Croatian Open Competition in Informatics

Round 2, November 14th 2020

Tasks

Task	Time limit	Memory limit	Points
Crtanje	1 second	512 MiB	50
Odašiljači	1 second	512 MiB	70
Euklid	1 second	512 MiB	110
Sjekira	1 second	512 MiB	110
Svjetlo	2 seconds	512 MiB	110
Total			450

Task Crtanje

Josip used to code in Logo. He loved to draw pictures, but those days are sadly over. Nostalgic, he decided to draw a line that represents the net worth of his company over a period of n days.

For each of the n days, he knows if the net worth of his company increased by one unit (represented by `'+'`), decreased by one unit (represented by `'-'`), or remained the same (represented by `'='`) during that day. Before the first day, the net worth was equal to zero.

Josip will draw the line in a big infinite matrix of characters. Indices of matrix rows grow upwards, and indices of columns grow to the right. For the i-th day he will draw some character in the i-th column. The character and the index of the row are decided by the following rules:

- If the net worth increased during the i-th day, he will draw `'/'` in the row with index equal to the net worth at the beginning of the day.
- If the net worth decreased during the i-th day, he will draw `'\'` in the row with index equal to the net worth at the end of the day.
- If the net worth didn't change during the i-th day, he will draw `'_'` in the row with index equal to the net worth during the day.

All other cells are filled with `'.'`.

Your task is to output the minimal matrix that contains the whole line, i.e. contains all characters `'/'`, `'\'` and `'_'` that Josip drew.

Input

The first line contains an integer n ($1 \leq n \leq 100$), the number of days.

The second line contains a string of n characters `'+'`, `'-'` and `'='` that represents how the company's net worth changed over the given period.

Output

Output the described matrix.

Scoring

In test cases worth 20 points the input won't contain the character `'-'`.

Examples

input	input	input
7 ++---==	5 +=+=+	4 --=+
output	**output**	**output**
./\.... /..\... ....__	..._/ ._/.. /....	\... ._/

Task Odašiljači

Sadly, this is the last time Sean will play James Bond.

His mission is to network n antennas that are scattered across a vast desert, which can be represented as a 2D plane. He will set the transmission radius of each antenna to be the **same** non negative real number r. The range of an antenna is defined as the set of all points whose distance to the antenna is at most r. If ranges of two antennas have a common point, those antennas can directly communicate. Also, if antennas A and B can communicate, as well as antennas B and C, then antennas A and C are also able to communicate, through antenna B.

Sean wants to network the antennas, i.e. make possible for **every two** antennas to communicate. Since M has limited his spending for this mission, and larger radii require more money, Sean will choose the **smallest possible radius** r. Help him solve this problem!

Input

The first line contains an integer n ($1 \leq n \leq 1000$), the number of antennas.

Each of the following n lines contains integers x_i and y_i ($0 \leq x_i, y_i \leq 10^9$), coordinates of the i-th antenna.

Output

Output the minimal radius.

Your answer will be considered correct if its absolute or relative error doesn't exceed 10^{-6}.

Scoring

In test cases worth 35 points it holds that $1 \leq n \leq 100$.

Examples

input

```
2
1 1
2 2
```

output

```
0.7071068
```

input

```
7
2 3
3 4
4 5
0 1
3 1
4 2
1 5
```

output

```
1.4142135
```

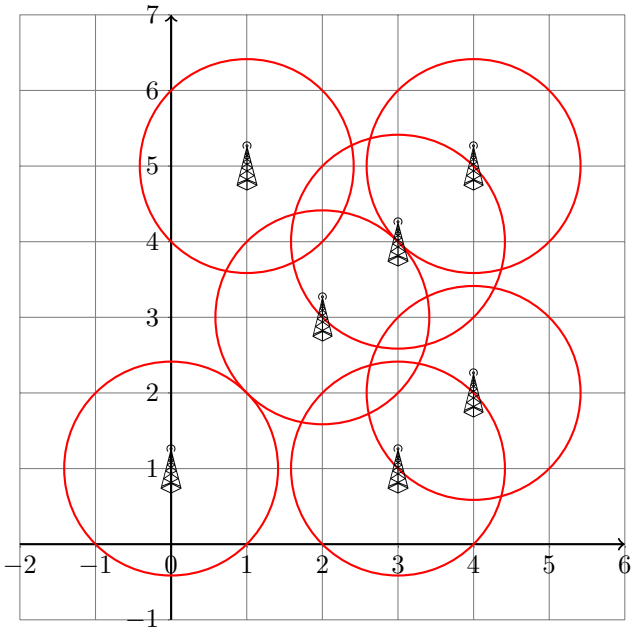
input

```
4
2020 20
20 2020
2020 2020
20 20
```

output

```
1000.0000000
```

Clarification of the second example:



Task Euklid

It is rarely mentioned that Euclid's grandma was from Vrsi in Croatia. It is from there that Euclid's less known (but equally talented in his youth) cousin Edicul* comes from.

It happened one day that they were playing "invent an algorithm". Edicul writes two positive integers on the sand. Then he does the following: while neither number on the sand is 1, he marks them as (a, b) so that $a \geq b$. Then the numbers are erased and he writes $(\lfloor \frac{a}{b} \rfloor, b)$ on the sand, and repeats the process. When one of the two numbers becomes 1, the other is the results of his algorithm.

Formally, if a and b are positive integers, the result $R(a, b)$ of Edicul's algorithm is:

$$R(a,b) = \begin{cases} R(b,a) & \text{if } a < b, \\ R(\lfloor \frac{a}{b} \rfloor, b) & \text{if } a \geq b > 1, \\ a & \text{if } a \geq b = 1. \end{cases}$$

Euclid thinks for a while, and says: "Edicul, I have a better idea...", and the rest is history. Unfortunately, Edicul never became famous for his idea in number theory. This sad story inspires the following problem:

Given positive integers g and h, find positive integers a and b such that their **greatest common divisor** is g, and **the result of Edicul's algorithm** $R(a, b)$ is h.

Input

The first line contains a single integer t ($1 \leq t \leq 40$) – the number of independent test cases.

Each of the following t lines contains two positive integers g_i and h_i ($h_i \geq 2$).

Output

Output t lines in total. For the i-th testcase, output positive integers a_i and b_i such that $gcd(a_i, b_i) = g_i$ and $R(a_i, b_i) = h_i$.

The numbers in the output must not be larget than 10^{18}. It can be proven that for the given constraints, a solution always exists.

If there are multiple solutions for some testcase, output any of them.

Scoring

In all subtasks, $1 \leq g \leq 200\,000$ and $\mathbf{2} \leq h \leq 200\,000$.

Subtask	Points	Constraints
1	4	$g = h$
2	8	$h = 2$
3	8	$g = h^2$
4	15	$g, h \leq 20$
5	40	$g, h \leq 2000$
6	35	No additional constraints.

*This sets up a pun in Croatian. The translation is a bit bland, sorry for that.

Examples

input

```
1
1 4
```

output

```
99 23
```

input

```
2
3 2
5 5
```

output

```
9 39
5 5
```

Clarification of the first example:

The integers 99 and 23 are coprime, i.e. their greatest common divisor is 1. We have $\left\lfloor \frac{99}{23} \right\rfloor = 4$, thus $R(99, 23) = R(4, 23) = R(23, 4)$. Then $\left\lfloor \frac{23}{4} \right\rfloor = 5$, so $R(23, 4) = R(5, 4) = R(1, 4) = R(4, 1) = 4$.

Clarification of the second example:

For the first testcase, $gcd(9, 39) = 3$ and $R(9, 39) = 2$.

For the second testcase, $gcd(5, 5) = 5$ and $R(5, 5) = 5$.

Task Sjekira

Mirko is tired of his stressful CEO job in a well-known multinational software company. With a golden parachute of several million dollars, he decided to live a simple life and move to Gorski Kotar. However, winters in the remote village he just moved in are tough. None of his neighbours were born after WWII, so he is destined to chop firewood himself.

Today, he is going to chop his first trunk. Before chopping, he labels the parts of the trunk which are small enough to fit in a fireplace, and measures their hardness.

Mirko is a programmer, so he notices that the parts and the connections between them form a **tree graph**.

The damage on his axe resulting from cutting a connection on the trunk is equal to the **sum of the maximal hardnesses in the two connected components formed by cutting the connection**.

Mirko has only one axe, so he wants the total damage to be as small as possible. He wants to know **the minimal total damage** on the axe, if he cuts the whole trunk into single parts which fit in a fireplace.

Input

The first line contains an integer n, the number of parts. The parts are labeled by integers from 1 to n.

The second line contains n integers t_i ($1 \leq t_i \leq 10^9$). The number t_i is the hardness of the part labeled i.

Each of the following $n-1$ lines contains two integers x and y ($1 \leq x, y \leq n$) – labels of parts that are directly connected.

Output

Output the minimal total damage after $n-1$ cuts.

Scoring

In all subtasks it holds that $1 \leq n \leq 100\,000$.

Subtask	Points	Constraints
1	10	$1 \leq n \leq 10$
2	10	Parts i and $i+1$ ($1 \leq i \leq n-1$) are directly connected.
3	30	$1 \leq n \leq 1000$
4	60	$1 \leq n \leq 100\,000$

Examples

input

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

output

```
8
```

input

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

output

```
15
```

input

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

output

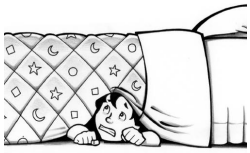
```
26
```

Clarification of the first example:

There are two ways to cut this trunk. He can first cut the connection $(1, 2)$, which causes $1 + 3 = 4$ damage, and then cut the connection $(2, 3)$, which causes $2 + 3 = 5$ damage. The total damage is 9 in this case.

Otherwise, he can first cut $(2, 3)$, and then $(1, 2)$. The total damage in that case $(2 + 3) + (1 + 2) = 8$.

Task Svjetlo



Oh no! It's nighttime, and little Fabijan is afraid of the dark. To make things worse, the chandelier in his room is broken.

The chandelier is made up of n light bulbs connected by $n-1$ wires, so that each wire connects two bulbs and all bulbs are connected, either directly or through other bulbs. In other words, the chandelier is a tree.

Each bulb has a button that changes its state. If the bulb is turned off, pressing the button turns it on, and if it's on, it turns it off. In the beginning, some bulbs are on and some are off (it's possible that all are turned off). **All n bulbs need to be turned on** in order for Fabijan to stop being afraid, since only then will there be enough light in the room.

Fabijan will **choose some sequence** of bulbs such that bulbs that are **consecutive** in the sequence are **directly connected** by some wire. Bulbs can be repeated. He will then go around the bulbs in order they appear in the sequence. Since Fabijan reaaaly likes pressing buttons, either on light bulbs, washing machines, or in elevators, **each time he visits a bulb he will press the corresponding button** once, changing its state.

Help Fabijan and determine the length of the **shortest sequence** of bulbs such that in the end all bulbs are turned on. **There will be at least one bulb that is turned off in the beginning.**

Input

The first line contanins an integer n, the number of light bulbs. Bulbs are labeled by integers from 1 to n.

The second line contans a sequence of n characters `'0'` and `'1'`. If the i-th character is equal to `'0'`, then in the beginning the i-th bulb is turned off, and if it's equal to `'1'`, it's turned on.

Each of the following $n-1$ lines contains two integers x and y ($1 \leq x, y \leq n$) – labels of light bulbs that are directly connected by a wire.

Output

Output the minimum possible length of a sequence such that all bulbs are turned on in the end.

It can be proven that such a sequence always exists.

Scoring

In all subtasks it holds that $2 \leq n \leq 500\,000$.

Subtask	Points	Constraints
1	20	$2 \leq n \leq 100$
2	30	Each bulb is directly connected with at most two other bulbs.
3	30	All bulbs are turned off in the beginning.
4	30	No additional constraints.

Examples

input	input	input
3 010 1 2 2 3	5 00000 1 2 2 3 2 4 3 5	5 00100 1 2 2 3 2 4 3 5
output	**output**	**output**
4	7	8

Clarification of the first example:

Fabijan can choose the sequence 1, 2, 3, 2.