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# Ad hoc

## Go up for ultras

```
#include <stdio>
#include <cmath>
#include <cstring>
#include <algorithm>

using namespace std;
int v[100005];
int seg[4000005];
int seg2[4000005];

int esquerda(int p){
    return 2 * p;
}

int direita(int p){
    return 2 * p + 1;
}

int query(int p, int i, int j, int L, int R){
    if(j < L || i > R) return 1000000000;
    if(i <= L && j >= R) return seg[p];
    int meio = (L + R) / 2;
    return min(query(esquerda(p), i, j, L, meio),
               query(direita(p), i, j, meio + 1, R));
}

int findL(int p, int i, int L, int R, int v){
    if(i <= L) return -1;
    if(v >= seg2[p]) return -1;
    if(L == R) return L;

    int meio = (L + R) / 2;
    int ret = -1;
    if(i > meio+1 && seg2[direita(p)] > v)
        ret = findL(direita(p), i, meio+1, R, v);
    if(ret != -1) return ret;
    return findL(esquerda(p), i, L, meio, v);
}

int findR(int p, int i, int L, int R, int v){
    if(i > R) return -1;
    if(v >= seg2[p]) return -1;
    if(L == R) return L;

    int meio = (L + R) / 2;
    int ret = -1;
```

```
    if(i < meio && seg2[esquerda(p)] > v)
        ret = findR(esquerda(p), i, L, meio, v);
    if(ret != -1) return ret;
    return findR(direita(p), i, meio+1, R, v);
}

int constructMax(int L, int R, int p){
    if(L == R) return seg2[p] = v[L];
    int mid = (L + R) / 2;
    return seg2[p] = max(constructMax(L, mid, esquerda(p)),
                        constructMax(mid+1, R, direita(p)));
}

int constructMin(int L, int R, int p){
    if(L == R) return seg[p] = v[L];
    int mid = (L + R) / 2;
    return seg[p] = min(constructMin(L, mid, esquerda(p)),
                       constructMin(mid+1, R, direita(p)));
}

int main(){
    int n;

    while(scanf("%d", &n) == 1){
        memset(seg, 0, sizeof(seg));
        memset(seg2, 0, sizeof(seg2));

        for(int i = 0; i < n; i++){
            scanf("%d", &v[i]);
        }

        constructMax(0, n-1, 1);
        constructMin(0, n-1, 1);

        bool first = true, ultra, left, right;
        for(int i = 0; i < n; i++){
            ultra = false;
            if((i == 0 || v[i] > v[i-1]) && (i == n-1 || v[i] > v[i+1])){
                int id = findL(1, i, 0, n-1, v[i]);
                int id2 = findR(1, i, 0, n-1, v[i]);
                if(id == -1 && id2 == -1){
                    if(v[i] >= 150000)
                        ultra = true;
                }
            }
            else{
                left = false;
                if(id == -1) left = true;
                else{
                    int d = query(1, id+1, i-1, 0, n-1);
                    if(v[i] - d >= 150000) left = true;
                }
                right = false;
                if(id2 == -1) right = true;
                else{
```

```

        int d = query(1, i+1, id2-1, 0, n-1);
        if(v[i] - d >= 150000) right = true;
    }
    if(left && right){
        ultra = true;
    }
}
if(ultra){
    if(!first) printf("_");
    printf("%d", i+1);

    first = false;
}
}
}
printf("\n");
}

return 0;
}

```

## Estrutura de Dados

### Consultas Horríveis

```

#include <stdio.h>
#include <string.h>

long long st[800004];
long long troca[800004];

void update(int p, int ini, int fim, int b, int e, long long valor){
    st[p] += (troca[p] * (fim - ini + 1));
    troca[(p << 1)] += troca[p];
    troca[(p << 1) + 1] += troca[p];
    troca[p] = 0;

    if(b > fim || e < ini) return;

    st[p] += ((fim < e ? fim : e) - (ini > b ? ini : b) + 1) * valor;

    if(b <= ini && e >= fim){
        troca[(p << 1)] += valor;
        troca[(p << 1) + 1] += valor;
        return;
    }

    int meio = (ini + fim) >> 1;

```

```

        if(b <= meio) update((p << 1), ini, meio, b, e, valor);
        if(e > meio) update((p << 1) + 1, meio+1, fim, b, e, valor);
    }

    long long query(int p, int ini, int fim, int b, int e){
        st[p] += (troca[p] * (fim - ini + 1));
        troca[(p << 1)] += troca[p];
        troca[(p << 1) + 1] += troca[p];

        troca[p] = 0;

        if(b > fim || e < ini) return 0;
        if(b <= ini && e >= fim) return st[p];

        int meio = (ini + fim) >> 1;

        return query((p << 1), ini, meio, b, e) + query((p << 1) + 1, meio+1, fim, b, e);
    }

    int main(){
        int t, n, c, i, p, q, v;

        scanf("%d", &t);
        while(t--){
            scanf("%d_%d", &n, &c);

            memset(st, 0, sizeof(st));
            memset(troca, 0, sizeof(troca));
            while(c--){
                scanf("%d_%d_%d", &i, &p, &q);
                if(!i){
                    scanf("%d", &v);
                    update(1, 0, n-1, p-1, q-1, v);
                }
                else printf("%lld\n", query(1, 0, n-1, p-1, q-1));
            }

            return 0;
        }
    }

```

### Contra Ataque Ramsay

```

#include <iostream>
#include <cstdio>
#include <cstring>
#include <list>
#include <vector>

#define LADO 800
#define SEG_LADO 1400000

```

```

using namespace std;

class Sgtree{
private:
    int arv[SEG_LADO];
public:
    int query(int L, int R, int D, int U, int l, int r, int d, int u, int p);
    void update(int L, int R, int D, int U, int pos_x, int pos_y, int num, int p);
    Sgtree(){memset(arv, 0, SEG_LADO<<2);}
}tipo_segtree;

typedef struct _sold{
    int x,y;
    bool pai;
}tipo_soldado;

int Sgtree::query(int L, int R, int D, int U, int l, int r, int d, int u, int p) {
    if(r < L || l > R || d > U || u < D)
        return 0;
    if(L >= l && R <= r && U <= u && D >= d){
        return arv[p];
    }
    int tmp1, tmp2, tmp3, tmp4;
    tmp1 = query(L, (L+R)>>1, D, (U+D)>>1, l, r, d, u, (p<<2)+1);
    tmp2 = query(L, (L+R)>>1, ((U+D)>>1) + 1, U, l, r, d, u, (p<<2)+2);
    tmp3 = query(((L+R)>>1) + 1, R, D, (U+D)>>1, l, r, d, u, (p<<2)+3);
    tmp4 = query(((L+R)>>1) + 1, R, ((U+D)>>1) + 1, U, l, r, d, u, (p<<2)+4);

    tmp1 = max(tmp1, tmp2);
    tmp1 = max(tmp1, tmp3);
    return max(tmp1, tmp4);
}

void Sgtree::update(int L, int R, int D, int U, int pos_x, int pos_y, int num, int p){
    if(L == R && U == D){
        arv[p] = num;
    }
    else{
        if(pos_x <= (L+R)>>1){
            if(pos_y <= (U+D)>>1)
                update(L, (L+R)>>1, D, (U+D)>>1, pos_x, pos_y, num, (p<<2)+1);
            else
                update(L, (L+R)>>1, ((U+D)>>1) + 1, U, pos_x, pos_y, num, (p<<2)+2);
        }
        else{
            if(pos_y <= (U+D)>>1)
                update(((L+R)>>1) + 1, R, D, (U+D)>>1, pos_x, pos_y, num, (p<<2)+3);
            else
                update(((L+R)>>1) + 1, R, ((U+D)>>1) + 1, U, pos_x, pos_y, num, (p<<2)+4);
        }
    }
}

}

int tmp1, tmp2;
tmp1 = max(arv[(p<<2)+1], arv[(p<<2)+2]);
tmp2 = max(arv[(p<<2)+3], arv[(p<<2)+4]);
arv[p] = max(tmp1, tmp2);
}

vector<int> G[50001];
Sgtree *tree;
tipo_soldado soldado[50001];
bool is_root[50001];
int ans = 1;
void dfs(int no){
    int tmp = tree->query(0, LADO, 0, LADO, 0, soldado[no].x-1, 0, soldado[no].y-1, 0);
    tmp++;
    tree->update(0, LADO, 0, LADO, soldado[no].x, soldado[no].y, tmp, 0);

    ans = max(ans, tmp);
    for(int j : G[no])
        dfs(j);
    tree->update(0, LADO, 0, LADO, soldado[no].x, soldado[no].y, 0, 0);
}

int main() {
    int N, M, i, j, no_pai, no_filho;
    tree = new Sgtree();

    scanf("%d%d", &N, &M);
    for(i = 1; i <= N; i++){
        scanf("%d", &soldado[i].x);
        scanf("%d", &soldado[i].y);
        soldado[i].x += 400;
        soldado[i].y += 400;
    }

    for(i = 1; i <= N; i++) is_root[i] = 1;
    for(i = 1; i <= M; i++){
        scanf("%d%d", &no_filho, &no_pai);
        G[no_pai].push_back(no_filho);
        is_root[no_filho] = 0;
    }

    for(i = 1; i <= N; i++){
        if(!is_root[i]) continue;
        if(!G[i].empty())
            dfs(i);
    }

    printf("%d\n", ans);
}

```

```

    return 0;
}

```

## Paradigmas

### Garota Hiperativa

```

#include <stdio>
#include <cstring>
#include <utility>
#include <algorithm>
#define MOD (1000000000)
using namespace std;

int n, m, dp[104][104];
pair <int, int> activity[105];

int f(int prev, int next){
    if(dp[prev][next] != -1) return dp[prev][next];

    if(activity[next].second == m) return 1;

    int aux = 0;
    for(int i = next+1; i < n; i++)
        if(activity[i].first > activity[next].first &&
           activity[i].first <= activity[next].second &&
           activity[i].second > activity[next].second &&
           (prev == next || activity[i].first > activity[prev].second))
            aux = (aux + f(next, i)) % MOD;

    return dp[prev][next] = aux;
}

int main(){
    while(scanf("%d_%d", &m, &n) == 2 && n + m){
        for(int i = 0; i < n; i++)
            scanf("%d_%d", &activity[i].first, &activity[i].second);

        memset(dp, -1, sizeof dp);
        sort(activity, activity+n);

        int ans = 0;
        for(int i = 0; i < n && activity[i].first == 0; i++)
            ans = (ans + f(i, i)) % MOD;

        printf("%d\n", ans);
    }
}

```

```

    return 0;
}

```

## Hard Problem

```

#include <bits/stdc++.h>

#define oo 1000000000000000000

using namespace std;

string s[100005];
string r[100005];
int n, c[100005];

long long dp[100005][2];
bool mark[100005][2];

long long f(int x, int rev){
    if(mark[x][rev]) return dp[x][rev];
    mark[x][rev] = 1;

    if(x == n) return 0;

    if(x == 0) return min(c[x] + f(x+1, 1), f(x+1, 0));

    bool canforward = false, canreverse = false;
    long long ans = oo;

    if(rev){
        if(s[x] >= r[x-1]) canforward = true;
        if(r[x] >= r[x-1]) canreverse = true;
    }
    else{
        if(s[x] >= s[x-1]) canforward = true;
        if(r[x] >= s[x-1]) canreverse = true;
    }

    if(canforward) ans = min(ans, f(x+1, 0));
    if(canreverse) ans = min(ans, c[x]+f(x+1, 1));

    return dp[x][rev] = ans;
}

int main(){
    scanf("%d", &n);

    for(int i = 0; i < n; i++)
        scanf("%d", &c[i]);
}

```

```

    for(int i = 0; i < n; i++){
        cin >> s[i];
        r[i] = s[i];
        reverse(r[i].begin(), r[i].end());
    }

    long long ret = f(0, 0);
    printf("%lld\n", ret == oo ? -1 : ret);

    return 0;
}

```

## Cartões

```

#include <stdio.h>

long long max(long long a, long long b){
    return (a > b ? a : b);
}
long long min(long long a, long long b){
    return (a < b ? a : b);
}

int main(){
    int n, i, j;
    int cards[10005];
    long long dp[10005];

    while(scanf("%d", &n) == 1){
        for(i = 0; i < n; i++)
            scanf("%d", cards + i);

        for(i = 0; i < n; i++)
            dp[i] = max(cards[i], cards[i+1]);

        for(j = 3; j <= n; j++)
            if(j & 1)
                for(i = 0; i < n; i++)
                    dp[i] = min(dp[i], dp[i+1]);
            else
                for(i = 0; i < n; i++)
                    dp[i] = max(cards[i+j-1] + dp[i], cards[i] + dp[i+1]);

        printf("%lld\n", dp[0]);
    }

    return 0;
}

```

## FFT

```

typedef complex<double> base;

void fft (vector<base> & a, bool invert) {
    int n = (int) a.size();
    if (n == 1) return;

    vector<base> a0 (n/2), a1 (n/2);
    for (int i=0; i<n; i+=2, ++j) {
        a0[j] = a[i];
        a1[j] = a[i+1];
    }
    fft (a0, invert);
    fft (a1, invert);

    double ang = 2*PI/n * (invert ? -1 : 1);
    base w (1), wn (cos(ang), sin(ang));
    for (int i=0; i<n/2; ++i) {
        a[i] = a0[i] + w * a1[i];
        a[i+n/2] = a0[i] - w * a1[i];
        if (invert)
            a[i] /= 2, a[i+n/2] /= 2;
        w *= wn;
    }
}

void multiply (const vector<int> & a, const vector<int> & b, vector<int> & res) {
    vector<base> fa (a.begin(), a.end()), fb (b.begin(), b.end());
    size_t n = 1;
    while (n < max (a.size(), b.size())) n <= 1;
    n <= 1;
    fa.resize (n), fb.resize (n);

    fft (fa, false), fft (fb, false);
    for (size_t i=0; i<n; ++i)
        fa[i] *= fb[i];
    fft (fa, true);

    res.resize (n);
    for (size_t i=0; i<n; ++i)
        res[i] = int (fa[i].real() + 0.5);
}

```

## FFT iterativa

```

typedef complex<double> base;

void fft (vector<base> & a, bool invert) {
    int n = (int) a.size();

    for (int i=1, j=0; i<n; ++i) {
        int bit = n >> 1;
        for (; j>=bit; bit>>=1)

```

```

        j -= bit;
        j += bit;
        if (i < j)
            swap (a[i], a[j]);
    }

    for (int len=2; len<=n; len<=1) {
        double ang = 2*PI/len * (invert ? -1 : 1);
        base wlen (cos(ang), sin(ang));
        for (int i=0; i<n; i+=len) {
            base w (1);
            for (int j=0; j<len/2; ++j) {
                base u = a[i+j], v = a[i+j+len/2] * w;
                a[i+j] = u + v;
                a[i+j+len/2] = u - v;
                w *= wlen;
            }
        }
    }
    if (invert)
        for (int i=0; i<n; ++i)
            a[i] /= n;
}

```

## NTT

```

const int mod = 7340033;
const int root = 5;
const int root_1 = 4404020;
const int root_pw = 1<<20;

void fft (vector<int> & a, bool invert) {
    int n = (int) a.size();

    for (int i=1, j=0; i<n; ++i) {
        int bit = n >> 1;
        for (; j>=bit; bit>>=1)
            j -= bit;
        j += bit;
        if (i < j)
            swap (a[i], a[j]);
    }

    for (int len=2; len<=n; len<=1) {
        int wlen = invert ? root_1 : root;
        for (int i=len; i<root_pw; i<=1)
            wlen = int (wlen * 111 * wlen % mod);
        for (int i=0; i<n; i+=len) {
            int w = 1;
            for (int j=0; j<len/2; ++j) {
                int u = a[i+j], v = int (a[i+j+len/2] * 111 * w % mod);

```

```

                a[i+j] = u+v < mod ? u+v : u+v-mod;
                a[i+j+len/2] = u-v >= 0 ? u-v : u-v+mod;
                w = int (w * 111 * wlen % mod);
            }
        }
    }
    if (invert) {
        int nrev = reverse (n, mod);
        for (int i=0; i<n; ++i)
            a[i] = int (a[i] * 111 * nrev % mod);
    }
}

```

## Matemática

### Quantos zeros e quantos digitos?

```

#include <bits/stdc++.h>

using namespace std;

int main(){
    vector<pair<int,int>> v(1000);

    for(int i = 1; i < 1000; i++){
        pair<int, int> last = {1, 1};
        int tmp = i;
        for(int j = 2; j*j <= tmp; j++){
            if(tmp % j == 0){
                last = {j, 0};
                while(tmp % j == 0){
                    tmp /= j;
                    last.second++;
                }
            }
        }
        if(tmp > 1){
            last = {tmp, 1};
        }
        v[i] = last;
    }

    int n, b;

    while(scanf("%d_%d", &n, &b) == 2){
        double tmp1 = 0;
        for(int i = 1; i <= n; i++)
            tmp1 += log(i);
        int digits = 1 + (int) (tmp1 / log(b) + 1e-9);
    }
}

```



```

    int tmp = v[b].first, count = 0;
    while(tmp <= n){
        count += n / tmp;
        tmp *= v[b].first;
    }

    int zeros = count / v[b].second;

    printf("%d_%d\n", zeros, digits);
}

return 0;
}

```

## RSA com Euclides Extendido

```

#include <bits/stdc++.h>

#define ff first
#define ss second
#define mp make_pair

using namespace std;

int pot(int base, int exp, int mod){
    int resp = 1;

    while(exp){
        if(exp & 1)
            resp = ((long long)resp * base) % mod;
        base = ((long long)base * base) % mod;

        exp >>= 1;
    }
    return resp;
}

int totiente(int n){
    long long i;
    int ans = 1, tmp;
    for(i = 2; i*i <= n; i++){
        if(n % i == 0){
            tmp = 0;
            ans *= i-1;
            while(n % i == 0){ n /= i; tmp++; }
            ans *= pot(i, tmp-1, n);
        }
    }
}

```

```

    if(n > 1){
        ans *= n-1;
    }

    return ans;
}

pair<int, pair<int, int> > euclidesExt(int a, int b) {
    if(b == 0) return mp(a, mp(1, 0));

    pair<int, pair<int, int> > ret = euclidesExt(b, a%b);
    pair<int, int> tmp = ret.ss;

    ret.ss.ff = tmp.ss;
    ret.ss.ss = tmp.ff - tmp.ss*(a/b);

    return ret;
}

// a*b = 1 (mod c) <-> a*b + c*k = 1
int invmult(int a, int b){
    return (euclidesExt(a, b).ss.ff + b) % b;
}

int main(){
    int n, e, c, tot;

    scanf("%d_%d_%d", &n, &e, &c);

    tot = totiente(n);

    int d = invmult(e, tot);

    int m = pot(c, d, n);

    printf("%d\n", m);

    return 0;
}

```

## Grafos

### Floid Fill

### Lazy Painting

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

```

```

#include <iostream>
#include <algorithm>
#define ff first
#define ss second

using namespace std;

vector<vector<bool>> > mat;
vector<vector<int>> > prox;

int n, m, h, w, q, r, c, total;

int dx[] = {-1, 0, 0, 1};
int dy[] = {0, 1, -1, 0};

void dfs(int x, int y){
    if(mat[x][y] == true) return;
    total--;
    mat[x][y] = true;

    int a, b;
    for(int i = 0; i < 4; i++){
        a = dx[i] + x;
        b = dy[i] + y;
        if(a < r || a >= r+h || b < c || b >= c+w) continue;
        dfs(a, b);
    }
}

int main(){

    scanf("%d_%d_%d_%d_%d", &n, &m, &h, &w, &q);
    mat.assign(n, vector<bool> (m, false));
    prox.assign(n, vector<int> (m, 1));

    total = n*m;

    for(int i = 0; i < q; i++){
        scanf("%d_%d", &r, &c); r--; c--;
        for(int j = r; j < r+h; ){
            dfs(j, c);
            int tmp = prox[j][c];
            prox[j][c] = max(prox[j][c], r+h - j);
            j += tmp;
        }
        printf("%d\n", total);
    }

    return 0;
}

```

```

}

```

## LCA

### Colonia

```

#include <bits/stdc++.h>

#define mp make_pair
#define ff first
#define ss second

using namespace std;

typedef long long ll;

vector<pair<int,int>>> G[100005];
int lvl[100005], p[100005], anc[100005][20], logg;
ll dist[100005];

void dfs(int v, int l, ll d){
    lvl[v] = l;
    dist[v] = d;
    for(pair<int,int> &x : G[v]){
        if(lvl[x.ff] == -1){
            p[x.ff] = v;
            dfs(x.ff, l+1,d+x.ss);
        }
    }
}

int LCA(int u, int v){
    if(lvl[u] < lvl[v]) swap(u,v);

    for(int i = logg; i >= 0; i--){
        if(lvl[u] - (1<<i) >= lvl[v]){
            u = anc[u][i];
        }
    }

    if(u == v) return u;

    for(int i = logg; i >= 0; i--){
        if(anc[u][i] != -1 && anc[u][i] != anc[v][i]){
            u = anc[u][i];
            v = anc[v][i];
        }
    }

    return anc[u][0];
}

int main() {

```

```

int a,b,n,q,i,j;

while(scanf("%d", &n),n){
    for(int i = 1; i <= n-1; i++){
        scanf("%d%d", &a,&b);
        G[i].push_back(mp(a,b));
        G[a].push_back(mp(i,b));
        lvl[i] = -1;
    }
    dfs(0,0,0);
    for(logg = 0; 1<<logg <= n; logg++){
        for(i = 0; i < n; i++)
            for(j = 0; j < logg; j++)
                anc[i][j] = -1;
        for(i = 0; i < n; i++)
            anc[i][0] = p[i];
        for(j = 1; j <= logg; j++)
            for(i = 0; i < n; i++)
                if(anc[i][j-1] != -1)
                    anc[i][j] = anc[ anc[i][j-1] ][j-1];
        scanf("%d", &q);
        while(q--){
            scanf("%d%d", &a,&b);
            int x = LCA(a,b);
            ll ans = dist[a]+dist[b]-2*dist[x];
            if(q) printf("%lld_", ans);
            else printf("%lld", ans);
        }
        printf("\n");
        for(i = 0; i < n; i++) G[i].clear();
    }

    return 0;
}

```

## Jogo da Memoria

```

#include <bits/stdc++.h>

using namespace std;

#define ff first
#define ss second
#define pb push_back

const int oo = 1000000000;

typedef long long ll;
typedef pair<int,int> pii;
typedef vector<pii> vii;
typedef vector<int> vi;

```

```

typedef vector<vi> vvi;

int p[50005], L[50005], vis[50005], n, root;
vvi g;

int dfs(int u){
    vis[u] = 1;
    for(int i = 0; i < g[u].size(); i++){
        if(vis[ g[u][i] ] == 0){
            p[ g[u][i] ] = u;
            L[ g[u][i] ] = L[u]+1;
            dfs(g[u][i]);
        }
    }
}

int dp[50005][20];

int f(int u, int level){
    if(dp[u][level] != -1) return dp[u][level];

    if(level == 0) return p[u];

    return dp[u][level] = f(f(u, level-1), level-1);
}

int lg(int n){
    int ans = 0;
    while(n)
        ans++, n/=2;
    return ans;
}

int LCA(int u, int v){
    if(L[u] < L[v]) swap(u, v);
    int k = lg(L[u]);

    for(int k = lg(L[u]); k >= 0; k--){
        if(L[ f(u, k) ] >= L[v])
            u = f(u, k);
    }

    if(u == v) return u;

    for(int k = lg(L[u]); k >= 0; k--){
        if(f(u, k) != f(v, k)){
            u = f(u, k);
            v = f(v, k);
        }
    }

    return p[u];
}

```

```

int main(){
    int a, b;
    scanf("%d", &n);

    vvi c(n+1);
    for(int i = 1; i <= n; i++){
        scanf("%d", &a);
        c[a].pb(i);
    }

    g.assign(n+1, vi());
    for(int i = 1; i < n; i++){
        scanf("%d_%d", &a, &b);
        g[a].pb(b);
        g[b].pb(a);
    }

    memset(vis, 0, sizeof vis);
    root = 1;
    p[root] = root;
    L[root] = 0;
    dfs(root);

    memset(dp, -1, sizeof dp);

    int ans = 0;
    for(int i = 1; i <= n/2; i++){
        ans += L[ c[i][0] ] + L[ c[i][1] ] - 2*L[ LCA(c[i][0], c[i][1]) ];
    }

    printf("%d\n", ans);
}

```

## Query on Tree II

```

#include <bits/stdc++.h>

using namespace std;
#define MAXL 18
#define mp make_pair
#define ff first
#define ss second

typedef long long ll;
typedef pair<int,int> ii;

int p[10100], L[10100], vis[10100], dp[10100][MAXL], pw[10100], dp2[10100][MAXL];

vector<vector<ii> > g;

```

```

void dfs(int u){
    vis[u] = 1;

    for(ii &v : g[u]){
        if(!vis[v.ff]){
            p[v.ff] = u;
            L[v.ff] = L[u]+1;
            pw[v.ff] = v.ss;
            dfs(v.ff);
        }
    }
}

int f(int u, int j){
    if(j == 0) return p[u];
    if(dp[u][j] != -1) return dp[u][j];
    return dp[u][j] = f(f(u, j-1), j-1);
}

ll h(int u, int j){
    if(j == 0) return pw[u];
    if(dp2[u][j] != -1) return dp2[u][j];
    return dp2[u][j] = h(u, j-1) + h(f(u, j-1), j-1);
}

int LCA(int u, int v){
    if(L[u] < L[v]) swap(u, v);

    for(int i = MAXL-1; i >= 0; i--){
        if(L[ f(u, i) ] >= L[v])
            u = f(u, i);
    }

    if(u == v) return v;

    for(int i = MAXL-1; i >= 0; i--){
        if(f(u, i) != f(v, i))
            u = f(u, i), v = f(v, i);
    }

    return p[u];
}

long long DIST(int u, int v){
    if(L[u] < L[v]) swap(u, v);

    ll ans = 0;

    for(int i = MAXL-1; i >= 0; i--){
        if(L[ f(u, i) ] >= L[v])
            ans += h(u, i), u = f(u, i);
    }

    if(u == v) return ans;
}

```

```

    for(int i = MAXL-1; i >= 0; i--)
        if(f(u, i) != f(v, i))
            ans += h(u, i) + h(v, i), u = f(u, i), v = f(v, i);

    ans += pw[u] + pw[v];
    return ans;
}

int KTH(int a, int b, int c){
    int lca = LCA(a, b);
    int u = a, v = b;
    if(c > L[a] - L[lca] + 1){
        c -= L[a] - L[lca] + 1;
        for(int i = MAXL-1; i >= 0; i--)
            if(L[ f(v, i) ] - L[lca] >= c)
                v = f(v, i);

        return v;
    }
    else{
        for(int i = MAXL-1; i >= 0; i--)
            if(L[a] - L[ f(u, i) ] + 1 <= c)
                u = f(u, i);

        return u;
    }
}

return 0;
}

int main(){
    int n, T, a, b, c;

    scanf("%d", &T);

    for(int t = 1; t <= T; t++){
        scanf("%d", &n);
        g.assign(n+1, vector<ii>());

        for(int i = 1; i < n; i++){
            scanf("%d_%d_%d", &a, &b, &c);
            g[a].push_back(ii(b, c));
            g[b].push_back(ii(a, c));
        }

        memset(vis, 0, sizeof vis);
        memset(p, 0, sizeof p);
        memset(L, 0, sizeof L);
        L[1] = 0;
        p[1] = 1;
        dfs(1);

        memset(dp, -1, sizeof dp);

```

```

        memset(dp2, -1, sizeof dp2);

        char s[10];

        while(scanf("%s", s) == 1 && s[1] != 'O'){
            if(s[0] == 'D'){
                scanf("%d_%d", &a, &b);
                printf("%lld\n", DIST(a, b));
            }
            else{
                scanf("%d_%d_%d", &a, &b, &c);
                printf("%d\n", KTH(a, b, c));
            }
        }
        printf("\n");
    }
}

```

## Fluxo Máximo

### The Cool Monkeys

```

#include <bits/stdc++.h>

using namespace std;

#define ff first
#define ss second
#define pb push_back
#define mp make_pair

const int oo = 1000000000;

typedef pair<int,int> ii;

vector<vector<int>> > g;

int m, na, nb, t, source, target, ha[505], hb[505];
int mat[2020][2020], p[2020], vis[2020];

int back(int u, int minEdge){
    if(u == source) return minEdge;
    int f = back(p[u], min(minEdge, mat[ p[u] ][u]));
    mat[ p[u] ][u] -= f;
    mat[u][ p[u] ] += f;
    return f;
}

int maxflow(){
    int mf = 0, f = 1;
    while(f){

```

```

queue<int> q;
q.push(source);
memset(vis, 0, sizeof vis);

vis[source] = 1;
p[source] = source;

while(!q.empty()){
    int u = q.front(); q.pop();

    if(u == target) break;

    for(int i = 0; i < g[u].size(); i++){
        int v = g[u][i];
        if(mat[u][v] > 0 && vis[v] != 1){
            vis[v] = 1;
            p[v] = u;
            q.push(v);
        }
    }

    if(vis[target] != 1) break;
    f = back(target, oo);
    mf += f;
}

return mf;
}

int buildRun(int *ha, int na, int *hb, int nb){
    g.assign(2020, vector<int>());
    sort(ha, ha+na, greater<int>());
    sort(hb, hb+nb);

    memset(mat, 0, sizeof mat);

    int cnt = 0;
    for(int i = 0; i < na; i++){
        for(int j = 0; j < nb; j++){
            int vin = i;
            int uin = na+j;
            int vout = na+nb+i;
            int uout = na+nb+na+j;
            if(abs(ha[i] - hb[j]) < t){
                // vout -> uin
                // uout -> vin
                // printf("%d -> %d\n", i, j);
                g[vout].pb(uin);
                g[uin].pb(vout);
                g[uout].pb(vin);
                g[vin].pb(uout);
            }
        }
    }
}

```

```

        mat[vout][uin] = oo;
        mat[uout][vin] = oo;
    }
}

for(int i = 0; i < na; i++){
    int vin = i;
    int vout = na+nb+i;
    g[vin].pb(vout);
    g[vout].pb(vin);
    mat[vin][vout] = 1;
}

for(int j = 0; j < nb; j++){
    int uin = na+j;
    int uout = na+nb+na+j;
    g[uin].pb(uout);
    g[uout].pb(uin);
    mat[uin][uout] = 1;
}

for(int i = 0; i < m; i++){
    int vin = i;
    int uout = na+nb+na+i;
    g[source].pb(vin);
    g[vin].pb(source);
    mat[source][vin] = 1;

    g[uout].pb(target);
    g[target].pb(uout);
    mat[uout][target] = 1;
}

return maxflow();
}

int main(){
    source = 2018;
    target = 2019;

    scanf("%d%d%d%d", &m, &na, &nb, &t);

    for(int i = 0; i < na; i++)
        scanf("%d", ha+i);
    for(int i = 0; i < nb; i++)
        scanf("%d", hb+i);

    if(buildRun(ha, na, hb, nb) == m || buildRun(hb, nb, ha, na) == m) printf("S\n");
    else printf("N\n");
}

```

```
    return 0;
}
```

## Batalha Naval

```
#include <bits/stdc++.h>

using namespace std;

int pX[200200], pY[200200], distX[200200], distY[200200];
int n, ptrx = 1, ptry = 100100;

vector<vector<int>> > g(200200);

bool bfs(){
    bool found = false;
    queue<int> Q;

    for(int i = 1; i < ptrx; i++)
        if(pX[i] == -1)
            Q.push(i);

    memset(distX, 0, sizeof distX);
    memset(distY, 0, sizeof distY);

    while(!Q.empty()){
        int u = Q.front(); Q.pop();
        for(int i = 0; i < (int)g[u].size(); i++){
            int v = g[u][i];
            if(distY[v] == 0){
                distY[v] = distX[u]+1;
                if(pY[v] == -1) found = true;
            }
            else{
                distX[ pY[v] ] = distY[v]+1;
                Q.push(pY[v]);
            }
        }
    }

    return found;
}

bool dfs(int u){
    for(int i = 0; i < (int)g[u].size(); i++){
        int v = g[u][i];
        if(distX[u]+1 == distY[v]){
            distY[v] = 0; // "apaga" o vertice para a dfs
            if(pY[v] == -1 || dfs(pY[v])){
                pX[u] = v, pY[v] = u;
                return true;
            }
        }
    }
}
```

```
    }
}
return false;
}

int f(){
    int ans = 0;
    memset(pX, -1, sizeof pX);
    memset(pY, -1, sizeof pY);

    while(bfs())
        for(int i = 1; i < ptrx; i++)
            if(pX[i] == -1 && dfs(i)) // eh possivel escolher um par para i
                ans++;

    return ans;
}

int main(){
    int x, y;

    map<int, int> mapx;
    map<int, int> mapy;

    while(scanf("%d", &n) == 1){
        g.assign(200200, vector<int>());

        for(int i = 0; i < n; i++){
            scanf("%d_%d", &x, &y);

            if(mapx.find(x) == mapx.end()) mapx[x] = ptrx++;
            if(mapy.find(y) == mapy.end()) mapy[y] = ptry++;

            x = mapx[x];
            y = mapy[y];

            g[x].push_back(y);
            g[y].push_back(x);
        }

        printf("%d\n", f());
    }
    return 0;
}
```

## Strings

### YATG

```
#include <bits/stdc++.h>
```

```

#define ff first
#define ss second
#define mp make_pair
#define oo 1000000000

using namespace std;

int n, k, mat[300005][26], ans;

int dfs(int u){
    int ret = oo;
    ans++;

    for(int i = 0; i < 26; i++){
        if(mat[u][i]){
            ret = min(ret, dfs(mat[u][i]));
        }
    }
    if(ret == oo){
        ret = 0;
        ans++;
    }
    ret++;
    if(ret > k){
        ans++;
        ret = 1;
    }
    return ret;
}

int main(){

    scanf("%d_%d", &n, &k);

    char s[100005];

    int ptr = 1;

    for(int i = 0; i < n; i++){
        scanf("_%s", s);
        int node = 0;
        for(int j = 0; s[j]; j++){
            int letra = s[j] - 'a';
            if(!mat[node][letra])
                mat[node][letra] = ptr++;
            node = mat[node][letra];
        }
    }

    for(int i = 0; i < 26; i++)
        if(mat[0][i])

```

```

        dfs(mat[0][i]);

    ans += n;

    printf("%d\n", ans);

    return 0;
}

```

## Vasiliy's Multiset

```

#include <bits/stdc++.h>

#define oo 1000000000000000000

using namespace std;

int mat[6400640][2];
int cnt[6400640][2];

int main(){
    int n, x, ptr, next = 1;
    char c;

    scanf("%d", &n);

    ptr = 0;
    for(int i = 30; i >= 0; i--){
        if(!mat[ptr][0]) mat[ptr][0] = next++;
        cnt[ptr][0]++;
        ptr = mat[ptr][0];
    }

    for(int i = 0; i < n; i++){
        scanf("_%c_%d", &c, &x);

        if(c == '+'){
            ptr = 0;
            for(int i = 30; i >= 0; i--){
                if((1 << i) & x){
                    if(!mat[ptr][1]) mat[ptr][1] = next++;
                    cnt[ptr][1]++;
                    ptr = mat[ptr][1];
                }
            }
        }
        else{
            if(!mat[ptr][0]) mat[ptr][0] = next++;
            cnt[ptr][0]++;
            ptr = mat[ptr][0];
        }
    }
}

```



```

else if(c == '-') {
    ptr = 0;
    for(int i = 30; i >= 0; i--){
        if((1 << i) & x){
            cnt[ptr][1]--;
            ptr = mat[ptr][1];
        }
        else{
            cnt[ptr][0]--;
            ptr = mat[ptr][0];
        }
    }
}
else{
    int ans = 0;
    ptr = 0;
    for(int i = 30; i >= 0; i--){
        if((1 << i) & x){
            if(cnt[ptr][0] > 0){
                ans += (1 << i);
                ptr = mat[ptr][0];
            }
            else ptr = mat[ptr][1];
        }
        else{
            if(cnt[ptr][1] > 0){
                ans += (1 << i);
                ptr = mat[ptr][1];
            }
            else ptr = mat[ptr][0];
        }
    }
    printf("%d\n", ans);
}
}

return 0;
}

```

## Trie ponteiro

```

#include <bits/stdc++.h>

using namespace std;

typedef long long ll;

struct node{
    bool is_end;
    int prefixes, words, maxsize;
    struct node* edge[26];

```

```

//initialize()
//addword(vertex, word)
//countPrefixes(vertex, prefix)
//countWords(vertex, word)

node(){
    maxsize = 0;
    prefixes = 0;
    words = 0;
    is_end = false;
    for(int i = 0; i < 26; i++) edge[i] = NULL;
}

void addWord(string word, int tam){
    maxsize = max(tam, maxsize);
    if(word.empty()){
        prefixes++;
        words++;
    }
    else{
        prefixes++;
        int k = word[0] - 'a';
        if(edge[k] == NULL){
            node *p1 = new node();
            p1->addWord(word.substr(1, word.size()-1), tam );
            edge[k] = p1;
        }
        else
            edge[k]->addWord(word.substr(1, word.size()-1), tam );
    }
}

int countWords(string word){
    if(word.empty())
        return words;
    int k = word[0] - 'a';
    if(edge[k] == NULL)
        return 0;
    return edge[k]->countWords(word.substr(1, word.size()-1) );
}

int countPrefixes(string word){
    if(word.empty())
        return prefixes;
    int k = word[0] - 'a';
    if(edge[k] == NULL)
        return 0;
    return edge[k]->countPrefixes(word.substr(1, word.size()-1) );
}

int countSize(string word){
    if(word.empty())

```

```

        return maxsize;
    int k = word[0] - 'a';
    if(edge[k] == NULL)
        return 0;
    return edge[k]->countSize(word.substr(1,word.size()-1) );
}
};

int main() {
    int n,m;
    string s;

    while(scanf("%d", &n) != EOF){
        node *trie = new node();
        while(n--){
            cin >> s;
            trie->addWord(s, s.size());
        }
        scanf("%d", &m);
        while(m--){
            cin >> s;
            int x = trie->countPrefixes(s);
            if(x == 0)
                cout << "-1\n";
            else
                cout << x << "\n" << trie->countSize(s) << endl;
        }
    }

    return 0;
}

```

## Trie

```

#include <bits/stdc++.h>

#define oo 1000000000000000000

using namespace std;

int mat[6400640][2];
int cnt[6400640][2];

int main(){
    int n, x, ptr, next = 1;
    char c;

    scanf("%d", &n);

    ptr = 0;

```

```

    for(int i = 30; i >= 0; i--){
        if(!mat[ptr][0]) mat[ptr][0] = next++;
        cnt[ptr][0]++;
        ptr = mat[ptr][0];
    }

    for(int i = 0; i < n; i++){
        scanf("%c", &c, &x);

        if(c == '+'){
            ptr = 0;
            for(int i = 30; i >= 0; i--){
                if((1 << i) & x){
                    if(!mat[ptr][1]) mat[ptr][1] = next++;
                    cnt[ptr][1]++;
                    ptr = mat[ptr][1];
                }
            }
        }
        else if(c == '-'){
            ptr = 0;
            for(int i = 30; i >= 0; i--){
                if((1 << i) & x){
                    cnt[ptr][1]--;
                    ptr = mat[ptr][1];
                }
            }
        }
        else{
            cnt[ptr][0]--;
            ptr = mat[ptr][0];
        }
    }

    int ans = 0;
    ptr = 0;
    for(int i = 30; i >= 0; i--){
        if((1 << i) & x){
            if(cnt[ptr][0] > 0){
                ans += (1 << i);
                ptr = mat[ptr][0];
            }
            else ptr = mat[ptr][1];
        }
        else{
            if(cnt[ptr][1] > 0){
                ans += (1 << i);
                ptr = mat[ptr][1];
            }
        }
    }
}

```

```

        }
        else ptr = mat[ptr][0];
    }
    printf("%d\n", ans);
}

return 0;
}

```

## Geometria

### Dividindo a coca

```

#include <stdio>
#include <cmath>
using namespace std;

int main(){
    int c, n, l, b, H, i;
    double B, h, sup, inf, mid, bb, v;

    scanf("%d", &c);

    while(c--){

```

```

        scanf("%d_%d_%d_%lf_%d", &n, &l, &b, &B, &H);

        sup = H;
        inf = 0;

        while(sup - inf > 1e-9){
            mid = (sup + inf) / 2;

            bb = b + (B - b)*mid/sup;

            v = (M_PI*mid*(bb*bb + bb*b + b*b))/3;
            if(v*n > l){
                sup = mid;
                B = bb;
            }
            else inf = mid;
        }
        printf("%.2lf\n", sup);
    }

    return 0;
}

// r*r = B*B*H/h

// H/(R-r) = h/(R1-r)
// R1-r = (R-r)*h/H
// R1 = r + (R-r)*h/H

```