Lists and GCD

HackerRank

We call an integer $p > 1$ a *prime number* (or simply a *prime*) if its only positive divisors are 1 and p.

Fundamental theorem of arithmetic states: Every positive integer n can be uniquely expressed as a product of power of primes, i.e.,

$$N = p_1^{n_1} \times p_2^{n_2} \times p_3^{n_3} \times \ldots$$

where,

- p_i is the i^{th} prime, i.e., $p_1 = 2, p_2 = 3, p_3 = 5, \ldots$
- $\forall i. n_i \geq 0$

Greatest common divisor of two positive integers

For two positive integers, A and B, whose *prime factorization* is represented as

$$A = p_1^{a_1} \times p_2^{a_2} \times p_3^{a_3} \times \ldots$$

$$B = p_1^{b_1} \times p_2^{b_2} \times p_3^{b_3} \times \ldots$$

We calculate the *greatest common divisor*, $gcd(A, B)$, as

$$gcd(A, B) = p_1^{min(a_1, b_1)} \times p_2^{min(a_2, b_2)} \times p_3^{min(a_3, b_3)} \times \ldots$$

Greater common divisor of a list of numbers

Greatest common factor of a list of positive integers, $lst = \{l_1, l_2, \ldots l_q\}$, is represented as

$$gcd(lst) = gcd(l_1, gcd(l_2, gcd(l_3, \ldots, (gcd(l_{q-1}, l_q)) \ldots)))$$

Finite representation of prime factorization

Since primes are infinite, it is not possible to store factors in the form provided above. To that end, we will only consider those prime factors (p_i) whose power is greater than zero ($n_i > 0$). That is:

$$N = p_{i_1}^{n_{i_1}} \times p_{i_2}^{n_{i_2}} \times p_{i_3}^{n_{i_3}} \times \ldots$$

, where

- $p_{i_j} < p_{i_{j+1}}$
- $0 < n_{i_j}, \ \ j \in [1, 2, \ldots]$; for rest $n_i = 0$

And we will represent them as following:

$N = p_{i_1}\ n_{i_1}\ p_{i_2}\ n_{i_2}\ p_{i_3}\ n_{i_3}\ \ldots$

For example:

- $49 = 7^2 = 7\ 2$
- $28 = 2^2 \times 7^1 = 2\ 2\ 7\ 1$

Challenge

You are given the elements of list, lst, in the representation provided above. Find its greatest common divisor, i.e., $gcd(lst)$.

Input Format

First line contains an integer, q, which is the size of list, lst.
Then follows q lines, where i^{th} line represents the factors of i^{th} element of lst, l_i

Output Format

Print one line representing the greatest common divisor of lst ($gcd(lst)$) in the above representation.

Constraints

- $2 \le q \le 1000$
- All other integers lie in $[1, 10^5]$
- $1 \le$ Total number of prime factors of an element ≤ 100

Notes

- Test cases are designed such that $gcd(lst)$ will always be greater than 1.

Sample Input #00

```
2
7 2
2 2 7 1
```

Sample Output #00

```
7 1
```

Sample Input #01

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

```
2 2 3 3 5 4 7 6 19 18
3 10 5 15
```

Sample Output #01

```
3 2 5 3
```

Explanation

Test case #00: $lst = \{7^2, 2^2 \times 7^1\}$. Therefore $gcd(lst) = 7^1$.
Test case #01: $lst = \{2^2 \times 3^2 \times 5^3,\ 3^2 \times 5^3 \times 11^1,\ 2^2 \times 3^3 \times 5^4 \times 7^6 \times 19^{18}, 3^{10} \times 5^{15}\}$.
$gcd(lst) = 3^2 \times 5^3$