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1 Contest Setup

1.1 vimrc

```
1 | set number      " Show line numbers
2 | set mouse=a     " Enable inaction via mouse
3 | set showmatch   " Highlight matching brace
4 | set cursorline  " Show underline
5 | set cursorcolumn " highlight vertical column
6 |
7 | filetype on     "enable file detection
8 | syntax on       "syntax highlight
9 |
10 | set autoindent  " Auto-indent new lines
11 | set shiftwidth=4 " Number of auto-indent spaces
12 | set smartindent " Enable smart-indent
13 | set smarttab    " Enable smart-tabs
14 | set softtabstop=4 " Number of spaces per Tab
15 |
16 | " -----Optional-----
17 |
18 | set undolevels=10000 " Number of undo levels
19 | set scrolloff=5     " Auto scroll
20 |
21 | set hlsearch      " Highlight all search results
22 | set smartcase     " Enable smart-case search
23 | set ignorecase    " Always case-insensitive
24 | set incsearch     " Searches for strings incrementally
25 |
26 | highlight Comment ctermfg=cyan
27 | set showmode
28 |
29 | set encoding=utf-8
30 | set fileencoding=utf-8
31 | set scriptencoding=utf-8
```

1.2 bashrc

```
1 || alias g++="g++ -Wall -Wextra -O2"
```

1.3 C++ template

```
1 | #include <bits/stdc++.h>
2 |
3 | using namespace std;
4 |
5 | #define x first
6 | #define y second
7 |
8 | typedef long long int ll;
9 | typedef pair<int, int> ii;
10 |
11 | int main()
12 | {
13 |     return 0;
14 | }
```

1.4 Java template

```

1 import java.io.*;
2 import java.util.*;
3
4 public class Main
5 {
6     public static void main(String[] args)
7     {
8         MyScanner sc = new MyScanner();
9         out = new PrintWriter(new BufferedOutputStream(System.out));
10        // Start writing your solution here.
11
12        // Stop writing your solution here.
13        out.close();
14    }
15
16    public static PrintWriter out;
17
18    public static class MyScanner
19    {
20        BufferedReader br;
21        StringTokenizer st;
22
23        public MyScanner()
24        {
25            br = new BufferedReader(new InputStreamReader(System.in));
26        }
27
28        boolean hasNext()
29        {
30            while (st == null || !st.hasMoreElements()) {
31                try {
32                    st = new StringTokenizer(br.readLine());
33                } catch (Exception e) {
34                    return false;
35                }
36            }
37            return true;
38        }
39
40        String next()
41        {
42            if (hasNext())
43                return st.nextToken();
44            return null;
45        }
46
47        int nextInt()
48        {
49            return Integer.parseInt(next());
50        }
51
52        long nextLong()
53        {
54            return Long.parseLong(next());

```

```

55    }
56
57    double nextDouble()
58    {
59        return Double.parseDouble(next());
60    }
61
62    String nextLine()
63    {
64        String str = "";
65        try {
66            str = br.readLine();
67        } catch (IOException e) {
68            e.printStackTrace();
69        }
70        return str;
71    }
72 }
73 }

```

2 Reminder

1. Read the problem statements carefully. Input and output specifications are crucial!
2. Estimate the **time complexity** and **memory complexity** carefully.
3. Time penalty is 20 minutes per WA, **don't rush!**
4. Sample test cases must all be tested and passed before every submission!
5. Test the corner cases, such as 0, 1, -1. Test all edge cases of the input specification.

3 Useful code

3.1 Fast Exponentiation $O(\log(\exp))$

```

1 ll fast_pow(ll base, ll exp, ll mod)
2 {
3     if (exp == 0)
4         return 1LL;
5     ll res = 1;
6     while (exp > 0) {
7         if (exp & 1) {
8             res = ((res % mod) * (base % mod)) % mod;
9         }
10        exp >>= 1;
11        base = (base * base) % mod;
12    }
13    return res;
14 }

```

3.2 GCD

注意負數的 case!

```

1 ll gcd(ll a, ll b)
2 {
3     return b == 0 ? a : gcd(b, a % b);
4 }

```

3.3 Extended Euclidean Algorithm

$ax + by = \gcd(a, b)$

```

1 ll ext_gcd(ll a, ll b, ll *x, ll *y)
2 {
3     if (a == 0) {
4         *x = 0;
5         *y = 1;
6         return b;
7     }
8
9     ll x1, y1;
10    ll gcd = ext_gcd(b % a, a, &x1, &y1);
11
12    *x = y1 - b / a * x1;
13    *y = x1;
14
15    return gcd;
16 }
```

3.4 Leap year

```

1 || year % 400 == 0 || (year % 4 == 0 && year % 100 != 0)
```

3.5 Prime Generator

```

1 bool is_prime[N];
2 vector<ll> primes;
3 void init()
4 {
5     fill(is_prime, is_prime + N, true);
6     for (int i = 2; i < N; i++) {
7         if (is_prime[i] == true) {
8             primes.push_back(i);
9             for (int j = i * i; j < N; j += i)
10                 is_prime[j] = false;
11         }
12     }
13 }
```

3.6 STL quick reference

3.6.1 Map

```

1 map<T1, T2> m; // iterable
2 void clear();
3 void erase(T1 key);
4 it find(T1 key); // <key, val>
5 void insert(pair<T1, T2> P);
6 T2& [](T1 key); // if key not in map, new key will be inserted with
   default val
7 it lower_bound(T1 key); // = m.end() if not found, *it = <key, val>
8 it upper_bound(T1 key); // = m.end() if not found, *it = <key, val>
```

3.6.2 Set

```

1 set<T> s; // iterable
2 void clear();
3 size_t count(T val); // number of val in set
4 void erase(T val);
5 it find(T val); // = s.end() if not found
6 void insert(T val);
7 it lower_bound(T val); // = s.end() if not found, *it = <key, val>
8 it upper_bound(T val); // = s.end() if not found, *it = <key, val>
```

3.6.3 Algorithm

```

1 // return if i is smaller than j
2 comp = [&](const T& i, const T& j) -> bool;
3 vector<T> v;
4 bool any_of(v.begin(), v.end(), [&](const T& i) -> bool);
5 bool all_of(v.begin(), v.end(), [&](const T& i) -> bool);
6 void copy(inp.begin(), inp.end(), out.begin());
7 int count(v.begin(), v.end(), int val); // number of val in v
8 it unique(v.begin(), v.end()); // it - v.begin() = size
9 // after calling, v[nth] will be n-th smallest elem in v
10 void nth_element(v.begin(), nth_it, bin_comp);
11 void merge(in1.begin(), in1.end(), in2.begin(), in2.end(), out.begin(),
   comp);
12 // include union, intersection, difference, symmetric_difference(xor)
13 void set_union(in1.begin(), in1.end(), in2.begin(), in2.end(), out.
   begin(), comp);
14 bool next_permutation(v.begin(), v.end());
15 // v1, v2 need sorted already, whether v1 includes v2
16 bool inclues(v1.begin(), v1.end(), v2.begin(), v2.end());
17 it find(v.begin(), v.end(), T val); // = v.end() if not found
18 it search(v1.begin(), v1.end(), v2.begin(), v2.end());
19 it lower_bound(v.begin(), v.end(), T val);
20 it upper_bound(v.begin(), v.end(), T val);
21 bool binary_search(v.begin(), v.end(), T val); // exist in v ?
22 void sort(v.begin(), v.end(), comp);
23 void stable_sort(v.begin(), v.end(), comp);
```

3.6.4 String

4 Search

4.1 Binary Search

4.1.1 Find key

4.1.2 Upper / lower Bound

4.2 折半完全列舉

4.3 Two-pointer 爬行法

5 Basic data structure

5.1 1D BIT

5.2 2D BIT

5.3 Union Find

5.4 Segment Tree

6 Dynamic Programming

7 Tree

7.1 LCA

8 Graph

8.1 Articulation point / edge

8.2 BCC vertex

8.3 BCC edge

8.4 SCC

8.5 Shortest Path

8.5.1 Dijkstra

8.5.2 SPFA

8.5.3 Bellman-Ford

8.5.4 Floyd-Warshall

8.6 Flow

8.6.1 Max Flow (Dinic)

8.6.2 Min-Cut

8.6.3 Min Cost Max Flow

8.6.4 Maximum Bipartite Graph