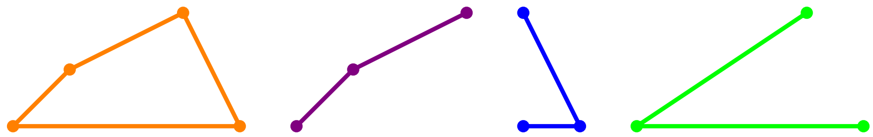

Figure B.2: Visualisation of Sample Input 5: Note that the border pieces can cover the country border, but the leftmost vertex of the second (blue) border piece would not coincide with a vertex of the country border.

Figures B.1 and B.2 illustrate Sample Inputs 1 and 5, respectively.

Input

The input consists of:

- One line with two integers n and m ($3 \leq n \leq 7 \cdot 10^5, 1 \leq m \leq 10^6$), the number of vertices of the country border and the number of border pieces.
- n lines, each with two integers x and y ($1 \leq x, y \leq 10^9$), describing the vertices of the country border.
- m descriptions of border pieces, the ith of which consists of:
  - One line with an integer k_i ($2 \leq k_i < n$), the number of vertices of the ith country border.
  - k_i lines, each with two integers x and y ($1 \leq x, y \leq 10^9$), describing the vertices of the ith country border.

Additionally, the input satisfies the following constraints:

- In total, the country borders have at most 10^6 vertices, i.e. $\sum_{i=1}^{m} k_i \leq 10^6$.
- The vertices of the country border are given in counter-clockwise order.
- No three consecutive vertices of the country border or a border piece are collinear.
- The country border and border pieces are simple, i.e. two non-incident line segments do not intersect and two incident line-segments intersect in exactly one vertex.

Output

Print either "YES" or "NO", depending on whether it is possible to reconstruct the country border from the border pieces.

Sample Input 1

```
7 4
1 1
5 3
9 2
7 3
8 7
5 9
1 9
3
1 9
1 1
5 3
4
7 7
3 8
1 5
1 1
3
9 1
9 5
1 5
4
5 3
9 2
7 3
8 7
```

Sample Output 1

```
YES
```

Sample Input 2

```
4 1
2 1
3 1
3 2
2 2
2
2 1
2 2
```

Sample Output 2

```
YES
```

Sample Input 3

```
4 1
1 1
2 1
2 2
1 2
3
1 1
2 1
2 2
```

Sample Output 3

```
YES
```

Sample Input 4	Sample Output 4
7 3 1 1 5 3 9 2 7 3 8 7 5 9 1 9 4 7 7 3 8 1 5 1 1 3 9 1 9 5 1 5 4 5 3 9 2 7 3 8 7	NO

Sample Input 5	Sample Output 5
4 3 1 1 5 1 4 3 2 2 3 6 1 7 2 9 3 3 10 1 11 1 10 3 3 16 1 12 1 15 3	NO

Problem C: Christmas Calories
Time limit: 1 second

Some delicious cookies with a lot of calories. Image by Nicole Michalou, Pexels

In the time around Christmas people usually spend most of their time inside. After all, it is cold and nasty outside and so the nicely decorated living room and a cup of tea is much more appealing. In combination with plenty of delicious and unhealthy food, this motivates a lot of people to add "do more sports" to their list of New Year's resolutions.

This year, that group includes you. You have started to run regularly and are enjoying it so far, and you have even met a new friend, Caro!

Today you are going to meet Caro for a training session at a nearby stadium with a running track.

Due to the stadium's architecture you cannot see the track until you are already on it, but then you can see the entire track from any position. However, today it is quite foggy and you can only see ℓ meters in any direction.

Assuming that Caro is already on the track at a random position, what is the probability that you do not see her immediately upon arriving on the track?

For simplicity, it can be assumed that the track is a perfect circle with a radius of r meters (i.e. there is only one lane which has width zero).

Input

The input consists of:

- One line with two integers r and ℓ ($1 \leq r, \ell \leq 10^9$), the radius of the track and the distance you can see.

Output

Print a single real number, the probability that you do not see Caro upon arriving on the track. Your answer should have an absolute or relative error of at most 10^{-8}.

Sample Input 1	Sample Output 1
`100 141`	`0.5018939550`

Sample Input 2	Sample Output 2
`1 2`	`0.0000000000`

Sample Input 3	Sample Output 3
`3141592 100000`	`0.9898674517`

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Problem D: Discus Domination
Time limit: 2 seconds

Debbie wants to participate in her school's discus throwing competition. To determine a participant's score, the organisers have laid out a consecutive line of n squares with numbers written on them.


A discus thrower statue. Image from Wikimedia Commons

The rules are simple. Your score is equal to the number written on the square where your discus lands.

However, Debbie is not good at throwing her discus very far. More precisely, she can throw a distance of at most m squares. Therefore, she has convinced the organisers that participants are allowed to start throwing from any square but lose points according to the number written on their starting square.

Furthermore, participants are not allowed to throw their discus onto a square behind them but are allowed to throw them on the same square they are standing on.

Debbie is very precise when throwing her discus. She is pretty sure she won't miss her target if it is in her throwing range. What is the highest score Debbie can obtain?

Input

The input consists of:

- One line with two integers n and m $(1 \leq n, m \leq 2 \cdot 10^5)$, where n denotes the number of squares and m is the maximum number of squares Debbie can throw her discus forward.
- One line with n integers $a_1, \ldots, a_n$ $(0 \leq a_i \leq 10^9)$, where a_i denotes the points written on square i.

Output

Print the maximum score Debbie can obtain.

Notes

In Sample Input 1, the optimal solution for Debbie is to stand on the square with number 1 and throw her discus to the square with number 5, which makes a score of $5 - 1 = 4$. Notice that Debbie may not throw her discus to the square with number 7 when standing on the square with number 1 as she must throw forward. Similarly, she cannot throw her discus to the square with number 6 as it is out of her throwing range.

Furthermore, scores can be negative. If Debbie were standing on square 7 and her discus lands on square 1, she would score $1 - 7 = -6$ points.

Sample Input 1	Sample Output 1
6 2 7 2 1 5 3 6	4

Sample Input 2	Sample Output 2
2 5 1 7	6

Sample Input 3	Sample Output 3
7 3 1 9 5 4 5 15 7	11

Problem E: Elegant Exterior
Time limit: 1 second

Eric recently returned from his studies to his home village. Always admiring the traditional "Fachwerkhaus" style of building, he plans to build his own house in this way. He already determined that the wood construction in the front of the house should resemble the famous "Haus vom Nikolaus". That is, the wood forms a rectangle with diagonals included, on top of which a triangle constitutes the roof.

Eric only has wood for a construction of total length n. He wants to choose the height h and width w of the rectangle such that the area of the house front is as large as possible. To ease his calculations he determines that the triangle should have the same height h as the rectangle below it. Note that the base of the triangle and the top line of the rectangle coincide, so a single strip of wood is used for this part.

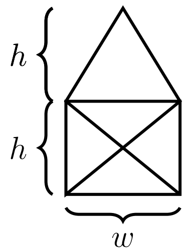

Figure E.1: The house front with maximal area for Sample Input 2.

Input

The input consists of:

- One integer n ($1 \leq n \leq 1000$), the total length of the wood Eric may use.

Output

Print the maximum area of the front of Eric's house with total wood length of at most n. Your answer should have an absolute or relative error of at most 10^{-6}.

Sample Input 1	Sample Output 1
1	0.0185303139

Sample Input 2	Sample Output 2
7	0.9079853822

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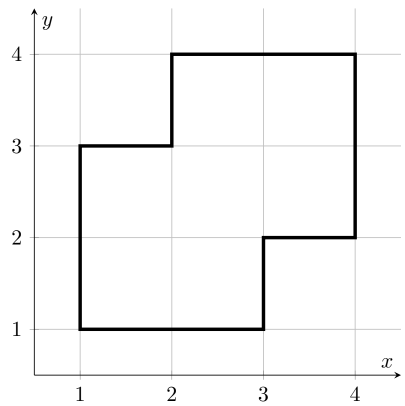
Problem F: Fragmented Floor
Time limit: 2 seconds

A friend of yours has recently moved to the Netherlands, and while visiting potential new homes she discovered an odd peculiarity of Dutch renting practices: You can rent a flat with an oven, fridge, dishwasher and whatnot, but you most likely will have to bring your own floor. Of course the flats have a *floor*, but there is nothing *on* it. No parquet, tiles, laminate or carpet.

As a consequence, every sufficiently large Dutch settlement has several Flooring shops right in the city centre, next to cafés, restaurants and residential buildings (and probably a canal). Funnily enough, by the stacks of laminate on the side walks you can easily tell where someone is currently moving out.

For your friend this odd tradition unfortunately results in another factor that has to be considered before moving in.

She has already decided on the type of floor (some very fine "Tapijt"), but the shop she chose has a pricing policy that makes it hard to find the minimum price for laying the floor: They of course charge by the square-meter, but additionally they charge a fixed 300€ per piece of carpet delivered, no matter its size. Since this is a substantial amount of money, your friend asks you for help in determining the minimum cost for covering the floor of her new dwelling with the chosen "Vloerbedekking".



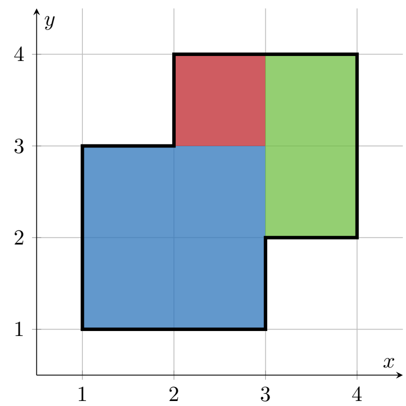


Figure F.1: In Sample Input 2 you need three rectangular carpets to cover the whole floor.

For practical reasons, any piece of carpet the shop sells is perfectly rectangular, but the customer may choose the exact width and height of it. Also, the rectangular carpet pieces have to cover the floor exactly without overlap, since your friend does not own a box cutter and is afraid she would not be able to cut precisely enough anyway.

The cost without the fixed price per piece is easy, she can just multiply the area of the flat with the cost per square-meter. However, she struggles with finding the minimum number of carpet pieces and this is where you come in: Given the floor plan of the flat, determine the minimum number of rectangular carpet pieces needed to cover the entire floor without overlap.

Input

The input consists of:

- One line with an integer n ($4 \leq n \leq 3\,000$), the number of corners of the flat.
- n lines, each with two integers x and y ($1 \leq x, y \leq 10^9$) giving the coordinates of one corner. The walls of the flat are built between two consecutive corners and between the

first and the last corner.

Additionally, the input satisfies the following constraints:

- The corners are given in counterclockwise order.
- The walls of the flat do not touch or intersect each other, except for consecutive walls, which share their endpoints to form a corner.
- The walls of the flat alternate between horizontal and vertical.

Output

Print one integer, the minimum number of rectangular carpet pieces to cover the floor.

Sample Input 1

```
4
1 1
2 1
2 2
1 2
```

Sample Output 1

```
1
```

Sample Input 2

```
8
1 1
3 1
3 2
4 2
4 4
2 4
2 3
1 3
```

Sample Output 2

```
3
```

Sample Input 3

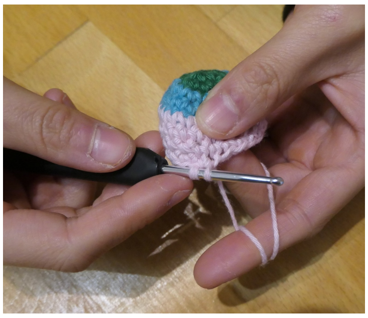
```
16
7 1
7 3
6 3
6 2
5 2
5 4
4 4
4 5
3 5
3 6
2 6
2 4
3 4
3 3
1 3
1 1
```

Sample Output 3

```
6
```

Problem G: Gorgeous Garment

Time limit: 1.5 seconds



Crocheting a (tiny) hat.

It is absolutely freezing outside, and you are in desperate need of a new hat. Since you have just found a nice crocheting pattern for a hat, you want to make it yourself. The pattern is crocheted round by round and consists of n rounds in total, where each round i consists of t_i stitches. Round 1 is the most inner round. Since the hat is wider at the edges, the rounds get larger towards the outer edges, i.e. $t_{i+1} \geq t_i$ for all $1 \leq i \leq n-1$.

Further, you have k different colours of yarn $c_1, c_2, \ldots, c_k$ which you want to use in exactly this order for the hat. At the start of each round, you can either decide to continue with the current colour or to switch to the next colour. Within a round, you cannot switch to another colour. For aesthetic reasons, you want the "colour stripes" to get wider towards the outer edges, i.e. you want to use colour c_{i+1} for at least as many rounds as colour c_i for all $1 \leq i \leq k-1$.

Unfortunately, you only have a limited amount of each kind of yarn and the amount of colour c_i you have at hand suffices only for s_i stitches. You decide to just start with round 1 and to crochet as many rounds as possible such that each colour stripe is at least as wide as the previous one.

Note that it is possible to use a colour for 0 rounds.

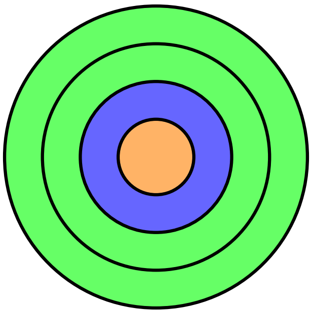


Figure G.1: Sample Input 2: The first round can be crocheted using c_1 colours, the second round using c_2 and the third and fourth round using c_3. The only other optimal solution is to use c_1 for zero rounds and to crochet round 1 and 2 using c_2 and round 3 and 4 using c_3. Note that it is not possible to use both c_1 and c_2 for two rounds and to use c_3 for zero rounds.

What is the maximum number of rounds of the given pattern you can crochet with the yarn you have?

Input

The input consists of:

- One line with two integers n ($1 \leq n \leq 10^5$) and k ($1 \leq k \leq 10^5$), the number of rounds in the pattern and the number of different colours.
- One line with n integers, where the ith integer represents the number t_i of stitches in round i. It is $t_{i+1} \geq t_i$ for all $1 \leq i \leq n-1$, $1 \leq t_1$ and $t_n \leq 10^5$.
- One line with k integers, where the ith integer represents the number s_i $(1 \leq s_i \leq 10^5)$ of stitches you can crochet using colour c_i.

Output

Output the maximum number of rounds of the given pattern you can crochet with the yarn you have such that each colour stripe is at least as wide as the previous one.

Sample Input 1	Sample Output 1
5 3 1 2 3 4 5 4 5 1	1

Sample Input 2	Sample Output 2
6 3 1 2 3 4 5 7 4 10 7	4

Problem H: Hungry Hunting

Time limit: 1 second

A bowl of peanuts. Image by floriana_t, Pixabay

Hannah participates in the NWERC and after the practice session, several presentations and the boat tour she is very hungry. Luckily the organisers of the NWERC expected people to be hungry in the evening. For dinner there are several food booths offering different dishes. Hannah can go to every booth as often as she likes. But unsurprisingly everyone else is also very hungry, so in front of every booth there is a big line that cannot be avoided. Thus, every time she wants to get more food she has to queue.

Hannah is quite experienced in being hungry, so she learned to estimate her hunger in *peanut equivalents (PE)*. She also knows how many PE one serving of some dish will give her. One of her friends, Herbert, is a volunteer at the NWERC and responsible for handing out one of the dishes. Herbert knows that Hannah is very hungry, so he will always give Hannah a double serving, even if she would prefer a normal one. Of course, Hannah does not like to queue for food and she definitely does not want to waste food. How often does she have to queue until she gets the exact amount of food she needs to be full?

Input

The input consists of:

- One line containing two integers n and w ($1 \leq n \leq 10^3, 1 \leq w \leq 10^4$), the number of dishes and Hannahs hunger in PE, respectively.
- One line containing n integers $c_1, \ldots, c_n$ ($1 \leq c_1, \ldots, c_n \leq w$), where c_i is the number of PE Hannah gets if she eats one serving of dish i.

Output

Print n integers $s_1, \ldots, s_n$, where s_i is the minimum number of times Hannah has to queue if her friend Herbert is serving dish i. If it is not possible to get full without wasting food if Herbert is serving dish i, print “impossible” instead.

Sample Input 1	Sample Output 1
2 20 7 3	3 3

Sample Input 2	Sample Output 2
3 5 2 3 2	2 impossible 2

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Problem I: Infinity Issues

Time limit: 1 second

After a long and stressful day at school, Bertha finally got home, but there is one thing she needs to do before she can have some fun. You guessed right, she has to do homework. Her task is to write a summary of "The never ending story". Being a little special, Bertha thought she can at least have some fun while doing this. She came up with the idea to write her summary on a never ending strip of paper. Funny, right? Anyway, her desired result was to print the text on a single line. Unfortunately, she has no printer which can handle infinite paper and standard A4 paper is not wide enough to fit her text in one line.

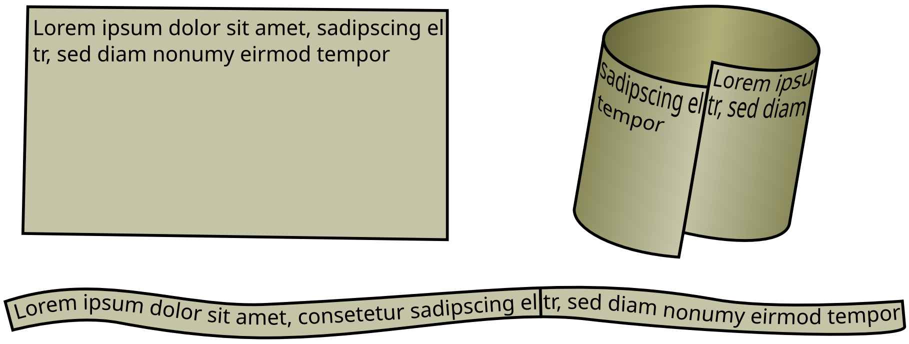

Figure I.1: A text written on a sheet of paper. The paper then was rolled up and glued together. And finally, it was cut into one long piece of paper.

However, Bertha had a brilliant idea, she could print the text in multiple lines of a single A4 sheet and glue the lines together. She can simply glue the left and right sides of the paper together such that the end of line i is at the start of line $i+1$ resulting in a slightly skewed cylinder where the text forms a continuous line. If she additionally starts cutting below the line, she would end up with her desired strip of text. However, there is one problem with that idea. How should Bertha format her text such that the result looks like she intends?

Input

The input consists of:

- One line with two integers n and w ($1 \leq n, w \leq 1000$), the number of words in your text and the number of characters that fit in one line.
- The next line contains n lowercase words s_i ($1 \leq |s_i| \leq 100$), the text you want to print. It is guaranteed that the words are separated by single spaces.

Output

Output the text such that printing it and gluing the page together as described above results in a text identical to the input. Note that whitespaces at the end of a line can be omitted or added, since this won't change the result. The same holds for new lines at the end of the text. Besides that, you need to print the text whitespace sensitive.

Sample Input 1

```
4 4
das ist ein test
```

Sample Output 1

```
das
ist
ein
test
```

Sample Input 2

```
4 3
das ist ein test
```

Sample Output 2

```
das
 is
t e
in
tes
t
```

Sample Input 3

```
4 100
das ist ein test
```

Sample Output 3

```
das ist ein test
```

Problem J: Jinxed Jewelry

Time limit: 3 seconds

Eitri – the king of the dwarfs – is one of the mightiest blacksmiths in the universe. And still he was paralyzed by fear when he was tasked to repair the necklace of Harmonia which broke into n pieces. It was a wonderful jewelry, but it was also as dangerous as it looked beautiful since the necklace was jinxed and brought great misfortune to who ever owned it.

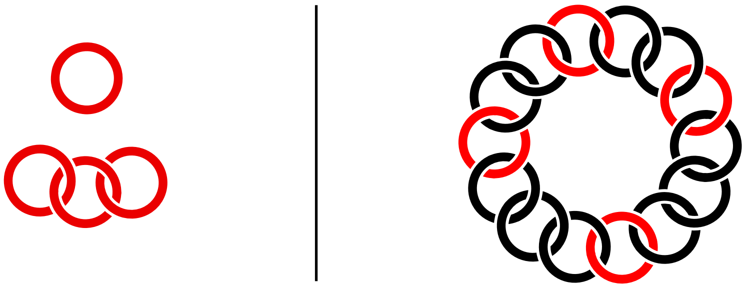

Figure J.1: In Test Case 2 of Sample Input 1, you can open up all chain links of the chains of length 1 and 3 to connect the remaining four chains. The resulting circular necklace can be seen on the right.

Unfortunately, this did not stop Eitri since he was gripped by pride when he got this task. However, the smart dwarf noticed that the n pieces were all simple chains, where the ith chain consists of a_i interlocked chain links. Thus, he could repair the chain by repeatedly opening a chain link, changing with which other chain links it was interlocked, and then closing the link again. He knew that this was enough to make the chains form one circular necklace in the end, but he was not smart enough to figure out how to do this fast and get rid of the jinxed jewelry as soon as possible. Suppose Eitri could open and close one chain link per minute, can you tell how long he would need?

Input

The input consists of:

- One line containing a single integer t, the number of test cases.
- t descriptions of test cases, each consisting of:
  - One line containing an integer n $(1 \leq n \leq 10^5)$, the number of chains.
  - One line containing n integers $a_1, \ldots, a_n$ $(1 \leq a_i < 10^5$ for each $i)$.

  It is guaranteed that you have at least 3 chain links in total.

It is guaranteed that the sum of n over all test cases is at most 10^6.

Output

For each test case print the minimum time required to form a single circular necklace from the chains.

Sample Input 1	Sample Output 1
2 3 3 4 5 6 1 2 2 3 3 3	3 4

Problem K: K.O. Kids II
Time limit: 1.5 seconds

Its Glen's birthday again and this year everybody is invited to take part in a parkour game. The game works as follows: The n kids queue up and do the parkour one-after-the-other. The parkour consists of k obstacles, which have to be beaten in order $1, 2, \ldots, k$. Obstacle i is overcome with probability a_i and failed with probability $1 - a_i$. In case a participant fails at an obstacle his or her run is over. There is one twist: once one participant manages to beat a certain obstacle, all the other participants see how it's done and will *always* beat this obstacle as well.

As it is his birthday, Glen can freely choose his position in the queue. Compute the maximum probability for him being the *first* to beat the parkour when he chooses the initial position in the queue optimally.

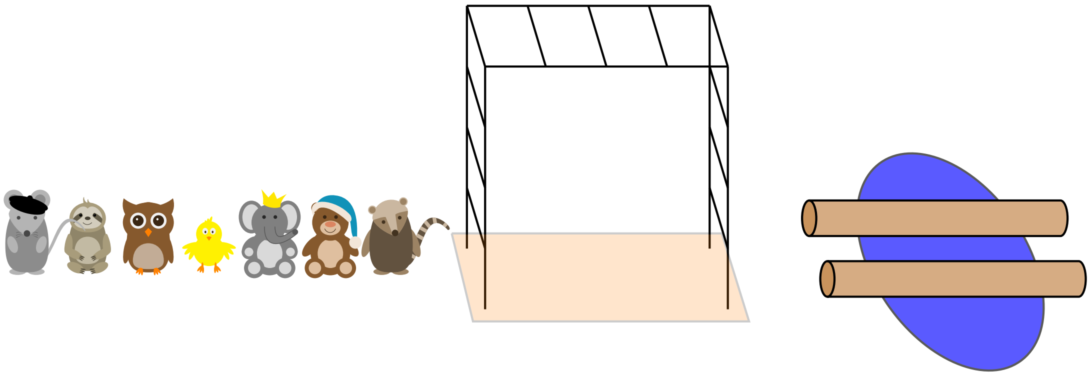

Figure K.1: Glen and his friends queueing up for the obstacle parkour course.

Input

The input consists of:

- One line with two integers n and k ($1 \leq n \leq 10^3, 1 \leq k \leq 10^4$), the number of kids and obstacles.
- One line with k real numbers $a_1, \ldots, a_k$ ($0 < a_i < 1$ for all i), where a_i is the probability that obstacle i is overcome. Every real number has at most six digits after the decimal point.

Output

Print the maximum probability for Glen to be the first to beat the parkour. Your answer should have an absolute or relative error of at most 10^{-6}.

Sample Input 1

```
3 3
0.5 0.5 0.5
```

Sample Output 1

```
0.1875000000
```

Sample Input 2

```
2 1
0.1
```

Sample Output 2

```
0.1000000000
```

Sample Input 3

```
3 3
0.5 0.4 0.3
```

Sample Output 3

```
0.1302000000
```

Problem L: Legendary LAN-Party

Time limit: 2 seconds

You want to throw a LAN-Party for your m best friends. You already bought n switches with m LAN-ports in total. However, only after you paid for them you realized your mistake. You cannot connect m people with those switches, since the switches themselves need to be connected. Luckily, your switches support *Power-line communication* (PLC), a technology which allows the switches to access the internet over their power cord. Even better, you also have n sockets for your power supply which support PLC. Therefore, the only things you need to buy are the power cords for the switches.

For your party, you want to place all the switches along a line, starting with the first switch at position 1. The next switch would be placed right after it at position $m_1 + 1$, assuming the previous switch has m_1 ports. You can assume that a switch with m_i ports is also m_i centimeter long.

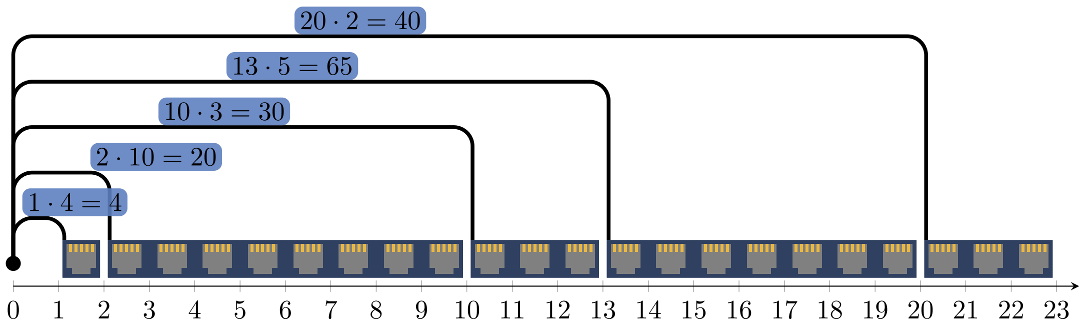

Figure L.1: Visualization of Sample Input 1. The cable length is the horizontal distance between the socket at 0 and the start of the switch. The total sum of the costs is 159.

Since all your sockets are at position 0, you need a 1cm cable for the first switch, a $(m_1 + 1)$cm cable for the second switch and so on. Unfortunately, the costs of the cables vary for different switches. Obviously, you do not want to pay too much for these cables. Since the order of the switches does not matter, you want to know how much you need to pay to connect all switches?

Input

The input consists of:

- One line with two integers n and m $(1 \leq n \leq 2 \cdot 10^5, 1 \leq m \leq 10^6)$, the number of network switches and the total number of ports.
- n lines, each with two integers c and m $(1 \leq c, m \leq 10^6)$, the cost for one centimeter of power cable and the number of ports for each switch.

Output

Print a single integer, the minimum total cost to connect all switches.

Sample Input 1	**Sample Output 1**

`5 22`
`5 7`
`2 3`
`4 1`
`3 3`
`10 8`
	`159`

Problem M: Massive Mountains
Time limit: 2 seconds

A gondola going up a snowy mountain. Image by Photo Mix Company, Pixabay

Mia and Mohammed are spending their vacation in a very scenic region of the Alps, and today they want to go to one of the peaks to enjoy the advertised magnificent view. As it is winter and the mountains are beautifully snowy, the hiking trails are metres deep under snow. Hence, Mia and Mohammed have to use the network of aerial lifts used by thousands of enthusiastic skiers, snowboarders and the occasional sled drivers.

Curiously, the lifts are operated by two different companies, namely Skylifts Ltd and M&M Ropeways. To the annoyance of many tourists, those two companies are absolutely unwilling to cooperate on anything, to the point that there is no single ticket that lets you use lifts from both companies.

Unfortunately, Mia and Mohammed somehow managed to buy one day ticket from Skylifts Ltd and one from M&M Ropeways. The ticket control systems of the two companies are very thorough and modern and not only register when a ticket is used to enter a lift but also when the passenger with that ticket leaves the lift. This makes it impossible for both Mia and Mohammed to use a lift of the same company at the same time. However, the tickets they bought are digital and not tied to a specific person, so Mia and Mohammed can switch between their tickets as they like. Note that such switching is only useful when neither of them is currently using a lift, because the ticket control systems keep track of which tickets are currently in use.

Since gondolas are not very comfortable and the view is definitely better from the mountain top, Mia and Mohammed want to get from the hotel to the destination as quickly as possible. To find the optimal route to take, they compiled a list of all stations and the time for all connections between stations.

Input

The input consist of:

- One line with three integers n, x and y $(2 \leq n \leq 75, 0 \leq x, y \leq n^2)$, the number of stations, lifts operated by Skylifts Ltd and lifts operated by M&M Ropeways, respectively.
- x lines with three integers u, v and w $(1 \leq u, v \leq n, 1 \leq w \leq 10^9, u \neq v)$, each indicating a lift operated by Skylifts Ltd going from station u to station v, where it takes w minutes to use that lift.
- y lines with three integers u, v and w $(1 \leq u, v \leq n, 1 \leq w \leq 10^9, u \neq v)$, each indicating a lift operated by M&M Ropeways going from station u to station v, where it takes w minutes to use that lift.

It is guaranteed that it is possible to reach the mountain top, i.e. station n, from the hotel, i.e. station 1. Note that a lift from u to v does not necessarily imply a lift from v to u. Also, it is guaranteed that for any two stations u, v there is at most one lift of Skylifts Ltd and at most one lift of M&M Ropeways per direction.

Output

Print the minimum time such that Mia and Mohammed can reach station n if they both start at station 1.

Notes

In Sample Input 1 and 2, the optimal solution for Mia is to use only lifts from company Skylifts Ltd and for Mohammed to use only lifts from company M&M Ropeways.

In Sample Input 3, the optimal solution goes as follows. Mia first uses the lift from station 1 to 2, which is operated by M&M Ropeways, then switches the tickets and uses the lift from station 2 to 3, which is operated by Skylifts Ltd. Mohammed waits for 1 minute and then uses the same lifts that Mia used.

In Sample Input 4, one optimal solution goes as follows. Mia uses only lifts from Skylifts Ltd to get from station 1 to station 3. Mohammed waits for 2 minutes and then uses only lifts from Skylifts Ltd to get from station 1 to station 3.

Sample Input 1

```
3 2 2
1 2 3
2 3 5
1 2 5
2 3 3
```

Sample Output 1

```
8
```

Sample Input 2

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

Sample Output 2

```
10
```

Sample Input 3

```
3 2 1
1 2 3
2 3 1
1 2 1
```

Sample Output 3

```
3
```

Sample Input 4

```
3 2 1
1 2 1
2 3 1
1 2 3
```

Sample Output 4

```
4
```