Little Shino and Number of Divisors

Attempted by: **1603** / Accuracy: **93%** / Maximum Score: **30** / 27 Votes

Tag(s): Math, Medium, Number Theory

It's well known fact that the number of divisors of $n = \prod p_i^{\alpha_i}$ equals $\prod(\alpha_i + 1)$ where p_i are primes in the factorization of n. Lets define P as the product of all divisors of n. If we find β_i where $P = \prod p_i^{\beta_i}$ we will solve the problem.

All divisors of $n = \prod p_i^{\alpha_i}$ can be represented as $d = \prod p_i^{k_i}$ where $0 \leq k_i \leq \alpha_i$. Lets fix some i_0 and $0 \leq k_0 \leq \alpha_i$. There are $\prod_{i \neq i_0}(\alpha_i + 1)$ divisors that $k_{i_0} = k_0$. So $\beta_i = (0 + 1 + \ldots + \alpha_i) \cdot \prod_{i \neq i_0}(\alpha_i + 1) = \frac{\alpha_i(\alpha_i+1)}{2} \cdot \prod_{i \neq i_0}(\alpha_i + 1) = \frac{\alpha_i(\alpha_i+1)}{2} \cdot \frac{allProd}{\alpha_i+1} = \frac{\alpha_i}{2} \cdot allProd$, where $allProd = \prod(\alpha_i + 1)$.

Now the can calculate the number of divisors of P using β_i.

Author Solution by Akash Sharma

```
1.
2. #pragma GCC optimize("O3")
3. #include <bits/stdc++.h>
4.
5. #define ll long long
6. #define ull unsigned long long
7. #define pb push_back
8. #define mp make_pair
9. #define fi first
10. #define se second
11. #define be begin()
12. #define en end()
13. #define all(x) (x).begin(),(x).end()
```

```
#define alli(a, n, k) (a+k),(a+n+k)
#define REP(i, a, b, k) for(__typeof(a) i = a;i < b;i += k)
#define REPI(i, a, b, k) for(__typeof(a) i = a;i > b;i -= k)
#define REPITER(it, a) for(__typeof(a.begin()) it = a.begin();it != a.end(); ++it)

#define y0 sdkfaslhagaklsldk
#define y1 aasdfasdfasdf
#define yn askfhwqriuperikldjk
#define j1 assdgsdgasghsf
#define tm sdfjahlfasfh
#define lr asgasgash
#define norm asdfasdgasdgsd
#define have adsgagshdshfhds

#define eps 1e-6
#define pi 3.141592653589793

using namespace std;

template<class T> inline T gcd(T a, T b) { while(b) b ^= a ^= b ^= a %= b; return a; }
template<class T> inline T mod(T x) { if(x < 0) return -x; else return x; }

typedef vector<int> VII;
typedef vector<ll> VLL;
typedef pair<int, int> PII;
typedef pair<ll, ll> PLL;
typedef pair<int, PII > PPII;
typedef vector< PII > VPII;
typedef vector< PPII > VPPI;

const int MOD = 1e9 + 7;
const int INF = 1e9;
const int MAX = 1e6 + 5;
ll A[MAX];

ll mpow (ll a, ll b, ll c) {
    ll res = 1;
    while (b) {
        if (b & 1) res = (res * a) % c;
        b >>= 1;
        a = (a *a) % c;
    }
    return res;
}

int main(int argc, char* argv[])
{
    if(argc == 2 or argc == 3) freopen(argv[1], "r", stdin);
    if(argc == 3) freopen(argv[2], "w", stdout);
    ios::sync_with_stdio(false);
    ll pro = 1, x, ans = 1, pro1;
    int n;
    cin >> n;
    REP(i, 0, n, 1) {
```

```
        cin >> A[i];
        pro = (pro * (A[i] + 1)) % MOD;
    }
    REP(i, 0, n, 1) {
        pro1 = (pro * mpow(A[i]+1, MOD-2, MOD)) % MOD;
        x = (A[i] * (A[i]+1)) % MOD;
        x = (x * mpow(2, MOD-2, MOD)) % MOD;
        ans = (ans * ((pro1*x + 1) % MOD)) % MOD;
    }
    cout << ans << endl;
    return 0;
}
```

Tester Solution by Илья Кучумов

```
#include <iostream>
#include <cstdio>
#include <cstdlib>
#include <cstring>
#include <string>
#include <vector>
#include <algorithm>
#include <set>
#include <map>
#include <cmath>
#include <ctime>
#include <functional>
#include <sstream>
#include <fstream>
#include <valarray>
#include <complex>
#include <queue>
#include <cassert>
#include <bitset>
using namespace std;

#ifdef LOCAL
        #define debug_flag 1
#else
        #define debug_flag 0
#endif

template <class T1, class T2 >
std::ostream& operator << (std::ostream& os, const pair<T1, T2> &p)
{
        os << "[" << p.first << ", " << p.second << "]";
        return os;
}

template <class T >
std::ostream& operator << (std::ostream& os, const std::vector<T>& v)
{
        os << "[";
```

```
        bool first = true;
        for (typename std::vector<T>::const_iterator it = v.begin(); it != v.end();
++it)
        {
                if (!first)
                        os << ", ";
                first = false;
                os << *it;
        }
        os << "]";
        return os;
}

#define dbg(args...) { if (debug_flag) { _print(_split(#args, ',').begin(), args); cerr
<< endl; } else { void(0);} }

vector<string> _split(const string& s, char c) {
        vector<string> v;
        stringstream ss(s);
        string x;
        while (getline(ss, x, c))
                v.emplace_back(x);
        return v;
}

void _print(vector<string>::iterator) {}
template<typename T, typename... Args>
void _print(vector<string>::iterator it, T a, Args... args) {
    string name = it -> substr((*it)[0] == ' ', it -> length());
    if (isalpha(name[0]))
            cerr << name  << " = " << a << " ";
        else
            cerr << name << " ";
        _print(++it, args...);
}

typedef long long int int64;

const int mod = (int)1e9 + 7;
const int rev_two = mod / 2 + 1;

int add(int a, int b) {
        a += b;
        if (a >= mod) {
                a -= mod;
        }
        return a;
}

int mul(int a, int b) {
        return a * b % mod;
}

const int N = (int)1e6 + 100;
```

```
91.
92. int n;
93. int a_list[N];
94.
95. int main()
96. {
97. #ifdef LOCAL
98.         freopen ("input.txt", "r", stdin);
99. #endif
100.
101.        scanf("%d", &n);
102.        for (int i = 0; i < n; i++) {
103.                scanf("%d", &a_list[i]);
104.        }
105.
106.        int P = 1;
107.        for (int i = 0; i < n; i++) {
108.                P = mul(P, a_list[i] + 1);
109.        }
110.
111.        int ans = 1;
112.        for (int i = 0; i < n; i++) {
113.                int c = mul(a_list[i], P);
114.                c = mul(c, rev_two);
115.                ans = mul(ans, add(c, 1));
116.        }
117.        printf("%d\n", ans);
118.
119.        return 0;
120. }
```

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nuclode 11 hours ago

Can anyone explain what is rev_two doing in tester solution

▲ 1 vote ● Responder ● Mensaje ● Permalink

Subal Chatterjee 9 hours ago

Can anyone explain what is rev_two doing in tester solution and why add(c,1) ?

▲ 0 votes ● Responder ● Mensaje ● Permalink