Between Two Sets ☆

Problem   Submissions   Leaderboard   Editorial

Editorial by zemen

Though this problem can be solved with a brute force approach, there's a faster, easier way!

Observations

- All numbers in A evenly divide x if and only if x is divisible by the Least Common Multiple (LCM) of all numbers in A. Let's denote the LCM of A as $factor$.
- x evenly divides all numbers in B if and only if x divides the Greatest Common Divisor (GCD) of all numbers in B. Let's denote the GCD of B as $multiple$.

Approach

Let's find the number of x values satisfying $x \bmod factor = 0$ and $multiple \bmod x = 0$.

- If $multiple$ is not divisible by $factor$, no such x exists.
- If some x exists, we can divide $multiple$, x, and $factor$ by $factor$ (i.e., $multiple \bmod factor = 0$, $x \bmod factor = 0$, and $factor \bmod factor = 0$ are all true). Now we just need to find the number of divisors of $\frac{multiple}{factor}$, which we can do in $O(\sqrt{C})$ time (or faster), where C is the maximum number in sets A and B.

Tips

- Be sure to be careful in calculating $factor$, as this number can be quite large.
- If $factor$ becomes greater than C, then we need stop calculating and say that our answer is zero.

Set by zemen

Problem Setter's code:

C++

```cpp
#include <bits/stdc++.h>
using namespace std;
#define forn(i,n) for (int i = 0; i < int(n); ++i)

const int maxc = 100;

int gcd(int a, int b) {
    while (a && b) {
        if (a >= b)
            a %= b;
        else
            b %= a;
    }
    return a + b;
}

int lcm(int a, int b) {
    return (a / gcd(a, b)) * b;
}

int main() {
    #ifdef LOCAL
    assert(freopen("test.in", "r", stdin));
    #endif
    int n, m;
    cin >> n >> m;
    int A = 1, B = 0;
    forn (i, n) {

        int x;
```

```
            cin >> x;
            A = lcm(A, x);
            if (A > maxc) {
                cout << 0 << '\n';
                return 0;
            }
        }
        forn (i, m) {
            int x;
            cin >> x;
            B = gcd(B, x);
        }
        if (B % A != 0) {
            cout << 0 << '\n';
            return 0;
        }
        B /= A;
        int res = 0;
        for (int i = 1; i * i <= B; ++i) {
            if (B % i == 0) {
                ++res;
                if (i * i != B)
                    ++res;
            }
        }
        cout << res << '\n';
    }
```

Tested by [AllisonP](#)

Problem Tester's code:

Java

```java
import java.util.*;

public class Solution {
    public static int gcd(int a, int b) {
        while (a > 0 && b > 0) {

            if (a >= b) {
                a = a % b;
            }
            else {
                b = b % a;
            }
        }

        return a + b;
    }

    public static int lcm(int a, int b) {
        return (a / gcd(a, b)) * b;
    }

    public static int getTotalX(int[] a, int[] b) {

        int multiple = 0;
        for(int i : b) {
            multiple = gcd(multiple, i);
        }
//        System.err.println("Multiple: " + multiple);

        int factor = 1;
        for(int i : a) {
            factor = lcm(factor, i);
            if (factor > multiple) {
                return 0;
            }
        }
```

```java
            if (multiple % factor != 0) {
                return 0;
            }
//          System.err.println("Factor: " + factor);

            int value = multiple / factor;

            int max = Math.max(factor, value);
            int totalX = 1;

            for (int i = factor; i < multiple; i++) {
                if (multiple % i == 0 && i % factor == 0) {
                    totalX++;
                }
            }

            return totalX;

    }


    public static void main(String[] args) {
        Scanner scan = new Scanner(System.in);
        int n = scan.nextInt();
        int m = scan.nextInt();
        int[] a = new int[n];
        for (int i = 0; i < n; i++) {
            a[i] = scan.nextInt();
        }
        int[] b = new int[m];
        for (int i = 0; i < m; i++) {
            b[i] = scan.nextInt();
        }
        scan.close();

        int total = getTotalX(a, b);
        System.out.println(total);
    }
}
```

Feedback

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