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Basic

BigInt

```

struct BigInt{
    static const int LEN = 60;
    static const int BIGMOD = 10000;
    int s;
    int vl, v[LEN];
    // vector<int> v;
    BigInt() : s(1) { vl = 0; }
    BigInt(long long a) {
        s = 1; vl = 0;
        if (a < 0) { s = -1; a = -a; }
        while (a) {
            push_back(a % BIGMOD);
            a /= BIGMOD;
        }
    }
    BigInt(string str) {
        s = 1; vl = 0;
        int stPos = 0, num = 0;
        if (!str.empty() && str[0] == '-') {
            stPos = 1;
            s = -1;
        }
        for (int i=SZ(str)-1, q=1; i>=stPos; i--) {
            num += (str[i] - '0') * q;
            if ((q *= 10) >= BIGMOD) {
                push_back(num);
                num = 0; q = 1;
            }
        }
        if (num) push_back(num);
    }
    int len() const { return vl; /* return SZ(v); */ }
    bool empty() const { return len() == 0; }
    void push_back(int x) { v[vl++] = x; /* v.PB(x); */ }
    void pop_back() { vl--; /* v.pop_back(); */ }
    int back() const { return v[vl-1]; /* return v.back(); */ }
    void n() { while (!empty() && !back()) pop_back(); }
    void resize(int nl) {
        vl = nl; fill(v, v+vl, 0);
        // v.resize(nl); // fill(ALL(v), 0);
    }
    void print() const {
        if (empty()) { putchar('0'); return; }
        if (s == -1) putchar('-');
        printf("%d", back());
        for (int i=len()-2; i>=0; i--) printf("%.4d", v[i]);
    }
    friend std::ostream& operator << (std::ostream& out,
        const BigInt &a) {
        if (a.empty()) { out << "0"; return out; }
        if (a.s == -1) out << "-";
        out << a.back();
        for (int i=a.len()-2; i>=0; i--) {
            char str[10];
            snprintf(str, 5, "%.4d", a.v[i]);
            out << str;
        }
        return out;
    }
    int cp3(const BigInt &b) const {
        if (s != b.s) return s > b.s ? 1 : -1;
        if (s == -1) return -(*this).cp3(-b);
        if (len() != b.len()) return len() > b.len() ? 1 : -1;
        for (int i=len()-1; i>=0; i--)
            if (v[i] != b.v[i]) return v[i] > b.v[i] ? 1 : -1;
        return 0;
    }
    bool operator < (const BigInt &b) const { return cp3(b) == -1; }
    bool operator <= (const BigInt &b) const { return cp3(b) >= 0; }
    bool operator >= (const BigInt &b) const { return cp3(b) >= 0; }
    bool operator == (const BigInt &b) const { return cp3(b) == 0; }
}

```

```

bool operator != (const Bigint &b)const{ return cp3(b)
    !=0; }
bool operator > (const Bigint &b)const{ return cp3(b)
    ==1; }
Bigint operator - () const {
    Bigint r = (*this);
    r.s = -r.s;
    return r;
}
Bigint operator + (const Bigint &b) const {
    if (s == -1) return -(*this)+(-b);
    if (b.s == -1) return (*this)-(-b);
    Bigint r;
    int nl = max(len(), b.len());
    r.resize(nl + 1);
    for (int i=0; i<nl; i++) {
        if (i < len()) r.v[i] += v[i];
        if (i < b.len()) r.v[i] += b.v[i];
        if (r.v[i] >= BIGMOD) {
            r.v[i+1] += r.v[i] / BIGMOD;
            r.v[i] %= BIGMOD;
        }
    }
    r.n();
    return r;
}
Bigint operator - (const Bigint &b) const {
    if (s == -1) return -(*this)-(-b);
    if (b.s == -1) return (*this)+(-b);
    if ((*this) < b) return -(b-(*this));
    Bigint r;
    r.resize(len());
    for (int i=0; i<len(); i++) {
        r.v[i] += v[i];
        if (i < b.len()) r.v[i] -= b.v[i];
        if (r.v[i] < 0) {
            r.v[i] += BIGMOD;
            r.v[i+1]--;
        }
    }
    r.n();
    return r;
}
Bigint operator * (const Bigint &b) {
    Bigint r;
    r.resize(len() + b.len() + 1);
    r.s = s * b.s;
    for (int i=0; i<len(); i++) {
        for (int j=0; j<b.len(); j++) {
            r.v[i+j] += v[i] * b.v[j];
            if (r.v[i+j] >= BIGMOD) {
                r.v[i+j+1] += r.v[i+j] / BIGMOD;
                r.v[i+j] %= BIGMOD;
            }
        }
    }
    r.n();
    return r;
}
Bigint operator / (const Bigint &b) {
    Bigint r;
    r.resize(max(1, len()-b.len()+1));
    int oriS = s;
    Bigint b2 = b; // b2 = abs(b)
    s = b2.s = r.s = 1;
    for (int i=r.len()-1; i>=0; i--) {
        int d=0, u=BIGMOD-1;
        while(d<u) {
            int m = (d+u+1)>>1;
            r.v[i] = m;
            if ((r*b2) > (*this)) u = m-1;
            else d = m;
        }
        r.v[i] = d;
    }
    s = oriS;
    r.s = s * b.s;
    r.n();
    return r;
}
Bigint operator % (const Bigint &b) {
    return (*this)-(*this)/b*b;
}

```

```

    }
};

```

Mathmatics

Miller Rabin

```

typedef long long LL;

LL bin_pow(LL a, LL n, LL MOD){
    LL re=1;
    while (n>0){
        if (n&1)re = re*a %MOD;
        a = a*a %MOD;
        n>>=1;
    }
    return re;
}
bool is_prime(LL n){
    //static LL sprp[3] = { 2LL, 7LL, 61LL};
    static LL sprp[7] = { 2LL, 325LL, 9375LL,
        28178LL, 450775LL, 9780504LL,
        1795265022LL };
    if (n==1 || (n&1)==0 ) return n==2;
    int u=n-1, t=0;
    while ( (u&1)==0 ) u>>=1, t++;
    for (int i=0; i<7; i++){
        LL x = bin_pow( sprp[i]%n, u, n);
        if (x==0 || x==1 || x==n-1)continue;

        for (int j=1; j<t; j++){
            x=x*x%n;
            if (x==1 || x==n-1)break;
        }
        if (x==n-1)continue;
        return 0;
    }
    return 1;
}

```

Geometry

Flow

Dinic

```

struct Edge{
    int from, to, cap, flow;
};

const int INF = 1<<29;
const int MAXV = 5003;
struct Dinic{ //0(VVE)
    int n, m, s, t;
    vector<Edge> edges;
    vector<int> G[MAXV];
    bool vis[MAXV];
    int d[MAXV];
    int cur[MAXV];

    void AddEdge(int from, int to, int cap){
        edges.push_back( {from,to,cap,0} );
        edges.push_back( {to,from,0,0} );
        m = edges.size();
        G[from].push_back(m-2);
        G[to].push_back(m-1);
    }

    bool dinicBFS(){
        memset(vis,0,sizeof(vis));
        queue<int> que;
        que.push(s); vis[s]=1;
        while (!que.empty()){
            int u = que.front(); que.pop();

```

```

    for (int ei:G[u]){
        Edge &e = edges[ei];
        if (!vis[e.to] && e.cap>e.flow ){
            vis[e.to]=1;
            d[e.to] = d[u]+1;
            que.push(e.to);
        }
    }
    return vis[t];
}

int dinicDFS(int u, int a){
    if (u==t || a==0)return a;
    int flow=0, f;
    for (int &i=cur[u]; i<(int)G[u].size(); i++){
        Edge &e = edges[ G[u][i] ];
        if (d[u]+1!=d[e.to])continue;
        f = dinicDFS(e.to, min(a, e.cap-e.flow) );
        if (f>0){
            e.flow += f;
            edges[ G[u][i]^1 ].flow -=f;
            flow += f;
            a -= f;
            if (a==0)break;
        }
    }
    return flow;
}

int maxflow(int s, int t){
    this->s = s, this->t = t;
    int flow=0, mf;
    while ( dinicBFS() ){
        memset(cur,0,sizeof(cur));
        while ( (mf=dinicDFS(s,INF)) )flow+=mf;
    }
    return flow;
}
};

```

Graph

LCA

```

//lv紀錄深度
//father[多少幕次][誰]
//已經建好每個人的父親是誰 (father[0][i]已經建好)
//已經建好深度 (lv[i]已經建好)
void makePPC(){
    for(int i = 1; i < 20; i++){
        for(int j = 2; j <= n; j++){
            father[i][j]=father[i-1][ father[i-1][j] ];
        }
    }
}

int find(int a, int b){
    if(lv[a] < lv[b]) swap(a,b);
    int need = lv[a] - lv[b];
    for(int i = 0; need!=0; i++){
        if(need&1) a=father[i][a];
        need >>= 1;
    }
    for(int i = 19; i >= 0; i--){
        if(father[i][a] != father[i][b]){
            a=father[i][a];
            b=father[i][b];
        }
    }
    return a!=b?father[0][a] : a;
}

```

Data Structure

Disjoint Set

```

struct DisjointSet{
    int n, fa[MAXN];

    void init(int size) {
        for (int i = 0; i <= size; i++) {
            fa[i] = i;
        }
    }

    void find(int x) {
        return fa[x] == x ? x : find(fa[x]);
    }

    void unite(int x, int y) {
        p[find(x)] = find(y);
    }
} djs;

```

Sparse Table

```

const int MAXN = 200005;
const int lgN = 20;

struct SP{ //sparse table
    int Sp[MAXN][lgN];
    function<int(int,int)> opt;
    void build(int n, int *a){ // 0 base
        for (int i=0 ;i<n; i++) Sp[i][0]=a[i];

        for (int h=1; h<lgN; h++){
            int len = 1<<(h-1), i=0;
            for (; i+len<n; i++){
                Sp[i][h] = opt( Sp[i][h-1] , Sp[i+len][h-1] );
            }
            for (; i<n; i++)
                Sp[i][h] = Sp[i][h-1];
        }
    }
    int query(int l, int r){
        int h = __lg(r-l+1);
        int len = 1<<h;
        return opt( Sp[l][h] , Sp[r-len+1][h] );
    }
};

```

String

KMP

```

template<typename T>
void build_KMP(int n, T *s, int *f){ // 1 base
    f[0]=-1, f[1]=0;
    for (int i=2; i<=n; i++){
        int w = f[i-1];
        while (w>=0 && s[w+1]!=s[i])w = f[w];
        f[i]=w+1;
    }
}

template<typename T>
int KMP(int n, T *a, int m, T *b){
    build_KMP(n,b,f);
    int ans=0;

    for (int i=1, w=0; i<=n; i++){
        while ( w>=0 && b[w+1]!=a[i] )w = f[w];
        w++;
        if (w==m){
            ans++;
            w=f[w];
        }
    }
    return ans;
}

```

Dark Code

輸入優化

```
#include <stdio.h>

char getc(){
    static const int bufsize = 1<<16;
    static char B[bufsize], *S=B, *T=B;
    return (S==T&&(T=(S=B)+fread(B,1,bufsize,stdin),S==T)
        ?0:*S++);
}

template <class T>
bool input(T& a){
    a=(T)0;
    register char p;
    while ((p = getc()) < '-')
        if (p==0 || p==EOF) return false;
    if (p == '-')
        while ((p = getc()) >= '0') a = a*10 - (p^'0');
    else {
        a = p ^ '0';
        while ((p = getc()) >= '0') a = a*10 + (p^'0');
    }
    return true;
}

template <class T, class... U>
bool input(T& a, U&... b){
    if (!input(a)) return false;
    return input(b...);
}
```

Search

Others

Persistence