COCI 2016/2017

Round #1, October 15th, 2016

Tasks

Task	Time limit	Memory limit	Score
Tarifa	1 s	64 MB	50
Jetpack	1 s	64 MB	80
Cezar	1 s	64 MB	100
Mag	4 s	256 MB	120
Kralj	2 s	128 MB	140
Vještica	2 s	64 MB	160
Total			650

Pero has negotiated a Very Good data plan with his internet provider. The provider will let Pero use up X megabytes to surf the internet per month. Each megabyte that he doesn't spend in that month gets transferred to the next month and can still be spent. Of course, Pero can only spend the megabytes he actually has.

If we know how much megabytes Pero has spent in each of the first N months of using the plan, determine how many megabytes Pero will have available in the N + 1 month of using the plan.

INPUT

The first line of input contains the integer X ($1 \le X \le 100$).
The second line of input contains the integer N ($1 \le N \le 100$).
Each of the following N lines contains an integer P_i ($0 \le P_i \le 10\ 000$), the number of megabytes spent in each of the first N months of using the plan. Numbers P_i will be such that Pero will never use more megabytes than he actually has.

OUTPUT

The first and only line of output must contain the required value from the task.

SAMPLE TESTS

input	**input**	**input**
10 3 4 6 2	10 3 10 2 12	15 3 15 10 20
output	**output**	**output**
28	16	15

Clarification of the first test case:
In the first month, out of 10 total megabytes, Pero has spent 4 and transferred 6 into the next month. In the second month, out of 16 (10+6) total megabytes, Pero has spent 6 and transferred 10. In the third month, out of 20 (10+10) total megabytes, Pero has spent 2 and transferred 18. In the fourth month, he had a total of 28 megabytes to spend.

Little Mirko got a new mobile phone for his birthday! As all kids nowadays, he quickly downloaded all of the popular mobile games, including Jetpack Joyride.

In the game, the protagonist Barry is running across a field consisting of 10 rows and *N* columns of squares of equal size. Initially, Barry is located in the center of the square in the lower left corner. Barry is constantly running to the right at the speed of one square per second. Additionally, he must avoid obstacles that are in his way.

When Mirko presses the phone screen, Barry turns on his super-duper special jetpack and starts his ascent at the speed of one square per second (still moving to the right, now moving diagonally up at an angle of 45°, until he reaches the ceiling, when he will continue moving to the right until Mirko releases the screen). When Mirko releases the phone screen, Barry starts falling down at the speed of one square per second (now moving diagonally again, but this time facing down, until he reaches the floor, when he will continue moving to the right).

Mirko just started playing the game recently and he's still not good at it. He saw on YouTube that someone managed to complete the game by crossing all *N* columns, so he is asking you for your help. He will give you the layout of the fields in the game, and you must output the moves he has to play in order to win.

INPUT

The first line of input contains the integer N ($1 \le N \le 10^5$), the size of the field.
Each of the following 10 lines contains *N* characters '.' and 'X', the layout of the field in the game. The characters 'X' denote obstacles, and '.' walkable fields.

OUTPUT

The first line of output must contain the integer P ($0 \le P \le 5 \cdot 10^4$), the number of moves Mirko has to make.
In the following *P* lines, output any series of *P* moves, each in its own line, such that it solves Mirko's problem from the task.
A move is determined by two **integers** t_i and x_i, where t_i denotes the second in which Mirko has to press the screen, and x_i denotes how long he needs to keep the screen pressed.

A series of moves must be sorted in chronological order. In other words, it must hold $t_i + x_i \le t_{i+1}$.
Also, no move should begin after the end of the game, $t_i < N$.

The input data will be such that a solution will surely exist.

SAMPLE TESTS

input

```
11
.....XX...X
....XX...XX
...XX...XX.
...........
....XXX....
...........
.....X.....
....XX...X.
...XX...XX.
...X...XX..
```

output

```
2
1 4
7 2
```

input

```
20
X..................X
.X................X.
..X..............X..
...X............X...
....X..........X....
.....X........X.....
......X......X......
.......X....X.......
........X..X........
.........XX.........
```

output

```
1
8 10
```

Clarification of the first test case:

The path Mirko has to take is denoted with ‘*’:

```
.....XX...X
....XX...XX
...XX...XX.
...........
....XXX....
.....*...*.
....*X*.*.*
...*XX.*.X.
..*XX...XX.
**.X...XX..
```

Mirko has an array of *N* **different** words that he wants to encrypt using a substitution cypher.

We encrypt the text using a substitution cypher by first choosing a *key* – a permutation of the English alphabet. Then we replace all occurrences of letter ‘a’ with the first letter of the key, all occurrences of letter ‘b’ with the second letter of the key, and so on until letter ‘z’.

Besides the words, Mirko has an array *A* consisting of numbers from 1 to *N* given in a certain order (in other words, array *A* is a permutation of numbers from 1 to *N*). Mirko wants to pick a key such that the array of words after encrypting and lexicographic sorting corresponds to array *A*. More precisely, he wants the word initially located at A_i to be at location *i* after encryption and sorting.

Let’s recall that the lexicographic word order is the order in which the words appear in the dictionary. If we are comparing two words, going from left to right, we search for the first position in both words where the letters differ and, based on that, we determine which word is lexicographically smaller. If word *X* is the beginning of the word Y, then word X is lexicographically smaller than word *Y*.

Mirko is currently not in the mood for encrypting, so he kindly asks you to do it for him.

INPUT

The first line of input contains the integer *N* (2 ≤ *N* ≤ 100).
Each of the following *N* lines contains a single word that consists of at most 100 lowercase letters of the English alphabet. The words will be mutually distinct.
The last line contains *N* integers – the elements of array *A*.

OUTPUT

In the case when a solution doesn’t exist, output “NE”.
Otherwise, output “DA” in the first line, and in the second line output a word consisting of 26 different letters of the English alphabet – the key for the substitution cipher.
If multiple solutions exist, output any.

SCORING

In test cases worth 30 points total, the words will consist of only the first 6 letters of the English alphabet.

SAMPLE TESTS

input

```
2
ab
bc
2 1
```

output

```
DA
bacdefghijklmnopqrst
uvwxyz
```

input

```
3
abc
bcd
add
1 2 3
```

output

```
NE
```

input

```
3
bbb
ccc
ddd
2 3 1
```

output

```
DA
adbcefghijklmnopqrst
uvwxyz
```

Note: Outputs are split into multiple lines due to lack of horizontal space.

Clarification of the first test case:
After encrypting, the words become “ba”, “ac”, after lexicographic sorting, the array becomes “ac”, “ba”, which means the first word ended up in the second spot, and the second word in the first spot.

Clarification of the third test case:
After encrypting, the words become “ddd”, “bbb”, “ccc”, after lexicographic sorting, the array becomes “bbb”, “ccc”, “ddd”, which means the first word ended up in the third spot, the third word in the second spot, and the second word in the first spot.

You are given an undirected tree[1] with each of its node assigned a magic X_i.
The magic of a path[2] is defined as the product of the magic of the nodes on that path divided by the number of the nodes on the path. For example, the magic of a path that consists of nodes with magic 3 and 5 is 7.5 ($3 \cdot 5$ / 2).

In the given tree, find the path with the minimal magic and output the magic of that path.

INPUT

The first line of input contains the integer N ($1 \le N \le 10^6$), the number of nodes in the tree.
Each of the following N - 1 lines contains two integers, A_i and B_i ($1 \le A_i$, $B_i \le N$), the labels of nodes connected with an edge.
The i^{th} of the following N lines contains the integer X_i ($1 \le X_i \le 10^9$), magic of the i^{th} node.

OUTPUT

Output the magic of the path with minimal magic in the form of a completely reduced fraction P/Q (P and Q are relatively prime integers).

In all test cases, it will hold that the required P and Q are smaller than 10^{18}.

SCORING

In test cases worth 24 points total, it will hold $N \le 1\ 000$.
In test cases worth 36 additional points total, there will not be a node that is connected to more than 2 other nodes.

SAMPLE TESTS

input

```
2
1 2
3
4
```

input

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

[1] An *undirected tree* is a connected graph that consists of N nodes and N - 1 undirected edges.
[2] A *path* is a series of one or more nodes such that there exists an edge between each 2 adjacent nodes on the path.

	`3`
output	**output**
`3/1`	`1/2`

Clarification of the first test case:

Notice that the path may begin and end in the same node. The path with the minimal magic consists of the node with magic 3, so the entire path's magic is 3 / 1.

Clarification of the second test case:

The path that consists of nodes with labels 2 and 4 is of magic (1 · 1) / 2 = 1 / 2.
That is also the path with the minimal possible magic.

Young ruler Mirko has declared himself king of dwarves. Upon hearing this, Slavko felt threatened and soon declared himself king of elves! As there cannot be more than one king in the land, they have decided to resolve the issue of power once and for all.

Slavko will, along with *N* strongest elves of the kingdom, labeled with numbers from 1 to *N*, go visit Mirko's castle. In the castle hall, they will be greeted by *N* strongest dwarves sitting in a circle, labeled **clockwise** with numbers from 1 to *N*.

Mirko has, upon entering the castle, given a number A_i to each of Slavko's elves – the label of the dwarf it will fight against. Unfortunately, he didn't make sure that each elf should get a unique adversary, and soon a terrible fight broke out.

They have decided to solve the problem in the following way:

- Slavko will send his elves to the hall one by one, in the order he chooses. The next elf can enter the hall only after the one before him found a place to sit.
- The elf labeled *k* will first approach the dwarf labeled A_k. If there isn't an elf sitting beside the dwarf, he will sit there. Otherwise, he will continue walking, from dwarf to dwarf, clockwise, until he finds an unclaimed dwarf.

Now the *N* resulting pairs of elves and dwarves compete in armwrestling, and **the stronger one always wins**.

Slavko is well prepared for this event. He has studied all the fighters and determined the strength of each one. Now he wants to send the elves to the hall in the order which, after they all sit down, will bring the most victories for him.

Help him and calculate **the highest number of victories** in duels that can be achieved by **elves**!

INPUT

The first line of input contains the integer *N* ($1 \le N \le 5 \cdot 10^5$)
The second line of input contains *N* integers A_i ($1 \le A_i \le N$), the adversaries chosen by Mirko.
The third line of input contains *N* integers P_i ($1 \le P_i \le 10^9$), the dwarves' strengths.
The fourth line of input contains *N* integers V_i ($1 \le V_i \le 10^9$), the elves' strengths.

All strengths from the input will be mutually distinct.

OUTPUT

The first and only line of input must contain the maximum number of victories that can be achieved by elves.

SCORING

In test cases worth 40% of total points, Mirko will choose the dwarf labeled with 1 ($A_i = 1$ for each i from 1 to N) as an adversary in each elf duel.

SAMPLE TESTS

input

```
3
2 3 3
4 1 10
2 7 3
```

output

```
2
```

input

```
4
3 1 3 3
5 8 7 10
4 1 2 6
```

output

```
1
```

input

```
3
1 2 3
8 4 3
9 2 6
```

output

```
2
```

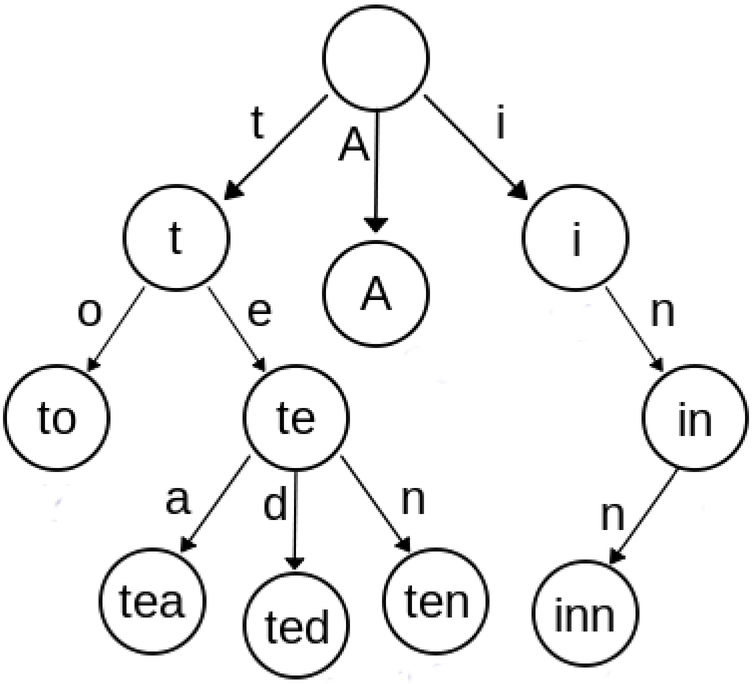
Clarification of the first test case:
Slavko can sort the elves in the following way: 3, 2, 1. This way, the elf number 3 will sit beside dwarf number 3, elf 2 will have to move one seat clockwise and sit beside dwarf 1, and the elf number 2 will sit beside the dwarf number 2. Elves 1 and 2 will win their duels, and elf 3 will lose.

Young hero, an adventurer Matej, has, after a long and strenuous journey, arrived to his final destination – the house of evil witch Marija. In order to complete his adventure, he must solve the final puzzle the witch gives him.

To even begin solving her puzzle, our hero needs to become familiar with the data structure called prefix tree (trie).

A prefix tree is a data structure that represents all prefixes[1] of words from a certain set in the following way:

- Each edge of the tree is denoted with a letter from the alphabet.
- The root of the tree represents an empty prefix.
- All other nodes in the tree represent a non-empty prefix in a way that each node represents a prefix obtained by concatenating letters written on the edges that lead from the root of the tree to that node (in that order).
- There will never be two edges labeled with the same letter coming out of a single node (this way we minimize the number of nodes necessary to represent all prefixes).



Prefix tree for words: "A", "to", "tea", "ted", "ten", "i", "in", i "inn".

Only after Matej learned what a prefix tree was does the real puzzle begin!

The witch, as you may have guessed, has *N* words that consist of lowercase letters of the English alphabet. The puzzle would be very simple if the witch wanted to know the number

[1] A prefix of a word is a consecutive subarray of letters from the beginning of the word to a certain position in the word.

of nodes of the prefix tree for that set of words, but she is not interested in this. She wants to know **the minimal number of nodes** a prefix tree can have **after permuting the letters of each word in an arbitrary manner**.

Help Matej find the answer to the puzzle!

INPUT

The first line of input contains the integer *N* (1 ≤ *N* ≤ 16).

Each of the following *N* lines contains a single word consisting of lowercase letter of the English alphabet.

The total length of all words will be less than 1 000 000.

OUTPUT

The first and only line of output must contain a number, the answer to witch Marija’s puzzle.

SAMPLE TESTS

input

```
3
a
ab
abc
```

output

```
4
```

input

```
3
a
ab
c
```

output

```
4
```

input

```
4
baab
abab
aabb
bbaa
```

output

```
5
```

Clarification of the third test case:
All words can be permuted into the word “aabb”, so the prefix tree will have 5 nodes (4 + 1 for the root of the tree – the empty prefix).