ICPC SouthWestern Europe Practice Contest 2019–2020

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- Carine Pivoteau (Université Gustave Eiffel)
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- Caterina Urban (Inria)

This problem set consists of 5 problems, on 11 pages.

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A: Splitting DNA

Time limit: 1 second

You are studying a protein that splits long chains of DNA into smaller chains. This protein works in the following way: to split a long chain of DNA, the protein first "reads" the whole chain and cuts it into two (non-necessarily equal) parts and, then, recursively splits the two smaller chains.

Splitting a chain S_1S_2 into the two parts S_1 and S_2 takes an amount of energy proportional to the length of S_1S_2 (which is the sum of the lengths of S_1 and S_2). More generally, splitting a chain $S_1 \ldots S_N$ ($N > 1$) takes an energy proportional to the length of $S_1 \ldots S_N$ to cut it into two, plus the energy required to recursively split the two smaller chains.

You know the original DNA chain $S_1 \ldots S_N$ and the N fragments $S_1, \ldots, S_N$ obtained after the split. Since nature is usually very energy-efficient, you wonder what the minimal energy required to split the DNA chain is.

You noticed that the computation of this minimal energy only depends on $L_1, \ldots, L_N$ where L_i is the length of S_i. Given these N integers $L_1, \ldots, L_N$, you want to compute the minimal energy required by the protein to split the long chain into these chunks.

Input

The input consists of two lines:

- on the first line: the number N of strings, an integer;
- on the second line: N space-separated integers representing $L_1, \ldots, L_N$.

Limits

- $1 \leqslant N \leqslant 500$;
- $0 \leqslant L_i \leqslant 10^{14}$ for all $1 \leqslant i \leqslant N$.

Output

The output should contain a single line with a single integer, the minimal total energy required to split the original chain.

Sample Input 1

```
3
1 2 1
```

Sample Output 1

```
7
```

Sample Explanation 1

We always need a first split on the original chain (of length 4) followed by a second cut on a chain of length 3. Therefore the minimal cost is $3 + 4 = 7$.

Sample Input 2

```
3
2 1 1
```

Sample Output 2

```
6
```

Sample Explanation 2

A first possibility is to split $S_1S_2S_3$ into S_1S_2 and S_3, and then split S_1S_2, for a total energy cost of 7. The only other possibility is to split $S_1S_2S_3$ into S_1 and S_2S_3, and then split S_2S_3, for a total cost of 6. Thus, the minimal energy required is 6.

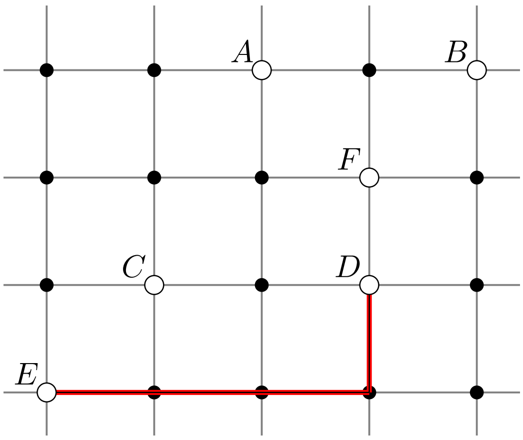
B: Hiding Nuts

Time limit: 1 second

Bob, a squirrel, has set up N hiding places throughout his territory, where he stores nuts before the winter. The hiding places are placed at integer coordinates on a grid. He would like to select one of those hiding places as his main den. He is very worried about his nuts being eaten by other animals. He would therefore like to choose a den that minimizes the average distance of the paths between the den and the $N-1$ remaining hiding places.

Bob has kind of a poor sense of direction. In order not to get lost between his den and each hiding place, he decides that he will only travel using the horizontal and vertical lines of the grid at integer coordinates.

For instance, the distance between the points D and E in the following grid is 4 (one path of minimal length between D and E is drawn in red below), and the average distance between D and the other points is $\frac{13}{5}$.



Input

The input consists of the following lines:

- on the first line: the total number N of hiding places, an integer;
- on the next N lines: X_i and Y_i, the integer coordinates of the i-th hiding place, separated by a space.

Limits

- $1 \leqslant N \leqslant 1\,000$;
- $0 \leqslant X_i, Y_i \leqslant 1\,000\,000$ for all points.

No two hiding places are at the same coordinates.

Output

The coordinates of a hiding place that minimizes the distance to the other hiding places. In case of equality, that hiding place must be the one with the smallest X coordinate and, in case there is still equality, with the smallest Y coordinate.

Sample Input

```
6
2 3
4 3
1 1
3 1
0 0
3 2
```

Sample Output

```
3 1
```

C: Visibility

Time limit: 2 seconds

In the Regional Park of the Haute Vallée de Chevreuse, N observation houses have been built, for the purpose of watching and counting local animals. Furthermore, to help animals and tourists move more efficiently, paths were built along the axes of a grid: these paths are all along the straight vertical (i.e., along a North–South axis) and horizontal (i.e., along an West–East axis) lines.

Every house has a wide observation window that is oriented towards the South. This window allows people to see in every direction that is within a 60° angle with the South – thereby covering a third of the plane – which offers a beautiful show in the spring and summer seasons. However, during winter, the animals stay home or migrate to warmer countries, and the trees have lost their leaves and become so thin that they are barely visible, so the only things that people can see and count are the other observation houses.

Yet, this is still a fun excursion in the wild for the days after SWERC. A group of N students have decided to go to the Regional Park. You are helping them with the planning, having the coordinates of every house. Each student is going to one of the houses.

Once arrived, each participant plans to stand at the observation window of her own house, and to take a picture of every other house she can see from that spot. After the excursion, you will have to gather all the pictures that the students have taken.

Given the list of coordinates of the observation houses, how many pictures will you gather?

Note

If a house Y lies on the border of the third of plane visible from another house X, the participant who went to house X will not take a picture of Y, as this picture would only be partial. If a house Z lies on the segment $[X, Y]$ when Y is visible from X, then the participant who went to house X will take one picture focusing only on the house Y, and another picture focusing only on the house Z.

Input

The input consists of the following lines:

- The first line contains the number N of students, which is also the number of observation houses, an integer;
- For all i such that $0 \leqslant i < N$, line $i + 2$ contains the coordinates X_i and Y_i of the i^{th} observation house, separated by a space.

Limits

- $2 \leqslant N \leqslant 100\,000$;
- $0 \leqslant X_i \leqslant 100\,000$ and $0 \leqslant Y_i \leqslant 100\,000$ for all i.

Output

Your output should contain a single line with a single integer equal to the total number of pictures that will be taken.

Sample Input

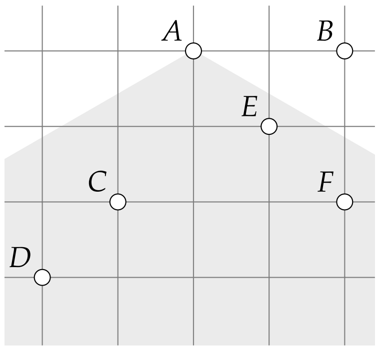
```
6
2 3
4 3
1 1
0 0
3 2
4 1
```

Sample Output

```
11
```

Sample Explanation

The map corresponding to this example is depicted on the right. From the house A, you can see the entire gray area, and thus the participant who chose to go to house A will take 4 pictures.



D: Migration

Time limit: 3 seconds

Each year, the Wildlife Protection Agency (WPA) tracks the migration of birds in order to assess the health of the bird population. During the migration, the birds stop in places they consider safe to rest and eat. There are only a limited number of such spots and the WPA uses them to check the tags attached to the birds' legs. Birds can follow different routes, which means that the WPA might have to cover several places to be sure to count all the birds (it is not a problem if some of the birds are counted multiple times as they have unique tags).

The routes that the birds follow can be seen as a directed graph in which the vertices correspond to the possible stops of birds and an edge links the node a to the node b whenever it is possible that a bird flies from a to b without stopping. The routes follow the birds' journey and therefore it is impossible to have a loop in this graph.

The WPA now needs to decide on a set of places it will monitor. Each bird resting in a monitored place will be accounted for and the agency wants the set of monitored places to be such that every bird is counted at least once. The WPA has the choice of different technologies to monitor places. Some technologies are cheap but have a low range and can only monitor small places, while others are a bit more expensive but can cover larger places. Obviously it is not reasonable to use two different technologies as it would imply to tag the birds with two different systems of tags. For each resting place r of the bird, the agency has determined the price $P(r)$ of the cheapest technology needed to monitor it. It is always possible to monitor a place r with all technologies that have a price $p \geqslant P(r)$. Therefore, if the WPA wants to monitor a set E of places, it will need to pay a price $\max_{r \in E}(P(r))$ per resting place, i.e., a total of $\max_{r \in E}(P(r)) \times |E|$, where $|E|$ is the size of E. Finally, some places are simply impossible to monitor, because of their size or terrain.

The WPA asks you to compute the minimum total price it has to pay to count at least once each of the migrating birds.

Input

The input consists of the following lines:

- On the first line, two space-separated integers N (the number of stops) and M (the number of links).
- On line $i + 2$ for $0 \leqslant i < N$, the integer $P(i)$, which is the price of the cheapest technology to monitor place i. If a place is impossible to monitor, a value of -1 is used.
- Each of the M remaining lines contains two space-separated integers a and b ($0 \leqslant a, b < N$, $a \neq b$) meaning that a bird can fly from place a to place b. It is guaranteed that the same pair a, b will not appear twice.

By convention, place 0 corresponds to the birds' summer home and place $N - 1$ corresponds to the birds' destination. Note that it might be possible to monitor only place 0 or only place $N - 1$. You are guaranteed that the graph is acyclic, that all places are reachable from 0 and that place $N - 1$ is reachable from all places.

Limits

- $2 < N \leqslant 2\,000$;
- $2 < M \leqslant 2\,000$;
- For all $0 \leqslant i < N$ we have $P(i) = -1$ or $1 \leqslant P(i) \leqslant 10^9$.

Output

Your output should contain a single line with a single integer corresponding to the minimum total price required to monitor all the birds during their migration. If it is not possible to count all the birds, then you should output -1.

Sample Input 1

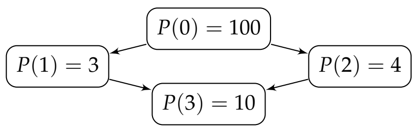
```
4 4
100
3
4
10
0 1
0 2
1 3
2 3
```

Sample Output 1

```
8
```

Sample Explanation 1

The graph is depicted on the right. We can track all the birds with a total price of 8 by buying two pieces of equipment of unit price 4, which we put on places 1 and 2.



Sample Input 2

```
4 4
-1
-1
1
-1
0 1
1 3
0 2
2 3
```

Sample Output 2

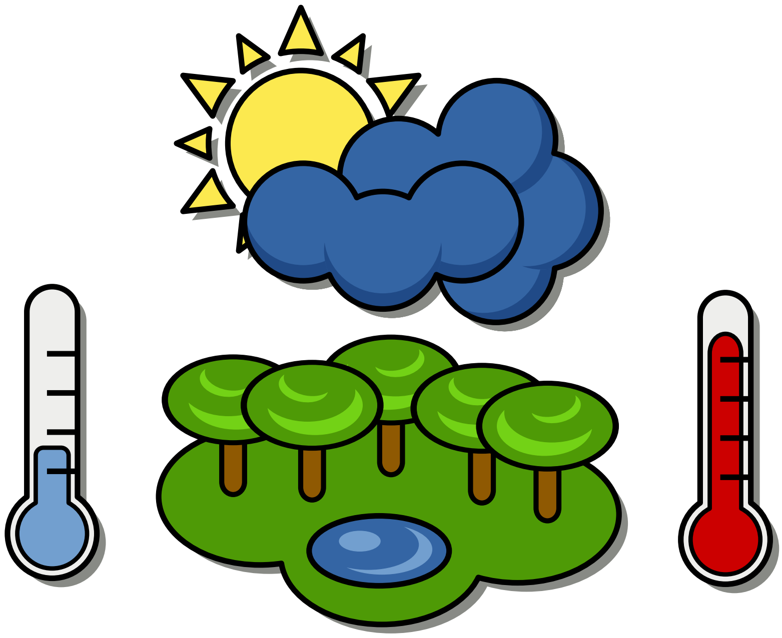
```
-1
```

Sample Explanation 2

We cannot track the birds as they can use a path going through unmonitorable places ($0 \to 1 \to 3$).

E: Extreme Temperatures

Time limit: 1 second



Kristen is a meteorologist, who is monitoring extreme temperatures in the forest of Palaiseau. She has collected temperature measurements at various times over several days. Help her find out what the lowest and highest temperatures were in her entire dataset.

Input

The input is formed of N lines, each line i with $1 \leqslant i \leqslant N$ being a space-separated list of k_i tokens:

- the first token is the date of the measurement, in the form YYYY-MM-DD;
- for $2 \leqslant j \leqslant k_i$, the j-th entry is an integer temperature measurement t_{ij}.

Limits

- $1 \leqslant N \leqslant 1\,000$;
- $2 \leqslant k_i \leqslant 100$ for $1 \leqslant i \leqslant N$;
- $-50 \leqslant t_{ij} \leqslant 50$ for $1 \leqslant i \leqslant N$ and $2 \leqslant j \leqslant k_i$.

Output

The output should contain a single line with two integers: the lowest and highest temperatures in the entire dataset, in this order.

Sample Input

```
2020-01-15 5 4 6 8 12 13 12 9 7
2020-01-16 6 3 4 6 10 12 11 7
```

Sample Output

```
3 13
```